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I. A PRELIMINARY NOTE ON SOME NEW SPECIES OF COPEPODA

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(With Plates IX—X.)

The following species of Copepoda, hitherto unknown to science, were obtained in two collections. The first of these is a large and extremely interesting collection made by members of the Zoological Survey of India during their survey of the Chilka Lake.¹ The Copepoda present an interesting mixture of freshwater and true marine forms. I give below a list of the various species that I have been able to identify from the Chilka collection :—

Family CALANIDAE.

Genus *Paracalanus*, Boeck.

Paracalanus crassirostris (Dahl).

Genus *Acrocalanus*, Giesbrecht.

Acrocalanus similis, Sewell.

Family CENTROPAGIDAE.

Genus *Pseudodiaptomus*, Herrick.

Pseudodiaptomus lobipes, Gurney.

Pseudodiaptomus hickmani, Sewell.

Pseudodiaptomus binghami, Sewell.

Pseudodiaptomus annandalei, sp. nov.

Pseudodiaptomus tollingeri, sp. nov.

Genus *Diaptomus*, Westwood.

Diaptomus cinctus, Gurney.

Family PONTELLIDAE.

Genus *Labidocera*, Lubbock.

Labidocera pavo, Giesbrecht.

Genus *Acartia*, Dana.

Acartia centrura, Giesbrecht.

Acartia spinicauda, Giesbrecht.

Acartia southwelli, Sewell.

Acartia chilkaensis, sp. nov.

¹ See *Mem. Ind. Mus.*, Vol. V.

Genus *Acartiella*, Sewell.

Acartiella major, sp. nov.

Acartiella minor, sp. nov.

In addition there were present examples of *Cyclops*, *Eutерpe*, *Oithona*, and numerous Harpacticids and nauplii that I have up to the present been unable to identify.

The second collection is a smaller one made by Dr. Gravely, Assistant Superintendent, Zoological Survey of India, in the backwater at Cochin, and contained another new species of the genus *Acartiella*, namely *A. gravelyi*, sp. nov.

It is particularly interesting to me to be able to record and describe three new species of the genus *Acartiella*; this genus was created by me (Sewell, 1914, p. 245) to accommodate two species from the Rangoon River estuary and the Gulf of Mannar respectively, and the occurrence of other species in such widely separate localities as Cochin and the Chilka Lake leads one to expect that the genus will prove to be represented throughout the brackish and estuarine waters of India.

Family CENTROPAGIDAE.

Genus *Pseudodiaptomus*, Herrick.

Pseudodiaptomus tollingeri, sp. nov.

(Plate X, fig. 8.)

Examples of both sexes were present in the Chilka Lake collection and in a collection from Port Canning in the Gangetic delta.

♀ Total length = 1.34 mm.

The proportional length of cephalo-thorax and abdomen—
60 : 40 = 100.

The head and 1st thoracic segments are fused as are also thoracic segments 4 and 5. The anterior extremity presents a uniformly rounded forehead and the rostrum consists of two short stout spines.

The posterior thoracic margin is armed with a single spine situated towards the dorsal surface and ventro-laterally there is a rounded projection fringed with hair.

The abdomen consists of four segments, having with the furca the following proportional lengths:—

33 : 19 : 19 : 9 : 20 = 100.

The first three segments are each furnished with a row of spines along the dorsal part of the posterior margin, and in addition the 1st or genital segment bears a transverse row of needle-like spines across the ventral aspect anterior to the genital opening, and two transverse rows of fine spinules on the dorsal surface. The furcal rami are symmetrical and bear five setae, of

which the central or 3rd one is expanded proximally to form a spear-shaped base as in *P. binghami* ♀

Mature females carry a pair of egg-sacs each containing 7 or 8 ova.

The 1st antennae.—When folded back the antenna reaches to the posterior end of the genital segment; it consists of 21 segments, having the following proportional lengths:—

Segments	1 : 2 : 3 : 4 : 5 : 6 : 7 : 8 : 9 : 10 : 11 : 12 : 13 : 14 : 15 : 16 : 17 :
	60 : 43 : 19 : 26 : 24 : 39 : 24 : 24 : 34 : 49 : 55 : 62 : 64 : 64 : 65 : 61 : 48 :
	18 : 19 : 20 : 21.
	48 : 52 : 59 : 70 = 1000.

The 2nd antenna has the form usual in this genus, but resembles that of *P. hickmani* in that it is armed with a row of fine spines on the terminal segment of the endopodite.

The maxilliped consists of the usual two basal segments and a terminal portion of five segments.

Basal 1 is provided with a stout spine-like seta at its distal end. Basal 2 bears 3 setae on its margin and is armed with a palisade of needle-like spines.

The 1st pair of legs have the usual structure, both exopod and endopod being composed of three segments.

Basal 1 is armed with a row of spines on its external margin about the middle of its length; exopod 1 bears a spine which projects as far as or a little beyond the distal end of the segment; exopod 2 is unarmed; exopod 3 bears two needle-like marginal spines and a delicate end-spine which is not quite as long as exopod 2 and 3 together.

The endopod reaches to a point a little beyond the middle of exopod 3.

The 2nd pair of legs.—Basal 1 bears two transverse rows of spines on its outer margin and basal 2 bears a few scattered spines externally.

The 3rd pair of legs.—There is a row of spines on the proximal part of basal 1, and a few spines distally on the same segment. Basal 2 bears three or four spines.

The 4th pair of legs.—There is a transverse row of spines on basal 1 near the distal margin, but basal 2 is unarmed.

The 5th pair of legs.—Each consists of a three-jointed exopod only. The 1st segment bears a few small spines on its outer border about the middle of its length and is armed internally with an oblique row of spines. The 2nd segment is produced at its distal internal angle in a lamelliform process which terminates in a sharp point: externally there is a single small needle-like spine. The 3rd segment bears three spines and is produced externally in a bluntly rounded process: of the three spines, the outer is long and curved and in length is nearly equal to the whole limb; it is finely serrated along both borders: the middle spine is straight, about half the length of the outer one and is serrated on both margins: the inner spine is somewhat curved and is short and

stout with coarse serrations on its inner, and fine teeth on its outer border.

Specimens from the Chilka Lake differ slightly from the above description, which is taken from Port Canning specimens. They are slightly smaller and on the 2nd segment of the 5th pair of legs there is a corona of fine spines on the external part of the distal margin.

♂ Total length = 1.20 mm.

Proportional length of cephalo-thorax and abdomen—

$$63 : 37 = 100.$$

The cephalo-thorax resembles that of the ♀. The abdomen consists of five segments: the 1st segment is short and unarmed: the 2nd and 3rd segments are armed with a complete circle of spines around the posterior margin and in addition bear a transverse row of spines on the ventral surface: the 4th segment bears only the distal ring of spines and segment 5 is unarmed. The proportional lengths of the abdominal segments and furca are as follows:—

$$13 : 20 : 19 : 17 : 9 : 22 = 100.$$

The furcal rami are symmetrical and bear five setae of which the 3rd resembles the others and is not expanded as in the ♀.

The 1st antennae.—That of the left side is unmodified as in the ♀: the segments have the following proportions:—

$$\begin{array}{l} \text{Segments } \frac{1 : 2 : 3 : 4 : 5 : 6 : 7 : 8 : 9 : 10 : 11 : 12 : 13 : 14 : 15 : 16 :}{65 : 54 : 19 : 32 : 38 : 22 : 24 : 27 : 27 : 43 : 54 : 59 : 65 : 65 : 65 : 59 :} \\ \frac{17 : 18 : 19 : 20 : 21.}{48 : 48 : 51 : 59 : 76} = 1000. \end{array}$$

On the right side the antenna is modified to form a grasping organ: the segments have the following proportional lengths:—

$$\begin{array}{l} \text{Segments } \frac{1 : 2 : 3 : 4 : 5 : 6 : 7 : 8-10 : 11 : 12 : 13 : 14 : 15 : 16 : 17 :}{75 : 53 : 22 : 19 : 19 : 19 : 11 : 68 : 19 : 26 : 30 : 64 : 64 : 68 : 56 :} \\ \frac{18 : 19 : 20-21.}{113 : 105 : 169} = 1000. \end{array}$$

Segments 13 to 17 are considerably swollen; segment 17 bears a tooth-plate that extends the whole length of its upper margin and overlaps the succeeding segment; segment 18 is armed with a tooth-plate that terminates distally in a sharp point; segment 19 bears two spine-like tooth-plates, of which the proximal is about half the length of the distal, and this latter extends to the extreme limit of the segment.

All tooth-plates are stained a brown colour.

The 2nd antennae, mouth-parts, and swimming legs are as in the ♀

The 5th pair of legs.—The right leg consists of four segments: the 1st segment (basal) is produced internally in an angular projection bearing at its internal angle a double process, the outer part rounded and the inner truncated and provided with a seta. Exopod 1 is produced at its distal external angle in a prominent

spine; exopod 2 is much dilated and bears a few spines on both internal and external margins; exopod 3 in shape closely resembles the corresponding joint in *P. lobipes*; about the middle of its length it is dilated the dilatation being fringed distally with spines, and it terminates in a long curved simple process.

The left leg consists of only three joints: of these the 1st (basal) bears a row of spines on its external margin and internally is produced into two processes which represent the remains of the endopod—the innermost is long and simple and the outer process is a broad flat plate terminating in two spines. Exopod 1 is provided with a row of needle-like spines on the proximal part of its inner margin, and externally it is produced at its distal end in a short stout spinous process, while the distal border is armed posteriorly with a row of spinules; exopod 2-3 (the terminal segment) bears a row of needle-like spines on the proximal part of its inner margin and externally it carries a large doubly-serrated spine; the terminal part of the joint is bent sharply on itself and terminates in three unequal processes.

***Pseudodiaptomus annandalei*, sp. nov.**

(Plate X, fig. 9.)

Examples of both sexes were present in the Chilka Lake collection. I have much pleasure in dedicating this species to Dr. N. Annandale, the Director of the Zoological Survey of India.

♀ Total length = 1.18 mm.

Proportional length of cephalo-thorax and abdomen—

$$71 : 29 = 100.$$

The head and first thoracic segments are fused, as also are thoracic segments 4 and 5: the forehead when viewed from above forms a sharply rounded prominence: the rostrum consists of two spinous processes. The posterior thoracic margin is rounded and is armed with a comb of 6-8 coarse curved teeth, and the last thoracic segment also bears laterally a double row of small spines.

The abdomen consists of four segments; of these the 1st is very nearly symmetrical and is produced on either side in a large recurved spine, but there are no spines on the posterior margin; segment 2 is armed with a row of very small spines on the posterior margin dorsally; segment 3 is armed with a corona of spines on the dorso-lateral part of the posterior border, which spines are somewhat larger laterally than on the dorsal surface.

The furcal rami are symmetrical and bear five setae which are short and stout and the 3rd seta is much dilated: all the setae and the inner margin of the furcal rami are fringed with bristle-like hairs. The proportional lengths of the abdominal segments and furca are as follows:—

$$40 : 14 : 14 : 9 : 23 = 100.$$

Mature females bear two egg-sacs each containing 6-8 ova.

The 1st antenna when folded back reaches to the posterior end of the genital segment of the abdomen. It consists of 21 segments having the following proportional lengths:—

Segments $1 : 2 : 3 : 4 : 5 : 6 : 7 : 8 : 9 : 10 : 11 : 12 : 13 : 14 : 15 : 16 :$
 $65 : 44 : 22 : 31 : 31 : 44 : 22 : 22 : 31 : 51 : 57 : 61 : 63 : 62 : 65 : 57 :$
 $17 : 18 : 19 : 20 : 21.$
 $48 : 51 : 51 : 57 : 65 = 1000.$

All the antennal setae appear to be bristle-like and devoid of plumose hairs.

The 2nd antenna is similar to that of *P. hickmani*.

The maxilliped consists of two basal joints and an end portion of 5 segments. Basal 1 bears distally a stout serrated spine; basal 2 is fringed with a palisade of spines.

The 1st pair of legs.—Basal 1 is armed with a transverse row of small spines on its external margin, and a second row about the junction of the proximal and middle thirds of the segment; basal 2 also bears an oblique row of spines. The exopod and endopod are each of three segments; exopod 1 bears a small marginal seta that barely reaches to the distal end of the segment.

The 2nd and 3rd pair of legs.—Basal 1 bears a transverse row of spines on the proximal part of the outer margin; basal 2 bears a longitudinal row of spines on its outer margin.

The 4th pair of legs.—Both basals are devoid of spines.

The 5th pair of legs.—Each consists of a three-jointed ramus: the 1st segment bears a row of spines on its outer surface: the 2nd segment is armed at its distal external angle with a single marginal serrated spine, and there is no trace of any internal lamelliform process such as is found in *P. tollingeri* and *P. lobipes*: the 3rd segment bears a small marginal spine and three end spines, of which the outer is by far the longest and stoutest and is serrated on both margins.

♂ Total length = 1.09 mm.

Proportional length of cephalo-thorax and abdomen—

$$67 : 33 = 100.$$

The male appears to differ very considerably from the female for the posterior thoracic margin is rounded and is totally devoid of spines, with the single exception of a small spine situated towards the dorsal end of the posterior margin. The abdomen consists of five segments having with the furca the following proportional lengths:—

$$11 : 22 : 20 : 17 : 9 : 21 = 100.$$

The 2nd, 3rd and 4th segments are each armed with a complete circle of spines on their distal margins and in addition the 2nd segment also bears a transverse row of small spines on both dorsal and ventral surfaces. The furcal setae are coarsely fringed as in the ♀, but the 3rd seta is not expanded: there is a very small dorsal accessory seta.

The 1st antennae.—That on the left side is unmodified and has the following proportional lengths of the segments:—

Segments	1 : 2 : 3 : 4 : 5 : 6 : 7 : 8 : 9 : 10 : 11 : 12 : 13 : 14 : 15 : 16 :
	65 : 55 : 25 : 30 : 30 : 42 : 20 : 20 : 30 : 38 : 50 : 55 : 62 : 63 : 65 : 58 :
	17 : 18 : 19 : 20 : 21.
	47 : 55 : 55 : 60 : 75. = 1000

The right antenna is as usual modified to form a grasping organ: the various joints have the following proportional lengths:—

Segments	1 : 2 : 3 : 4 : 5 : 6 : 7 : 8-9 : 10 : 11 : 12 : 13 : 14 : 15 : 16 : 17 :
	68 : 50 : 17 : 14 : 15 : 13 : 9 : 50 : 15 : 20 : 22 : 26 : 64 : 57 : 61 : 57 :
	18 : 19 : 20-21.
	128 : 117 : 194 = 1000.

The “endabschnitt” consists of two joints only and the knee-joint lies between segments 18 and 19: segments 13 to 17 are swollen; segment 17 bears on its anterior margin proximally a rounded chitinous plate; segment 18 has a tooth-plate which extends for $\frac{3}{4}$ of the length of the segment; segment 19 bears two spine-like tooth-plates, the proximal being short and armed with curved teeth.

The 2nd antennae, mouth-parts and swimming legs are similar to those of the ♀

The 5th pair of legs.—The right leg consists of three segments. Exopod 1 is produced internally in a spinous process and is armed with a transverse row of spines on its outer margin; exopod 2 is prolonged internally in a lamelliform plate bearing two spine-like processes, a proximal short and claw-like and a distal one much longer and straight; exopod 3 is curved, terminating in a sharp point and bears a single seta on its inner margin. The left leg consists of three segments; exopod 1 is produced internally in a large irregularly triangular plate; exopod 2 is produced internally in a stout spinous process at the base of which is a short stout spine; exopod 3 bears a serrated spine on its outer margin and terminates in two sharp chitinous teeth.

Pseudodiaptomus binghami, Sewell.

Associated in the Chilka Lake collection with large numbers of *P. binghami* ♀ and a few examples of *P. lobipes* were several unknown males. The female *P. binghami* was described by me from a collection made in the Rangoon River estuary, and I believe that the following form is the hitherto unknown ♂ of this species:

♂. Total length = 0.86 mm.

Proportional length of cephalo-thorax and abdomen—

$$64.5 : 35.5 = 100.0.$$

The head and 1st thoracic segment are fused, as also are thoracic segments 4 and 5. The forehead presents a uniform

rounded curve. The posterior thoracic margin is rounded and is armed towards the dorsal surface with a single spine.

The abdomen consists of five segments, which have with the furca the following proportional lengths:—

$$11 : 20 : 18 : 18 : 9 : 24 = 100.$$

Segments 2, 3 and 4 are each provided with a ring of spines on the posterior margin.

The furcal rami are symmetrical: the 3rd seta is not enlarged in this sex—a condition that is also found in *P. annandalei* and *P. tollingeri*.

The 1st antennae when folded back reach to the posterior thoracic margin. The left antenna is unmodified and resembles that of the ♀. I give below the proportional lengths of the various segments, and, as in my original description the terminal joints were missing, I also give the proportional lengths of the various segments in the corresponding appendage of the female for purposes of comparison.

Segments	1 : 2 : 3 : 4 : 5 : 6 : 7 : 8 : 9 : 10 : 11 : 12 : 13 : 14 : 15 :
♂	78 : 52 : 23 : 32 : 33 : 45 : 23 : 23 : 26 : 39 : 46 : 52 : 58 : 58 : 62 :
♀	78 : 39 : 19 : 28 : 28 : 39 : 22 : 22 : 28 : 39 : 48 : 50 : 59 : 62 : 64 :
	<u>16 : 17 : 18 : 19 : 20 : 21.</u>
	♂ <u>58 : 49 : 52 : 55 : 58 : 78 = 1000.</u>
	♀ <u>62 : 53 : 56 : 59 : 67 : 78 = 1000.</u>

The right antenna is as usual modified; the various segments have the following proportional lengths:—

Segments	1 : 2 : 3 : 4 : 5 : 6 : 7 : 8-9 : 10 : 11 : 12 : 13 : 14 : 15 : 16 : 17 :
	82 : 55 : 20 : 17 : 17 : 14 : 20 : 31 : 27 : 21 : 21 : 31 : 62 : 68 : 75 : 62 :
	<u>18 : 19 : 20-21</u>
	103 : 103 : 171 = 1000.

Segment 17 bears a tooth-plate which overlaps the proximal end of the following segment; segment 18 bears a tooth-plate; segment 19 bears two teeth plates. The tooth-plate on segment 17 is unarmed; that on segment 18 has rounded cusps and the tooth-plate on segment 19 bears spine-like teeth on its proximal portion only, the distal part being smooth.

The 2nd antennae, mouth-parts and swimming legs are identical with the corresponding appendages of *P. binghami* ♀

The 5th pair of legs very closely resemble those of *P. lobipes* with which this form was associated in the collection. The right leg: basal 1 carries a rounded eminence on its margin; basal 2 bears a similar projection; exopod 1 is produced in a long spine which is serrated on its inner margin only; exopod 2 is produced internally in a blunt chitinised tubercle; exopod 3 is curved and slender; its inner margin is produced about the middle of the length of the segment in a flattened plate, which at its upper angle bears a small rounded tubercle; below the tubercle the margin is armed with a series of small spines and above it the distal margin bears 3 teeth; beyond this plate the distal part of the

segment is claw-like and is serrated on its margin. The left leg: basal 1 is produced in a long claw-like process, terminating in a point; exopod 1 bears a distal marginal spine; exopod 2 and 3 forms a flattened leaf-like plate, broader than in *P. lobipes* and on the outer margin is a short sharp spine serrated on both borders; the inner margin of the plate is smooth.

Family PONTELLIDAE.

Genus *Acartia*, Dana.

Acartia chilkaensis, sp. nov.

(Plate IX, figs. 1-5.)

Examples of both sexes were present in the Chilka Lake collection.

♀ Total length = 0.75 mm.

Proportional length of cephalo-thorax and abdomen—
74 : 26 = 100.

The head and 1st thoracic segment are separate: thoracic segments 4 and 5 are fused. The posterior thoracic margin is rounded and is armed with a series of small spines.

The abdomen consists of three segments; of these the 1st and 2nd are armed on the dorsal part of the posterior margin with a row of minute spinules. The furcal rami are symmetrical; the 2nd furcal seta is much longer but not any stouter than the rest; the 5th seta arises about half-way along the outer margin of the ramus.

The abdominal segments and furca have the following proportional lengths:—

$$39 : 19 : 17 : 25 = 100.$$

The 1st antennae when folded back reach to the middle of the 1st abdominal segment. The segments have the following proportional lengths:—

Segments	1	2-6	7	8-10	11	12	13	14	15	16	17	18	19	20	21
	51	95	15	51	29	36	29	58	58	36	55	70	58	51	66
			22	23	24	25									
			48	66	44	29	= 1000.								

Segments 16, 17 and 19 are all armed with a transverse row of minute spines on the distal part of the posterior margin. There are no spines on any of the basal segments.

The 5th pair of legs.—These closely resemble those of *A. centrura*; the basal segment bears a long marginal seta, and the distal portion is dilated basally and is then produced in a curved spinous process with a small notch in the outer margin about the middle of its length.

♂ Total length = 0.70 mm.

Proportional length of cephalo-thorax and abdomen—
75 : 25 = 100.

The cephalo-thorax resembles that of the ♀

The abdomen consists of 5 segments, having with the furca the following proportional lengths:—

$$10 : 31 : 20 : 6 : 14 : 19 = 100.$$

The abdominal segments are all devoid of spines and the 2nd furcal seta is not appreciably longer than the others.

The 1st antennae.—This appendage when folded back does not quite reach as far as the posterior thoracic margin. The distal segments have the following proportional lengths:—

$$\text{Segments } \frac{13 : 14 : 15 : 16 : 17 : 18 : 19-21 : 22-25.}{37 : 43 : 31 : 37 : 82 : 85 : 85 : 159.}$$

Segment 17 bears a spine-like tooth-plate which projects beyond the distal border over the following segment; segment 18 bears a palisade of fine needle-like spines on its anterior border; segment 19 bears two spine-like tooth-plates and carries a single long seta at its distal end.

The 2nd antenna resembles that of *A. centrura*.

The maxilliped resembles that of *A. southwelli*.

The 5th pair of legs.—The right leg forms the usual claw; basal 1 bears a stout seta; exopod 2 is produced internally in a roughly quadrilateral plate, and exopod 3 is curved and is armed with a spine on its inner margin and a terminal spine. The left leg: exopod 1 is produced internally in a rounded projection from the base of which arises a seta; exopod 3 is curved and rounded at the top and bears a long seta on its inner margin.

Similar examples of the ♂ were obtained in both collections: it is interesting to note that the specimens from Cochin are somewhat larger than those from the Chilka Lake measuring 0.82 mm. in total length and furthermore the abdominal segments are armed, segments 2, 3 and 4 all bearing a row of minute spines on the posterior margin dorsally. As, however, the specimens agree in all other particulars, I am inclined to regard this as a local variation; a very similar state of affairs exists in specimens of *A. southwelli* obtained from the Gulf of Mannar and the Chilka Lake.

Genus *Acartiella*, Sewell.

Acartiella gravelyi, sp. nov.

(Plate IX, fig. 7; Plate X, figs. 1, 4 and 5.)

Several examples, of both sexes, were present in the collection from Cochin.

♀ Total length = 1.4 mm.

Proportional length of cephalo-thorax and abdomen—

$$62.8 : 37.2 = 100.$$

The head and 1st thoracic segment are separate, as also are thoracic segments 4 and 5.

The anterior end of the head presents a uniformly rounded "forehead" and the rostrum is absent. The posterior thoracic margin is rounded and unarmed. The abdomen consists of three segments, of which the 3rd is extremely short, so short that it gives the appearance of a two-jointed abdomen. The furcal rami are not symmetrical, that on the right side being the longer.

The abdominal segments and furca have the following relative lengths:—

$$35 : 41 : 5 : 19 = 100.$$

The genital swelling forms a well-marked projection on the ventral aspect of the 1st abdominal segment. The 2nd furcal seta is stouter and considerably longer than the rest; the 5th seta arises from the external margin, at the junction of the middle and distal thirds of the segment, and there is a well-developed accessory dorsal seta.

The 1st antenna when folded back reaches to the middle of the 2nd abdominal segment. As in other members both of this genus and of the genus *Acartia*, the proximal segments of the antenna tend to become fused together: as the line of demarcation between segments frequently runs in a spiral round the antenna, the least change in position gives a totally different length measurement for any given joint. So far as I can make them out the following are the proportional lengths of the various segments in this species:—

$$\begin{array}{l} \text{Segments } 1 : 2-4 : 5-6 : 7 : 8-9 : 10 : 11 : 12 : 13-14 : 15 : 16 : 17 : 18 : 19 : 20 : \\ \hline 53 : 120 : 37 : 42 : 50 : 32 : 24 : 26 : 66 : 37 : 79 : 55 : 55 : 63 : 50 : \\ \hline 21 : 22 : 23 : 24 : 25. \\ \hline 53 : 40 : 55 : 42 : 21 = 1000. \end{array}$$

Segments 2 to 4, 5 and 6, 8 and 9 and 13-14 appear to be fused together and segment 15 is also partially fused with the preceding segment. Many of the segments bear oblique rows of fine hair-like spines on their posterior surface.

The 2nd antenna has the same peculiar form as in *A. tortaniformis* (vide Sewell, 1912, p. 347 and pl. xxi, fig. 4).

The mandible bears four teeth of which the 1st is separated by an interval from the remaining three as in *A. tortaniformis*.

The maxilliped very closely resembles that of *A. tortaniformis*: the end joint bears the same four spinous processes, but the basal segment is armed with a row of 10-12 small spines instead of four large ones.

The 1st pair of legs.—Each consists of a two-jointed basal portion, a three-jointed exopod and a two-jointed endopod. Exopod 1 and 2 are devoid of marginal spines; exopod 3 bears one long seta-like marginal spine and the usual end-spine. On the inner margins the segments of the exopod bear 1, 1, and 5 setae respectively.

The 2nd pair of legs.—The exopod is three-jointed; exopod 1 bears a small marginal spine and one internal seta; exopod 2 has no marginal spine but bears one internal seta; exopod 3 bears a

marginal and an end-spine and carries five setae internally. The endopod is two-jointed. Endopod 1 bears two and endopod 2 seven setae.

The 3rd pair of legs.—The basal portion is two-jointed. The exopod consists of three joints; exopod 1 bears a claw-like marginal spine and one seta; exopod 2 has no spine and one seta; exopod 3 bears one marginal spine, one end-spine and five setae. The endopod is two-jointed, the joints bearing 2 and 7 setae respectively.

The 4th pair of legs.—The basal portion is two-jointed. The exopod consists of three joints; exopod 1 bears a claw-like marginal spine and one seta; exopod 2 bears a claw-like marginal spine and one seta; exopod 3 bears a claw-like marginal spine and one end-spine, and there are 5 setae. The endopod is two-jointed; the joints bearing 3 and 7 setae respectively.

The 5th pair of legs.—Each consists of a basal segment bearing an external seta, and as is usual in this genus a single-jointed exopod and endopod.

The exopod is curved and ends in a sharp point: about midway along its external margin is a single small spine, and the distal fourth of the inner margin is finely serrated. The endopod is about $\frac{1}{2}$ the length of the exopod and also terminates in a sharp point, and on the distal part of the external margin bears four teeth.

♂ Total length = 1.16 mm.

Proportional length of cephalo-thorax and abdomen—

$$64.6 : 35.4 = 100.0.$$

The head and thorax are the same as in the ♀

The abdomen consists of five segments and the furca: of the abdominal segments the anal is very short and the 2nd and 3rd are by far the longest.

The furcal rami are very slightly asymmetrical, the right ramus being slightly the longer: the furcal setae are similar to those of the ♀

The proportional lengths of the segments and furca are as follows:—

$$11 : 22 : 21 : 11 : 3 : 32 = 100.$$

The 1st antennae.—That of the left side is unmodified and resembles that of the female, though in several cases the segments are not as completely fused, thus rendering it possible to determine the lengths of individual segments:—

Segments	1 : 2-4 : 5-6 : 7 : 8 : 9 : 10 : 11 : 12 : 13 : 14 : 15 : 16 : 17 : 18 :
	44 : 103 : 33 : 18 : 24 : 12 : 36 : 36 : 27 : 36 : 36 : 41 : 84 : 62 : 62 :
	19 : 20 : 21 : 22 : 23 : 24 : 25.
	68 : 54 : 56 : 47 : 59 : 44 : 18 = 1000.

The right antenna is modified to form a grasping organ; the various segments have the following proportional lengths:—

Segments $\frac{1 : 2-4 : 5 : 6 : 7 : 8-10 : 11 : 12 : 13 : 14 : 15 : 16 : 17 : 18 : 19-21 : 41 : 120 : 35 : 17 : 18 : 111 : 23 : 23 : 44 : 35 : 44 : 47 : 73 : 111 : 108 : 22-25.}{150 = 1000.}$

The knee-joint is situated between segments 18 and 19 and the "endabschnitt" consists of two joints only. Segments 2 to 4 and 8 to 10 are fused; the 13th to 17th segments are somewhat dilated, though not markedly so; the 17th segment bears a tooth-plate which does not extend beyond the distal extremity of the segment; the 18th segment bears a tooth-plate and has two fang-like spines distally as in *A. tortaniformis*, and the 19th segment has two tooth-plates. All the tooth-plates are furnished with fine teeth.

The 2nd antenna, mouth-parts, and swimming legs are similar to those of the ♀

The 5th pair of legs.—Each leg consists of a single ramus. The right leg possesses four segments; of these the basal one is produced distally in a pair of rounded wing-like flaps, which overlap the proximal part of the next segment; the 2nd segment carries a single seta on its external margin; the 3rd segment bears a single seta on its internal margin, and the 4th distal segment is pointed and claw-like and bears a single seta on its inner margin. The left leg consists of the common basal segment and three free segments; the 1st segment bears a single bristle externally; the 2nd segment is armed with a small marginal spine distally on the external margin, and the terminal segment bears a single marginal spine on its external border, a small spine on its internal margin and terminates in two unequal spines.

I have much pleasure in dedicating this species to Dr. F. H. Gravely, Assistant Superintendent, Zoological Survey of India, by whom the collection from Cochin was made.

Acartiella major, sp. nov.

(Plate IX, fig. 8 and Plate X, figs. 2, 3 and 6.)

Numerous examples of both sexes were present in the Chilka Lake collection.

♀ Total length = 1.41 mm.

Proportional length of cephalo-thorax and abdomen—

$$67 : 33 = 100.$$

The head and 1st thoracic segment are separate: thoracic segments 4 and 5 are fused.

The head presents a rounded anterior surface, and the posterior thoracic margin is rounded and unarmed. The rostrum is as usual absent.

The abdomen consists of three segments, having with the furca the following proportional lengths:—

$$39 : 31 : 8 : 22 = 100.$$

The 1st abdominal segment bears a slight rounded prominence posteriorly near the right border.

The furcal rami are symmetrical, and the furcal setae are five in number, of which the 2nd is longer and stouter than the others.

The 1st antennae.—The proportional lengths of the various segments are as follows:—

Segments	1 : 2-4 : 5 : 6 : 7 : 8-9 : 10 : 11 : 12-13 : 14 : 15 : 16 : 17 : 18 : 19 :
	<u>64 : 108 : 32 : 37 : 23 : 44 : 23 : 25 : 71 : 34 : 37 : 44 : 57 : 57 : 71 :</u>
	20 : 21 : 22 : 23 : 24 : 25.
	54 : 54 : 44 : 57 : 44 : 20 = 1000.

There are oblique rows of hairs on segments 7 to 18 very like the rows of fine spines on the segments of the antenna in *A. tortaniformis*.

The 2nd antenna is of the same form as in *A. tortaniformis*.

The 1st and 2nd maxillae are as figured.

The maxilliped terminates in the usual segment bearing four long spines, but on the margin of the 1st segment there are only 2 spines.

The 1st pair of legs.—This appendage closely resembles that of *A. graveleyi* but differs in that exopod 3 bears two fine hair-like marginal spines as well as the usual end-spine.

The 2nd-4th pair of legs.—As in *A. graveleyi*.

The 5th pair of legs.—Each basal segment carries a marginal seta; the exopod is long and curved, terminating in a sharp point; the inner margin is serrated along the distal $\frac{1}{3}$, and on the outer margin is a single spine: the endopod is quite short, being only $\frac{1}{4}$ the length of the exopod, and it bears 2 or 3 teeth distally on its outer margin.

♂ Total length = 1.25 mm.

Proportional length of cephalo-thorax and abdomen—

$$65 : 35 = 100.$$

The abdomen consists of five segments, having with the furcal rami the following proportional lengths:—

$$11 : 21 : 18 : 9 : 5 : 36 = 100.$$

The furcal rami are not quite symmetrical, the right one being slightly the longer: the furcal setae are as in the ♀

The 1st antennae.—That on the left side is unmodified as in the ♀ and its terminal joints have the following proportional lengths:—

Segments	11 : 12 : 13 : 14 : 15 : 16 : 17 : 18 : 19 : 20 : 21 : 22 : 23 : 24 : 25.
	<u>27 : 34 : 34 : 34 : 34 : 48 : 62 : 66 : 70 : 52 : 55 : 39 : 55 : 39 : 20.</u>

The segments are furnished with oblique rows of hairs as in the ♀

The right antenna is modified to form a grasping organ: segments 13 to 17 are somewhat expanded and the knee-joint is situated between segments 18 and 19. The "endabschnitt" consists of two joints only; segments 19 to 21 and 22 to 25 are fused together.

The proportional lengths of the end segments are as follows:—

$$\text{Segments } \frac{13 : 14 : 15 : 16 : 17 : 18 : 19-21 : 22-25.}{45 : 48 : 41 : 48 : 57 : 123 : 109 : 140.}$$

Segment 17 bears a tooth-plate that slightly overlaps the following segment; segment 18 bears a tooth-plate and is armed with the usual two fang-like spines distally; segment 19-21 bears two tooth-plates, both of them spine-like, the distal being much the longer and overlapping the next segment; segment 19-21 also bears two setae, a terminal one and a small one about the middle of the length of the toothed surface. All tooth-plates are provided with fine needle-like teeth; on the proximal plates these are long, but on the distal plate of segment 19-21 they are very short.

The 5th pair of legs.—On the right side the basal joint is produced in a double flat process, the outer division being sharply pointed and the inner one rounded and wing-like. Each leg consists of three segments having the form typical of the genus.

On the right side exopod 1 bears a marginal seta; exopod 2 bears a single internal seta and exopod 3 terminates in a sharp point and bears a single seta on its inner margin.

On the left side exopod 1 bears a marginal seta; exopod 2 carries a distal marginal spine, and exopod 3 bears one marginal spine and three end-spines.

Acartiella minor, sp. nov.

(Plate IX, fig. 6 and Plate X, fig. 7.)

Examples of both sexes were present in the Chilka Lake collection.

♀ Total length = 1.14 mm.

Proportional length of cephalo-thorax and abdomen—

$$67 : 33 : = 100.$$

The head and 1st thoracic segment are separate and thoracic segments 4 and 5 are fused.

The forehead presents a rounded curved surface and the rostrum is absent; the posterior thoracic margin is rounded and devoid of spines.

The abdomen consists of three segments, having with the furca the following proportional lengths:—

$$31 : 20 : 26 : 23 = 100.$$

The furcal rami are asymmetrical, that of the right side being the longer; the furcal setae are as in *A. graveleyi*, the 5th seta arising from the external margin about the middle of the segment, while the 2nd seta is much longer than the rest.

The 1st antennae.—This resembles that of *A. graveleyi*; when folded back it reaches to the middle of the 1st abdominal segment.

The various joints of the antenna have the following proportional lengths:—

Segments	1 : 2-4 : 5 : 6 : 7 : 8 : 9-10 : 11 : 12-14 : 15-16 : 17 : 18 : 19 : 20 :
	<u>46 : 101 : 38 : 19 : 39 : 43 : 58 : 37 : 89 : 78 : 56 : 58 : 68 : 52 :</u>
	<u>21 : 22 : 23 : 24 : 25.</u>
	54 : 43 : 58 : 43 : 20 = 1000.

Segments 2 to 4, 9 and 10, 12 to 14 and 15 and 16 are respectively fused together. There are no spines on any of the segments.

The 2nd antennae, mouth-parts and swimming legs are as in *A. gravelyi*.

The 5th pair of legs have the form typical of the genus. The exopod is unserrated and is 3 to 4 times the length of the endopod which is short and pointed and is unarmed.

♂. Total length 1.07 mm.

Proportional length of cephalo-thorax and abdomen—

$$65 : 35 = 100.$$

The head and thorax are similar to those of the ♀.

The abdomen consists of five segments, having with the furca the following proportional lengths:—

$$10 : 20 : 16 : 10 : 6 : 38 = 100.$$

The furcal rami are nearly, though not quite, symmetrical, the right ramus being slightly the longer.

The 1st antennae.—That of the right side is modified to form a grasping organ. The proximal segments are so irregularly fused that it is almost impossible to determine their limits of demarcation. Segments 13 to 17 are somewhat swollen, and the knee-joint lies between segments 18 and 19. The "endabschnitt" consists of two joints.

The proportional lengths of the distal segments are as follows:—

Segments	13 : 14 : 15 : 16 : 17 : 18 : 19-21 : 22-25.
	<u>47 : 47 : 47 : 47 : 66 : 109 : 105 : 134.</u>

Segment 17 bears a tooth-plate that projects as a spine over the proximal end of segment 18; segment 18 bears a tooth-plate and two fang-like spines distally; segment 19-21 bears two spine-like tooth-plates of which the distal is much the longer and projects beyond the end of the joint; distally, segment 21 bears a single long seta. All the tooth-plates are armed with fine needle-like teeth.

The left antenna when folded back reaches to the hind end of the 3rd abdominal segment; it is unmodified as in the ♀. The proportional lengths of the distal segments are as follows:—

Segments	11 : 12 : 13 : 14 : 15 : 16 : 17 : 18 : 19 : 20 : 21 : 22 : 23 : 24 : 25.
	<u>13 : 33 : 38 : 38 : 38 : 44 : 61 : 55 : 65 : 53 : 57 : 41 : 61 : 41 : 19.</u>

The mouth-parts and swimming-legs are as in the ♀.

The 5th pair of legs.—The basal segment is produced on the right side in a single stout conical process which overlaps the

proximal end of exopod 1. On the right side, exopod 1 is a stout segment bearing a single seta on its external margin; exopod 2 bears a rounded prominence on its inner aspect about the middle of its length, from the summit of which a seta arises; exopod 3 is curved, tapering to a point and bears a single seta on its inner border.

On the left side exopod 1 bears on its inner margin distally a single small spiniform process; exopod 2 bears a single small marginal spine distally; exopod 3 bears a small spine on its outer border, on the inner margin is a single small seta, and terminally are three unequal spines.

The original species of the genus *Acartiella*, *A. tortaniformis* (Sewell) was discovered in a collection from the Rangoon River Estuary (Sewell, 1912, p. 346), and all these new species occur in similar localities where the water is brackish: it is interesting to note the association of *Pseudodiaptomus binghami*, Sewell, with *Acartiella major* and *minor* in the Chilka Lake collection, for the only other locality in which *P. binghami* has hitherto been found is the above-mentioned Rangoon River Estuary.

The only truly marine form in this genus is *Acartiella kempi*, Sewell, which occurs in the Gulf of Mannar, and it is exceedingly interesting to note that this species in some respects tends to approximate to species both of the genus *Tortanus*, a purely marine genus, and of the genus *Acartia* in which many of the species are truly marine: thus in all other members of the genus the 2nd antenna has the peculiar flattened form which I described and figured originally in my description of *A. tortaniformis* (*Acartia tortaniformis*, Sewell, 1912, p. 346 and pl. xxi, fig. 4), but in *Acartiella kempi* it presents the form commonly found in species of the genera *Acartia* and *Tortanus*; again the 5th pair of legs in *A. kempi* ♂ is different in form from the corresponding appendage of other members of the genus in that it possesses a long process on the segment exopod 1 of the right leg, and further there is no process on the basal joint of the same leg, a condition that approximates to that found in the genus *Tortanus*: as regards the length of the abdomen *Acartiella kempi* ♀ nearly approximates to the genus *Acartia*. The known forms of this genus form a distinct series in respect of the proportional length of cephalo-thorax and abdomen, and I give the varying proportions below together with the proportion in two species of *Acartia*:—

♀	Species.	Cephalo-thorax.	Abdomen.
	<i>Acartiella tortaniformis</i> ..	1.5	1.0
	<i>Acartiella graveleyi</i> ..	1.7	1.0
	<i>Acartiella major</i> } ..	2.0	1.0
	<i>Acartiella minor</i> }		
	<i>Acartiella kempi</i> ..	2.5	1.0
	<i>Acartia chilkaensis</i> ..	2.85	1.0
	<i>Acartia southwelli</i> ..	3.5	1.0

I give below an identification table by means of which the various species of the genus *Acartiella* can be distinguished from each other:—

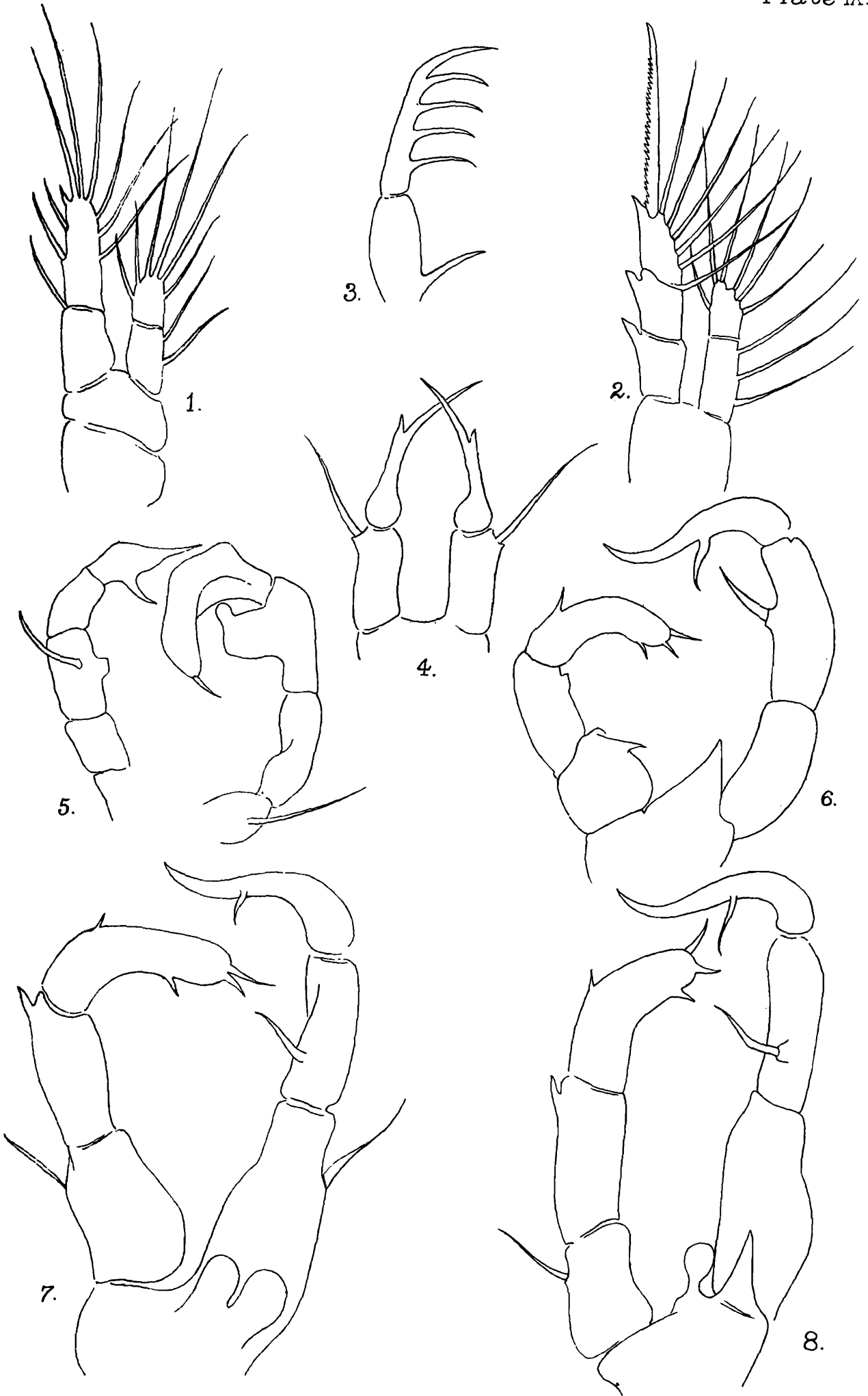
I. ♂ and ♀	(a) 4th and 5th thoracic segments separate	<i>A. gravelyi.</i>
	(b) 4th and 5th thoracic segments fused	vide II.
II. ♂ and ♀	(a) 2nd antenna normal; <i>Acartia</i> -like.	<i>A. kempi.</i>
	(b) 2nd antenna having the flattened form typical of the genus ...	vide III.
III. A. ♀	(a) 5th leg: endopod $\frac{1}{2}$ length of exopod and both serrated	<i>A. tortaniformis.</i>
	(b) 5th leg: endopod short, $\frac{1}{4}$ length of exopod:—	
	(1) Exopod serrated on inner margin	<i>A. major.</i>
	(2) Exopod unarmed on inner margin	<i>A. minor.</i>
III B. ♂.	(a) Basal of right leg produced in a single process.	
	(1) A short triangular plate	<i>A. minor.</i>
	(2) A long narrow process	<i>A. tortaniformis.</i>
	(b) Basal of right leg produced in two processes, one rounded and the other triangular	<i>A. major.</i>

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- Sewell, 1912.—“Notes on the Surface-living Copepoda of the Bay of Bengal, I and II.” *Records of the Indian Museum*, Vol. VII, Part IV, No. 29.
- Sewell, 1914.—“Notes on the Surface Copepoda of the Gulf of Mannar.” *Spolia Zeylanica*, Vol. IX, Part XXXV

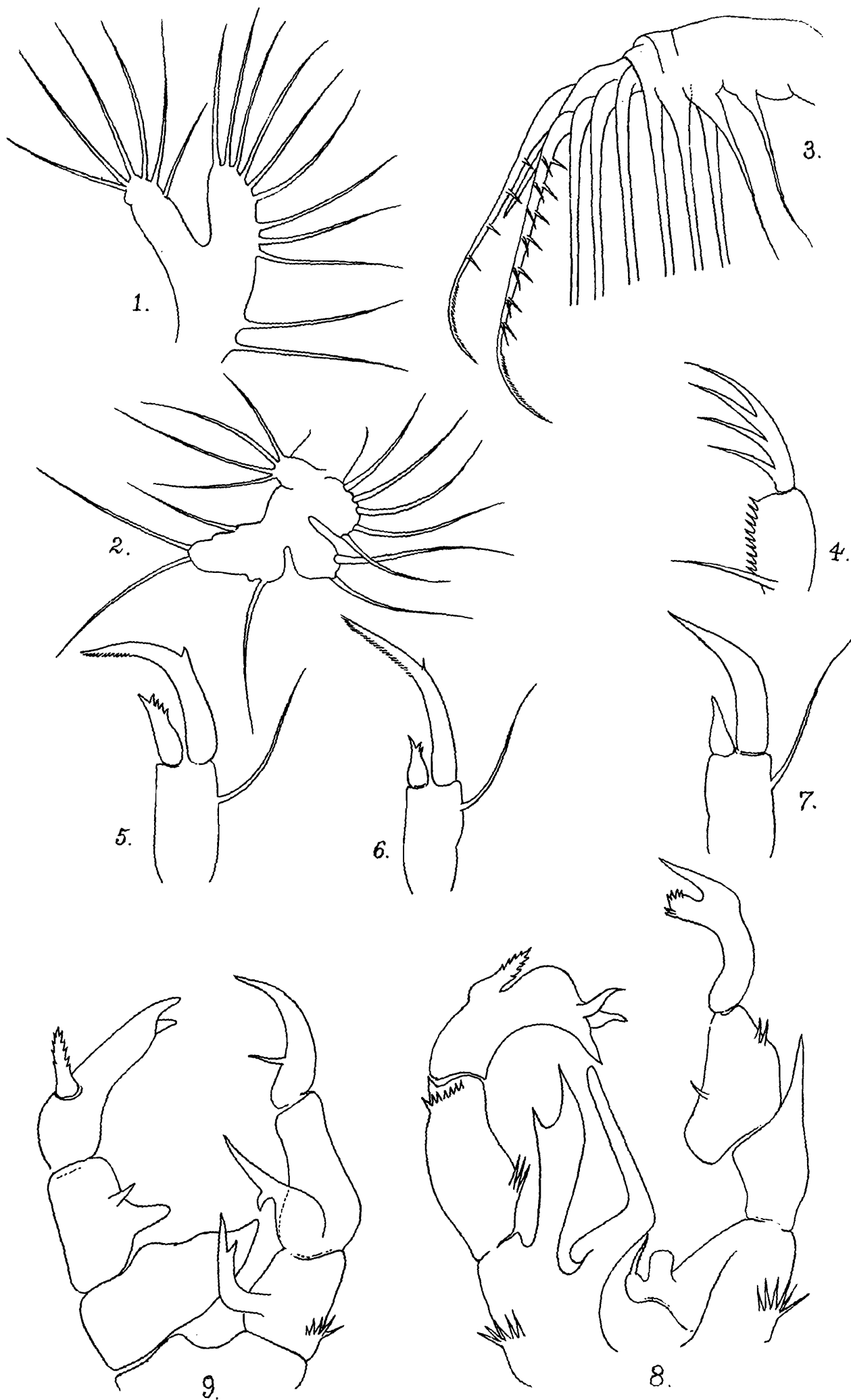
EXPLANATION OF PLATE IX.

- FIG. 1.—*Acartia chilkaensis*, sp. nov., 1st pair of legs.
,, 2. ,, ,, ,, 2nd-4th pair of legs.
,, 3. ,, ,, ,, maxilliped.
,, 4. ,, ,, ,, 5th pair of legs ♀
,, 5. ,, ,, ,, 5th pair of legs ♂.
,, 6.—*Acartiella minor*, sp. nov., 5th pair of legs ♂
,, 7. ,, *gravelyi*, sp. nov., 5th pair of legs ♂
,, 8. ,, *major*, sp. nov., 5th pair of legs ♂



EXPLANATION OF PLATE X.

- FIG. 1.—*Acartiella gravelyi*, sp. nov., 2nd antenna.
,, 2. ,, *major*, sp. nov., 1st maxilla.
,, 3. ,, ,, ,, 2nd maxilla.
,, 4. ,, *gravelyi*, sp. nov., maxilliped.
,, 5. ,, ,, ,, 5th leg ♀
,, 6. ,, *major*, sp. nov., 5th leg ♀.
,, 7. ,, *minor*, sp. nov., 5th leg ♀
,, 8.—*Pseudodiptomus tollingeri*, sp. nov., 5th pair of legs ♂.
,, 9. ,, *annandalei*, sp. nov., 5th pair of legs ♂.



II NOTES ON THE INDIAN GLOW-WORM [*LAMPROPHORUS TENEBROSUS* (Wlk.)]

By C. A. PAIVA, *Assistant, Zoological Survey of India.*

[Read at the Fifth Indian Science Congress, Lahore. January, 1918.]

(With Plate VIII.)

The present paper is based on personal observations made during the months of August, September and October, 1917. Although the Indian glow-worm is quite common in most parts, especially during the rainy season, when snails, which form its natural food, abound, and although a good deal is known of the structure of larvae of the family and also something about their habits, no detailed account of the natural history of any particular species of Indian glow-worm seems to have been recorded. As is well known, these creatures are entirely nocturnal in their habits and spend the entire day in a state of rest or sleep from which it is almost impossible to awaken them. As soon as the light begins to fade they wake up from their slumber and wander forth in search of food. In their natural surroundings they are probably obliged to search a good deal before they find their food, as those, which I have had under observation, although supplied with a number of snails, always took some time before they secured a snail each. They can walk rather fast and when in quest of food the head is protruded as far as possible with the antennae, which are retractile, extended to their fullest extent.

My specimens were kept in breeding cages 12" × 10" × 8" made of wood with perforated zinc sheeting and glass sides and door. Snails were constantly supplied to them.

Description of full-grown larva.

Length 60 to 65 mm. greatest breadth 19 mm.

Shining black, a rather broad yellowish ochraceous margin on the lateral areas of the thoracic and abdominal segments. The dorsal segments of the thorax and abdomen are composed of chitinous, somewhat flattened plates, partially overlapping each other, that of the pronotum concealing the head. Head protrusible, shining black, flat above, with a deep, central, V-shaped emargination bordered with light brown on anterior margin; mandibles dark red, their inner areas black, very robust, curved, rather bluntly pointed, not overlapping each other, but in the earlier stages these overlap each other to a great extent and are acutely pointed apically, base of mandibles broad with a strong blunt

tooth on inner margin, just below this tooth on the upper, flattened part of the mandible there is a patch of dense, silky, recumbent, light brown hairs, a shallow groove on the inner margin of each mandible along its attenuated portion, mouth light brown with two brushes of silky hairs interspersed with a few spinose hairs, visible only from above. Antennae three-jointed, basal joint whitish, very stout, a little shorter than second which is longest, second joint whitish with a dark line on its inner area, third joint very short, light brown, a few stiff, brown hairs at the apex of the second and on the third joint. Eyes very small, situated a little within the lateral margins of the head, almost immediately behind the bases of the antennae. Pronotum black, with two longitudinally oblique, discal fasciae, broadened anteriorly and narrowed posteriorly, extending from the anterior margin to a little before the middle of the disk and the lateral margins broadly yellowish ochraceous, lateral and posterior areas of disk rugose, anterior margin rounded, lateral margins oblique, the sides slightly recurved, posterior lateral angles rounded, the posterior margin slightly concavely sinuate near middle, a narrow longitudinal sulcation on middle of disk which extends nearly throughout the dorsal segments, a rather deep, oblique depression on each side of central area of disk; meso- and metanotum broader than pronotum, discally black and strongly rugose, with some pits or depressions, lateral areas similar in colour to those of pronotum, lateral margins almost straight, posterior margins very slightly concavely sinuate. Abdomen with the first seven segments black, the greater part of their posterior lateral areas broadly yellowish ochraceous and their lateral and posterior areas faintly rugose, the posterior margins of the sixth and seventh segments are broadly concavely sinuate, their posterior lateral angles being obtusely rounded, eighth segment much smaller than preceding segments, black with a whitish patch on each antero-lateral area, ninth segment almost entirely black with a very fine pale yellow line bordering its posterior margin, which is almost semicircular, its lateral margins rounded. Underside black with the head beneath light brown, margined with black. Membrane connecting sternal segments milky white. The ventral surface of each of the second abdominal segments to the ninth bears four longitudinal ridges, each ridge being furnished with a brush of short, stiff brownish hairs or bristles, which are easily broken off. A cluster of soft filamentous processes, which can be protruded at will, situated at the apex of the abdomen. The use of this appendage is explained on p. 22.

The first larva that attracted my attention was one brought by Dr. N. Annandale from Rambha, in the Ganjam district of the Madras Presidency in August, 1917. As soon as it woke up from its day's sleep it protruded its head about a quarter of an inch beyond the pronotum and commenced walking quickly about the floor of the cage in search of a snail. On finding a snail it examined it carefully and if it found that the snail had retracted

itself into its shell it sat on the shell with its head towards the opening and waited till the animal emerged in order to find out what was on top of it. The moment the snail appeared the larva made a sudden grab at its body and if it succeeded in obtaining a firm grip it allowed its head to be dragged in by the snail until it could go no further, then it commenced its meal, at first coiling itself round the shell and then lying on one side with the shell between its legs. It moved its mandibles sideways continuously while it fed. This operation lasted till there was nothing left of the snail and sometimes occupied a couple of hours. Often when a snail was on the move it was attacked by the larva, but either out of self-defence or from the result of a bite withdrew itself into its shell and secreted a quantity of frothy matter, which the larva invariably sucked up. This, however, did not prevent the larva from continuing its attack, for as soon as it cleared this frothy secretion it inserted its head into the shell, seized the snail, and gradually devoured it. Occasionally it threw out some part of the snail's body, and in one instance I saw it come back to the spot where it had thrown out some refuse, as it were, and eat up what it had a moment ago apparently rejected.

The number of small snails (*Macrochlamys indica*) usually devoured in one night was about four, but on one or two occasions I found two empty shells of a small-sized *Achatina fulica* besides four smaller shells. It is doubtless the case that these creatures spend the whole night either eating or searching for food, for at half past four one morning I saw the larva walking about the cage with its luminous organ glowing very brightly as if it were looking for food. It may also have been possible that it was looking for a place of repose for the day.

On the 17th August at about 8.30 P.M. after I had put out all the lights I approached the cage stealthily, with a candle which I lit quickly. I found the larva standing with its fore-legs resting on the side of a watch-glass containing water. Its head was extended up to the water's edge and its mandibles and palps were being moved rapidly to and fro in the water. This went on for some time and though I placed the lighted candle inside the cage in order to watch it more closely, the larva did not seem to be affected. It occasionally thrust its head further into the water, moving it from side to side all the time. The manner in which the larva cleaned itself was very interesting. It usually rested its fore-legs on the receptacle containing water and protruded its head to its fullest extent into the water and moved its mandibles and palps rapidly to and fro. After some time it left the water and walked away a short distance where it lay on its side and rolled itself up. It appeared as if it were preparing to sleep after having had a drink of water. But this was not the case. It had been busy with its toilet. Having completed washing its mouth-parts in the water it now laid down to clean its body. It extended the filamentous appendage at the posterior end of its body, consisting of a number of soft, slender, retractile, sticky-looking objects which form

a sort of brush when extended; this was pressed closely first against each ventral segment, being drawn in its expanded state across the segment. After each segment had been cleaned this organ was retracted only to be placed on the next and succeeding segments, until all, but the one bearing the organ, were cleaned. This process of cleaning was applied to every part of the body in turn, always beginning from the anterior part. First the centre of the ventral segments was cleaned, then the right and left lateral areas. Having cleaned the underside it moved off to another spot where it remained in a standing position and cleaned the dorsal segments. The only segment it could not clean was the apical one of the abdomen as it could not be reached. After having finished cleaning its body thoroughly it went back to the water and appeared to drink, as its jaws and palps were almost stationary. I left the cage in perfect darkness for a quarter of an hour. When I returned I found the larva perched on top of a small stone, which was lying at the bottom of the cage, apparently asleep. I left it thus for the rest of the night. By the morning of the 21st the larva had dug a round hole about an inch and a half in diameter in the soft earth at the bottom of the cage, adjoining a small stone on which I had seen it perched the night before. In this hole it coiled itself up and remained so for the rest of the day. During the night of the 21st it began to enlarge this hole and by the morning of the 22nd it had gone well under the earth. Through a small hole the larva could be seen. It was still in its larval state. All the snails in the cage were thrown away. At 7.15 P.M. the same day the larva commenced to close up the opening through which it could be seen and which had been used for the purpose of throwing out mud excavated from the interior of the hole. Small quantities of earth were held between the mandibles and carried towards the opening. The earth was gently stuck into the side at the bottom of the hole; gradually it was carried to the top of the hole; on reaching the opening it was thrust with some force against the side, which caused the earth at the top to fall inwards, but just sufficiently to diminish the size of the opening. Continuing in this manner the larva succeeded in closing the opening entirely. It was now completely enclosed in its "dug-out." By the morning of the 23rd it had gone further under the earth and could be seen asleep through a large opening a little distance away from the one which it had closed up the night before. Apparently it had spent the night either in increasing the size of its "dug-out" or in going further underground, the large opening having been made for the purpose of placing the excavated earth outside. At 7 P.M. on the 23rd it was still asleep. The light of a candle made it glow faintly, but it did not move. On the morning of the 24th it was in the same position as on the night before. At about 4 P.M. on the 24th it glowed for a short time. On the windows being opened it ceased to glow. By dusk it commenced to close up the opening, which was accomplished in the same manner as explained before. On

the 25th it could not be seen at all. On the 26th some earth was removed by me causing an opening through which it could be seen lying perfectly still on its side. In order not to disturb it I placed a small stone on top of the opening. On the 27th I touched the larva with a match stick, which it seemed to resent as it moved and glowed. The opening was left uncovered from 5 to 8.30 P.M. during which time it glowed continuously. Nothing took place on the 28th and 29th. On the morning of the 30th the doors of the room were all closed and the room was in perfect darkness. I removed the stone which covered the opening and a faint glow was visible, which gradually died away. Noise of any kind, even talking, caused it to glow, though very slightly. In the evening I introduced another similar larva into the cage. This larva was sent by the Deputy Commissioner of Angul, Orissa. It appeared much larger than the other which had hidden itself in a "dug-out." The Angul larva behaved in exactly the same manner as the one from Rambha, devouring snails every night, having no regard to size or species. Nothing of special interest happened till the 5th September, when I noticed an empty shell of *Macrochlamys* stuck at the entrance of the "dug-out" in which the Rambha larva was. I removed the shell and found that the larva had changed its position and appeared to occupy more room than it had done during the past week or two inside its "dug-out." It also appeared as if it had eaten the snail, the shell of which was at the opening. Up to 6th September the two larvae were in one cage. On this day after dusk the larva from Angul walked about the cage and in its wanderings it came across the entrance to the "dug-out" of the other larva. It stopped a while at the entrance, peered into the "dug-out" and on seeing a light inside, it remained quite still with the anterior portion of its body almost covering the opening. The larva in the "dug-out" glowed all the time, sometimes more brightly than at others. This, however, did not scare away the Angul larva, which, after a while, began to make its way into the "dug-out." Presuming that this would terminate in one larva eating the other, I pulled the Angul larva away. The other larva had in the meantime protected itself from attack by turning its dorsal surface towards the opening of the "dug-out," thus offering a hard surface to the Angul larva in case of attack, and also barring the entrance to the "dug-out." Once pulled away the Angul larva did not further attempt to enter the abode of the other larva although the opening was left open all night. As an alternative it seized a medium-sized *Achatina fulca*, this being the second specimen of that species which it had eaten during the 6th. On the 7th September the Angul larva was placed in a separate cage. On the evening of the 8th I found the hole, in which the Rambha larva had been, empty. It (the larva) had changed its skin, which I afterwards discovered, was its last but one moult, and now appeared much larger. On leaving its "dug-out" it went forth in search of food. I had left a medium-sized *Achatina* in the

cage and it was not long before it commenced devouring it. Inside the "dug-out" were pieces of its cast skin, and on the side, at the furthest end, two of the largest dorsal plates were stuck hard up against it. On the 9th there were no snails left from the supply put into the cages on the 6th. On the 10th some large specimens of *Achatina* were put into the cages. These larvae seemed to prefer the larger snails, but if they were unable to overcome these, they readily devoured the smaller ones. At about 9 P.M. on the 10th the Angul larva was observed digging a hole in the soft earth at the bottom of its cage. This was accomplished by small quantities of earth being carried between the mandibles and deposited some distance away from the hole. On the first night the hole was not completed, only a slight depression having been made in which the larva passed the night and where I found it on the morning of the 11th. After sunset on the 11th both larvae walked about their cages, presumably looking for food. The Angul larva did not devour any snails, but tried either to get under a very large *Achatina* or to get hold of its body but the snail was too tough to allow the larva to fix its jaws in its body. The earth at the bottom of the cages appeared very dry, so I poured some water on it and as soon as the larvae found everything around them in a moist condition, they each left off what it was doing. The Angul larva's attempts having proved unsuccessful, it gave up attacking the large *Achatina* and betook itself to its pit or depression where, after cleaning its body, it retired for the night by 9.30 P.M. The Rambha larva took advantage of the water in its cage and began to clean itself. On the 12th this latter larva had managed to overcome a large *Achatina*, which it devoured. During the night the Angul larva had dug itself well under the soft earth. This was done in precisely the same manner in which the Rambha larva had done preparatory to moulting. Nothing worthy of note took place from the 13th to the 20th, the Rambha larva continued to eat and the Angul larva remained hidden underground. On the 21st morning I made a small opening on the top of the "dug-out" in which the Angul larva was, and I saw it still in its larval state. I covered up this opening with a tin cover so as to shut out all light. At 7.30 P.M. I uncovered the opening and found that the Angul larva had cast its larval skin and the creature now appeared almost milk white, the only visible black spots being the stigmata situated on the segment containing the luminous organs. The insect was now very sluggish and though handled a good deal with a tea-spoon, in order to secure the cast skin intact, it did not attempt to protrude its head or even move its legs. It glowed very brightly when touched. This was the pupal stage. On the 22nd the pupa was in the same state and its glow was now continuous. It remained so till the 27th when it cast its pupal skin between 3 and 4 P.M. The pupal skin is quite different to the last larval skin. The last larval skin resembles the larva exactly, both in texture

and appearance, while the pupal skin is quite flimsy and transparent throughout. Both these skins were carefully removed and are preserved in the collection of the Zoological Survey of India.

After casting its pupal skin the insect became quite sluggish and did not seem affected by being handled. It did not attempt to walk. It lay quietly on its side and glowed only when touched or when any loud noise was made. Its glow, however, did not last long. The Rambha larva continued to eat snails from the 23rd to the 27th, until it gradually decreased its food to a single snail a night. It now refused to touch even the smallest snail. At about 6-15 P.M. on the 28th the insect from Angul, which had now been transformed into an adult female *Lampraphorus* emerged from its "dug-out" and took up its position near one of the sides of the cage. Here it lay slightly on one side and turned up the posterior end of its body and glowed very brightly. On a light being shone on its cage the glow of the insect gradually died out and it commenced to walk round the cage. It made several attempts to get out of the cage, but finding no exit, it tried to get under a stone in the vain hope of finding an opening there. Seeing it so restless I placed the cage on an exposed window sill. Had there been any males of its species flying in the neighbourhood they would certainly have been attracted to the cage by its bright glow, although the moon was shining brightly and the skies were clear. On the morning of the 29th the female had got under a tin cover which was placed in the cage, and remained there for the rest of the day. Its milky colour had now changed to a very pale ochraceous on the middle of the first nine dorsal segments, the margins of which were pale yellow. The dorsal plates now appeared more flat than rounded. The ventral surface remained creamy white. The adult female cleans itself in the same manner as does the larva. Up to the 12th October the female had walked about the cage every night exhibiting its light at intervals in different parts of the cage. On one occasion I opened the door of the cage and it immediately walked out. After going a short distance it stopped, turned up the posterior end of its body and began to glow very brightly. Having glowed for a few minutes it attempted to go further off, but I put it back into its cage and it kept on glowing at various parts of the cage. It ate nothing, although a number of snails were placed in the cage. A little water was put in the tin cover in the cage for the snails to drink. The next morning the female was found inside the water, apparently drowned. I rescued it and placed it under the tin cover, leaving no water in the cage. It remained very quiet and listless during the day, but by evening it had revived and was walking about the cage as usual. During the night, that is the night it strayed into the water, it had laid four globular, pale yellowish eggs measuring about 3 mm. in diameter. It continued to lay eggs every night up to the 14th. In all it laid fifteen eggs. These eggs were luminous and could with ease be counted at the bottom of the cage in pitchy darkness. The luminosity of the eggs

did not appear to last for more than one night. On the afternoon of the 14th the female appeared very sluggish and apparently lifeless. Its colour too had changed to a dark brown.

The following is a description of the female taken immediately after death:—

Dark brown. Dorsal segments greatly arched, shining, faintly, transversely rugose, especially on the lateral areas; posterior margins of the abdominal segments narrowly ochraceous; some large irregular patches on the disk of the meso- and metanotum also pale ochraceous; lateral margins of all the dorsal segments narrowly shining black; a distinct, short, central, longitudinal carina on anterior area of pronotum which is posteriorly bifurcate, and beyond this is a narrow central longitudinal sulcation continued to about the metanotum; the lateral areas of each dorsal segment with some shallow pits or depressions. Legs and underside dark castaneous, with the central discal area of the abdomen brownish ochraceous; apical margins of all the abdominal segments clothed with a few short stiff, spinose hairs, which are very easily broken off; underside of femora and tibiae of all the legs armed with short stiff yellowish hairs; apical joint of tarsi very long, as long as or longer than the remaining joints together. Antennae composed of six joints of which the basal joint is very stout, the second joint long, longer than the remaining joints together; these are very short and subequal in length; some stiff hairs on the antennal joints, the most conspicuous of all being two rather long ones at the apex of the second joint, and a single, long, curved one at the inner side of the apical joint; the palps are also hairy; jaws large, strongly curved, overlapping each other, pointed apically, black and shining on their distal half and reddish-brown on their proximal half. Eyes small, blackish, situated at the base of the antennae.

The larva from Rambha had eaten nothing for at least ten days. The earth at the bottom of its cage was damped and some water placed in a watch-glass. It was evidently very thirsty for it immediately went to the watch-glass and drank a good deal of water. During the night of the 11th October it tried to dig itself under the damp earth, but it did not make much progress. On the evening of the 12th it dug diligently for an hour or so until it made quite a deep pit. The excavated mud was carried in small quantities and placed first a little distance away from the hole and as the hole began to get deeper and the insect was able to get inside, it began to close up the entrance in the same manner as has been explained when referring to the Angul larva. It eventually hid itself entirely from view and I left it so till the 24th October when I noticed a change had commenced to take place. The larva had begun to cast its final larval skin, but this it did in a very awkward and certainly unusual manner, for insect larvae do not, as a rule, cast their skins piece-meal. First the three dorsal plates of the thorax were cast off, then the first dorsal plate of the abdomen and so on till all the dorsal plates had been

got rid of. It seemed greatly affected when any light shone on it. On the 25th morning the ventral plates still appeared to be uncast. Something seemed to have gone wrong with this creature as it lay on its back till the 28th, glowing very gently when exposed to view, either during the day or at night, but its moult was not completed. On the 29th it had discoloured altogether and had no resemblance, as far as colouration was concerned, to the pupa of the Angul insect. Its glow even began to be very irregular and faint. It was still limp and I took it out of its "dug-out." Several pieces of its larval skin still adhered to its ventral surface, especially over the stigmata. This probably caused asphyxia and the creature eventually died. I cannot assign any other reason for its death. It had lived under the same conditions as the larva from Angul, in fact it had been so well fed that it grew to an enormous size and prior to its leaving off eating it looked almost cylindrical. From the very beginning this larva seemed to have had some difficulty in ridding itself of its skin when moulting. At its last but one moult its larval skin was cast piece-meal, whereas in the case of the Angul specimen the larval and pupal skins were cast intact.

A point worthy of note is that I had never observed these larvae to glow during the day if undisturbed, though kept, for the most part, in a semi-dark room. The admission of strong sunlight did not even affect them, but any sound, however slight, caused them to glow immediately. After dusk the larva, when in the "dug-out," glowed continuously all night and the rays of light passing through the opening of the "dug-out" diverged to a great extent, reminding one of the rays of a search-light, for any object coming within these rays was enormously magnified. With regard to the glowing of the larva there is a difference in the use of the luminous organ when the creature is in the open and when it is in a hole. In the former condition it glows with both its luminous organs if it apprehends any danger, but in the latter state it only glows with that part which is uppermost and in a line with the opening of the "dug-out," the light being sufficiently strong to be seen at a great distance. The terminal sucker has been said to serve as an organ of locomotion, an organ of respiration, and an organ accessory to feeding. Of the first two there may be no doubt, but I have never seen a larva smear its head with any secretion preparatory to attacking a snail. Mr. C. J. Gahan says, "It is well known that Lampyrid larvae use the terminal sucker to clean their heads and limbs from the slime of the snail after having fed on the latter." This, which seems to be its chief use, I have explained fully on page 22. The luminous organ, as far as I have been able to observe, is used chiefly as a means of defence in the larva and as a means to attract the males in the adult female. These larvae belong to that group of Malacoderms in which the female is larviform and the male is winged. The light emitted by these insects, both males and females, is not intermittent, but a bright steady glow. In that

group in which the light is intermittent and subject to rapid diminutions and increase of brilliancy, the males and females are both winged and are our true "fire-flies," which are generally seen in swarms.

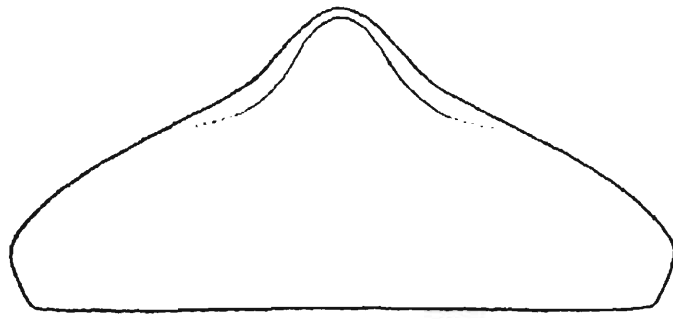
Another very interesting point is the manner in which these glow-worms bury themselves underground. In both the specimens I had in captivity I noticed that they began digging at the middle of the cage. As soon as the insect got well underground it closed up the hole by which it entered and which had been used to throw out the excavated mud; it then gradually enlarged the burrow and extended it towards the further end of the cage until it met with an obstacle, in this case the wooden frame of the cage, which prevented further progress in a straight line. On meeting with this obstacle, the excavation was continued for a short distance to the left along the frame-work of the cage, where a comparatively large compartment was made, large enough to hold the insect in comfort and to allow perfect freedom of movement. Once the insect enclosed itself in this "dug-out" all light was shut out as no opening was visible. For the purpose of observation I made openings in the "dug-out" of both specimens and kept the light out by covering these openings with tin covers. From the foregoing observations I am inclined to believe that these insects, being entirely nocturnal in habits, dig burrows in which they spend their lives, resting in them during the day and coming out only at dusk in search of food. In captivity, when there is no hole for them to hide in during the day, they invariably seek some dark corner of the cage and partially bury their heads either at the side of the cage or alongside some object such as a stone or even a large shell. In these burrows they must also change their larval and pupal skins; but when the time for pupation arrives these burrows must be extended for some distance, the female or even the male must find its way out by making a fresh opening. These burrows must also be used by the females for resting during the day, for the Angul specimen always went back to its shelter under the tin cover and remained there all day, only coming out after dusk.

I have compared the full-grown larva and the adult female which I have successfully bred from it, with larvae and females of various species of Malacoderms from various localities in the collection of the Zoological Survey of India and I find that my specimens agree with those of *Lamprophorus tenebrosus* (Wlk.) collected by Drs. N. Annandale and F. H. Gravely in Ceylon. This species, besides being known from Ceylon, has also been recorded from Pondicherry; Dharwar, "taken during the rains"; Madura; all recorded by Gorham. Among the unnamed Malacoderms in the collection of the Zoological Survey of India there is a male *Lamprophorus* collected by Dr. N. Annandale, at Balugaon, Puri district, Orissa (21-30-vii-1913). This specimen agrees exactly with males of *L. tenebrosus* from Ceylon in the above collection.

EXPLANATION OF PLATE VIII.

Larva of *Lamprophorus tenebrosus* (Wlk.).

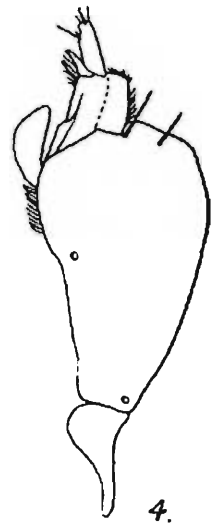
- FIG. 1.—Full-grown larva.
,, 2.—Head from above (enlarged).
,, 3.—Left mandible, dorsal view (enlarged).
,, 4.—Left maxilla, ventral view (enlarged).
,, 5.—Labium, ventral view (enlarged).
,, 6.—Hypopharynx, ventral view (enlarged).
,, 7.—Mentum, ventral view (enlarged).
,, 8.—Submentum, ventral view (enlarged).



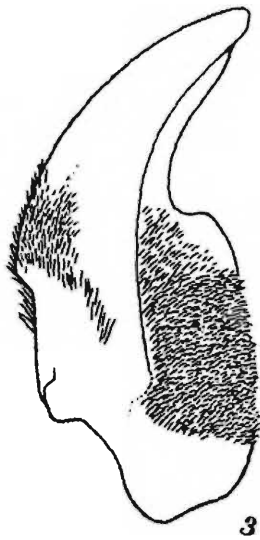
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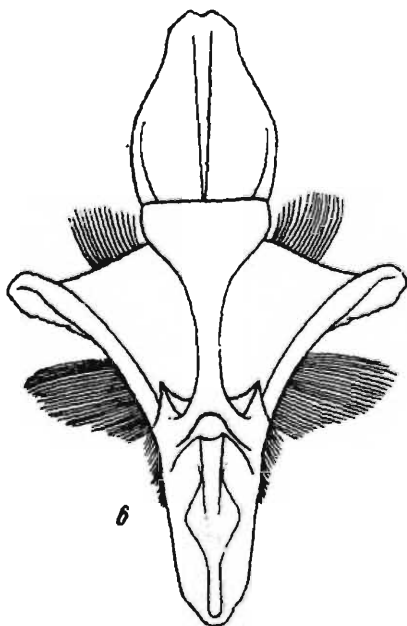
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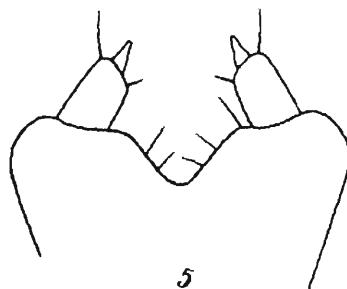
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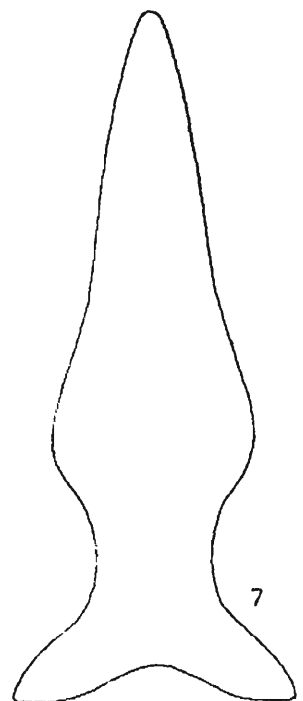
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LARVA OF *LAMPROPHORUS TENEBROSUS*, Walk.

III INDIAN LAND PLANARIANS

By R. H. WHITEHOUSE, M.Sc., Professor of Zoology, Government College, Lahore.

(With Plate XI.)

INTRODUCTION.

Until the present time the land planarians of India have been almost entirely neglected, while the Ceylon forms have been the subject of considerable attention; but it is hoped that the beginning thus made will develop into a comprehensive treatment of these animals which flourish abundantly in all parts where moisture is plentiful.

It was only to be expected that most of the collection would prove to be new; planarians, both land and freshwater, are strikingly local especially the latter; dry areas of any great extent prove complete barriers to their dispersal.

Previous records of Indian land planarians are rare, incomplete and uncertain. *Bipalium smithi* (v. Graff) is described, but with no figure, in von Graff's 'Monographie der Turbellarien—Landplanarien' 1899 and references are made there also to some three or four others which, however, must be regarded as doubtful. Reference might be made to the so-called *Bipalium ferudpoorensis* (E. P. Wright) and it is conjectured by Bell that Ferudpoor is a mis-spelling for Ferozpur in the Punjab; but this is most unlikely, since Ferozpur is in one of the driest and hottest parts of India, and scarcely a place likely to yield land planarians.

The following account is purely systematic, but it is hoped before long to begin anatomical details of the various forms, a work which will do much to clear up any doubtful points; for colour patterns are frequently variable, often due to the age of the specimens. At present it would be unsafe to make any general conclusions regarding distribution; what is known in each case is stated when dealing with each species.

Bipalium proserpina (Humbert).

(Plate XI, figs. 1 to 10.)

Indian Museum Collection Nos. ZEV $\frac{2768}{7}$; ZEV $\frac{6703}{7}$; ZEV $\frac{6707}{7}$; ZEV $\frac{6709}{7}$; ZEV $\frac{6710}{7}$; ZEV $\frac{6713}{7}$; ZEV $\frac{6714}{7}$; ZEV $\frac{6722}{7}$.

This planarian was previously reported from Ceylon only, but its distribution is now found to be quite extensive in India, specimens having been taken at Tenmalai, Maddathoray (Travancore)

and Cochin in Southern India, North Bengal, Lebong and Kurseong in the Eastern Himalayas, Naini Tal in Kumaon, Western Himalayas as well as in Ceylon. The specimen from Lebong may be doubtful since it is headless, but the trunk markings are characteristic of *B. proserpina*, and the doubt is lessened by the fact that the planarian fauna of the Eastern Himalayas is known to include this species. Thus *B. proserpina* will probably prove to be one of the most widely distributed land planarians in India.

The species has been fully described by v. Graff in his monograph and repetition is unnecessary; however, an interesting feature of those collected is the extent of the variation of the colour pattern apart from the mere differences of shade. The typical colouration exhibits a pair of closely approximated central black stripes, which on the head expand into a crescentic patch broken only by a middle club-shaped extension of the thin pale stripe which separates the median black lines; and a prominent black band extending from the 'neck' and following the edge of the trunk to the extremity (fig. 1).

The variations involve such changes in the typical pattern as follow:

The median lines may coalesce into a single broad band; associated with this, the central club-shaped expansion on the head remains, though it may be reduced (fig. 2).

The same two lines may be quite faintly shown, and indicated only as broken lines; with this variation, the head pattern remains characteristic (fig. 3).

The median lines may be absent, and in this case the dark crescentic head patch appears as an unbroken tract (fig. 4).

In some cases the median stripes may be more strongly marked than the laterals (fig. 5).

The lateral bands may vary in breadth and usually are stronger when the median ones are weaker; and vice versa.

The lateral bands may be split along their whole length to form a pair on each side (fig. 6).

As regards the head pattern, the crescentic patch may be only faintly indicated (figs. 7, 8); and in one specimen with coalesced central lines, a forked design is produced, owing to the median lighter piece opening out anteriorly (fig. 9).

Pelmatoplana sarasinorum (v. Graff).

(Plate XI, figs. 11 and 12.)

Indian Museum Collection No. ZEV ⁶⁶⁹⁹/₇.

Dr. Gravely records that a specimen of this animal from Ceylon was very dark above and paler beneath, with a dark mid-dorsal line. The preservative has doubtless removed some pigment and has also caused strong contraction of the body so that the dorsal surface has become concave; this latter feature is, however, undoubtedly not natural, the animal, in life, being practically cylindrical.

Its characters agree closely with v. Graff's specimens collected by M. Sarasin in 1883 in Ceylon. It is only half the size of the largest of those described by v. Graff, measuring about 36 mm. in length, and is unfortunately broken into two pieces. The upper side is brownish with a paler area along each side of the mid-dorsal line; the characteristically narrow ambulacral surface extends to the extreme anterior end round which are the fairly numerous eyes.

Bipalium smithi (v. Graff).

(Plate XI, figs. 13 and 14.)

Indian Museum Collection Nos. ZEV $\frac{6675}{7}$; ZEV $\frac{6701}{7}$; W $\frac{93}{1}$; W $\frac{94}{1}$.

Historically, the most interesting land planarian collected in India is *B. smithi*, since it was the first described from this country with any degree of certainty. The other few mentioned previous to 1914 were all vaguely described, and the accounts are practically useless. However, though he did not figure *B. smithi*, v. Graff describes it in his monograph and I have myself examined the specimen in the British Museum.

The species has, I believe, been found at least four times since; in its original home by Lord Carmichael and Dr. Gravely at Darjiling, and once by Major Bennett at Lebong in the same district.

The British Museum specimen measures 60 mm. in length, but the specimens found since are somewhat smaller; the measurements of the largest complete specimen are:—

Length of the body	45 mm.
Breadth of the body	. 6 mm.
Breadth of the head lobe	.. 7 mm.
Breadth of the ambulacral surface	2 mm.
Thickness of the body	3 mm.
Position of the mouth from the anterior end	24 mm.
Position of the genital opening from the anterior end	. 36 mm.

The specimen from Lebong is much larger, though incomplete, and is probably longer than the British Museum specimen.

The dorsal colour is variable; the deeper layers of the skin contain a bluish-black pigment which is usually masked by a brown colour on the surface closely resembling a mucus, and which is undoubtedly more pronounced in spirit preserved specimens. Thus there may be a predominance of one or the other of these colours and frequently a somewhat patchy appearance is shown. The best preserved specimen is distinctly dark, mostly bluish-black, but paler on the head. The eyes form a diffuse black rim to the edge of the head lobe.

Ventrally, the colour is definitely characteristic; it is light brown except for the ambulacral surface which, along the centre, is creamish brown, while each side has a bluish-green tinge.

Bipalium floweri (v. Graff).

(Plate XI, figs. 15 and 16).

Indian Museum Collection Nos. ZEV $\frac{6977}{7}$; ZEV $\frac{6704}{7}$; ZEV $\frac{6705}{7}$.

This is one of the larger land planarians of Ceylon; it was first collected by Mr. E. F. Green at Punduloya, Rambodda, and the specimen is now in the British Museum.

It has again been found by Dr. Gravely in Pattipola and on the Horton Plains at an altitude of 7,000 ft. One of the Pattipola specimens is the largest yet collected, being 78 mm. long and 8 mm. broad.

The dorsal head pattern is characteristic; a prominent black band follows the periphery of the head lobe and parallel to this band is an orange stripe, which in turn is followed by another dark band which passes gradually into the dark brown colour of the trunk; the trunk colouring lacks pattern and is an even dark muddy brown.

Ventrally, the general surface is somewhat paler than the dorsal side, especially on the head; the latter has a thin dark line at the extreme edge terminating at the angle of the lappets. The ambulacral surface is cream coloured and at the anterior end its raised central portion is a distinct light brown.

Dolichoplana feildení (v. Graff).

(Plate XI, figs. 17 and 18.)

Indian Museum Collection No. ZEV $\frac{6711}{7}$.

This species is most interesting from the fact that it is an exception to the general rule that land planarians are local in distribution, having been taken in Java, Ceylon and the Barbadoes. As v. Graff remarks, except for *Placocephalus kewensis*, which is cosmopolitan, it is the only land planarian that is found in the Oriental and Neotropical regions. It was previously recorded from Ceylon having been collected by Mr. E. E. Green and preserved in the British Museum.

The Indian Museum specimens, collected by Dr. Gravely, were taken at Peradeniya, Ceylon, in June 1910; they are about the same size as Green's specimens, measuring about 47 mm. in length and 3 mm. broad; the Javanese specimens are said to attain even a length of 300 mm. in the living condition, though the same individuals shrink to 77 mm. when preserved. It is therefore safe to assume that the Ceylon forms are capable of an extension to 150 mm. The species is described as being extremely active, exhibiting excessive contractions in its movements.

There is some variety in the general colour; the Javanese type is said to be yellowish while those from Ceylon are, at least in the preserved state, dark brown, though in life the same animal may be distinctly light coloured. Six longitudinal black stripes are distinguishable; a pair of median lines, very closely approxi-

mated and very fine; and two pairs of lateral stripes, the inner pair of which are much the strongest of all. Ventrally, the brown colour is continued from the dorsal side, except for the ambulacral surface which is grey; in light coloured varieties this contrasts with the general surface as darker, but where the brown pigment is marked, the ambulacral surface appears lighter in contrast.

***Bipalium diana* (Humbert).**

(Plate XI, figs. 19 and 20).

Indian Museum Collection No. ZEV $\frac{6732}{7}$.

Three specimens of this species, one only of which is complete, were collected by Dr. Gravely at Peradeniya, Ceylon. They are typical forms corresponding exactly with those already recorded from the same and other localities in Ceylon by a number of observers.

Dorsally, it is brownish-grey with mottlings of black; a closely approximated median pair of black lines runs the whole length of the body, expanding on the head to a crescentic marking; the pale stripe of ground colour between the median lines swells out to a club-shaped form on the middle of the head. The extreme edge of the head lobe is black with numerous eyes and the band between them and the black patch is devoid of mottling.

On the ventral side, the colour is grey with a cream ambulacral surface having a light brown centre.

The species is easy to recognize in older specimens, though in the young forms it is said to have lateral dark bands along the body, which are lost in older animals.

***Bipalium giganteum* (Whitehouse).**

Indian Museum Collection No. ZEV $\frac{6687}{7}$.

Previously recorded from Dibrugarh, Assam, this species was again taken in N.E. Assam at Tezapore by Major T. E. Spragge White. The tube contained three broken pieces of a specimen which is however still incomplete.

***Bipalium andrewesi*, n. sp.**

(Plate XI, figs. 21 and 22.)

Indian Museum Collection No. ZEV $\frac{6690}{7}$.

Only a single specimen of this attractive planarian was taken by Mr. Andrewes on the western slopes of the Nilgiri Hills at an altitude of 2000-3000 ft. in August 1911. In build, the animal is small and sturdy with a comparatively small head lobe. Its measurements are as follows:—

Length of the body	10 mm.
Breadth of the body	3 mm.
Breadth of the head lobe	4 mm.
Breadth of the ambulacral surface	1 mm.

Position of the mouth from anterior
end 6 mm.
Position of the genital opening not distinguishable.

The general ground colour of the dorsal side is a dark reddish-brown, though the markings upon it cover the greater part of the surface. Three longitudinal black stripes run from the 'neck' to the posterior extremity, a median broad band and a pair of less broad laterals at the edge of the body; all unite at the 'neck' in a narrow black transverse band. The head is slightly paler than the brown of the trunk, with a crescentic black band, which normally is probably continuous across the head, though in the specimen examined it is interrupted on the left side. The eyes are arranged along the extreme edge of the head lobe.

Ventrally, the animal is a dull drab brown, with a darker shade at the outer edge and also next to the ambulacral surface; this latter is very pale with a darker central stripe. The under side of the head is paler than the other parts and has a dark crescentic band corresponding to the black mark above.

Cotyloplana nilgiriense, n. sp.

(Plate XI, fig. 23).

Indian Museum Collection No. ZEV ⁶⁶⁹⁰/₇ B.

This is the second member of the genus to be found in India, and was taken in the Nilgiri Hills along with *Bipalium andrewesi*. The measurements of the larger of the two specimens are:—

Length of the body	(about) 12 mm.
Breadth of the body	3 mm.
Position of the mouth from anterior end	6 mm.
Position of the genital aperture from the anterior end	9 mm.
Breadth of the ambulacral surface .	(about) 5 mm.

Above and below the creature is of a greyish colour with touches of brown in parts; dorsally there is a single median black line passing from one extremity to the other and tapering suddenly at the head, which is somewhat lighter in colour. Round the anterior extremity of the ventral surface of the head is a slightly raised and fairly thick "lip," forming a type of sucker characteristic of the genus. The ambulacral surface is very narrow, appearing only as a pale line along the ventral side.

Bipalium brunneus, n. sp.

(Plate XI, figs. 24-26.)

Indian Museum Collection Nos. ZEV ⁶⁶⁷¹/₇; ZEV ⁶⁶⁹⁵/₇.

This handsome planarian was collected at Bagarkote in Kumaon in the Western Himalayas, and in the Cochin State,

S. India; it must therefore have a wide distribution in India and will probably be found in many other districts eventually.

The following description refers in particular to No. ZEV ⁶⁶⁷¹/₇ from Bagarkote at an altitude of 3,000 ft. which is the largest specimen.

Length of the body	58 mm.
Greatest breadth of the body	9 mm.
Thickness of the body	3 mm.
Breadth of the head lobe	6 mm.
Breadth of the ambulacral surface	3 mm.
Position of mouth from the anterior end	24 mm.
Position of the genital opening from the anterior end	33 mm.

The ground colour of the dorsal surface is a warm rusty brown with three longitudinal dark stripes, a median and a pair of laterals. The median stripe is prominent and jet black, extending from the extreme anterior to the posterior extremity, and widening slightly above the pharyngeal and genital regions. The lateral stripes are of diffuse black pigment and broader than the median, extending from the 'neck' to the posterior end of the body. The eyes are closely packed to form a thin jet black line round the edge of the head lobe; they are also found distributed generally over the head region.

The ventral surface, except for the creeping area, is a dull rusty brown with a greyish outer edge along the whole length but not sharply marked off from the brown. The ambulacral surface is purplish-grey, the middle being raised into a ridge; the mouth and genital openings are prominent and from them respectively protrude the frilled pharynx and genital organ.

The other specimen differs in minor particulars.

No. ZEV ⁶⁶⁹⁵/₇ from near the Forest Tramway in Cochin State at an altitude of 300 ft. is 17 mm. long and its dorsal colouring is of the same pattern as that of the specimen described above, with the following exceptions: The lateral bands are jet black and not diffused; the median line ends in a club-shaped expansion on the head, which is otherwise pale. These differences are such as may be met with in young specimens; it is characteristic of land planarians that stripes tend to disappear with age, a feature constantly illustrated in the case of *Bipalium diana*.

Pelmatoplana rotunda, n. sp.

(Plate XI, fig. 27).

Indian Museum Collection No. ZEV ⁶⁶⁷¹/₇ B.

One specimen of this Geoplanid was procured along with *Bipalium brunneus* at Bagarkote in Kumaon, Western Himalayas, at an altitude of 3,000 ft., in June 1914.

The animal is small and very blunt at each end; in transverse section it is almost circular. Its measurements are:—

Length of the body	15 mm.
Breadth of the body	3.5 mm.
Thickness of the body	3 mm.
Breadth of the ambulacral surface	1 mm.
Position of the mouth from anterior end	7 mm.
Position of genital opening from anterior end	11 mm.

The dorsal coloration is an even moderately light brown covering a deeper black pigment. The ventral surface is slightly darker except for the very prominent ambulacral surface, which is white with a fairly dark median line, and which extends from one extremity to the other. The eyes could not be distinguished with certainty, though on one side there is a somewhat paler circular patch in the middle of which one of a pair of eyes may be situated.

Bipalium splendens, n. sp.

(Plate XI, figs 29-31.)

Indian Museum Collection No. ZEV $\frac{6692}{7}$; ZEV $\frac{6716}{7}$.

This beautiful planarian is found at Kurseong in the Eastern Himalayas and Cherrapungi in Assam; the measurements of the larger specimen are as follows:—

Length of the body	90 mm.
Breadth of the body	4.5 mm.
Breadth of the head lobe	3 mm.
Breadth of the ambulacral surface	1 mm.
Position of the mouth from anterior end	45 mm.
Position of genital aperture from anterior end	54 mm.

The upper surface is flat while the lower is slightly arched; the head is flat and small being only a little wider than the 'neck' and narrower than the greater part of the trunk, the body tapers gradually towards the posterior end. Judging from the wrinkling of the body in the preserved animal, it would appear capable of considerably greater extension in life.

The colour pattern on the upper side of the trunk consists of three longitudinal jet black lines, one median, and a pair of laterals, at the extreme edge of the body, on a ground colour which differs in the two specimens, in one a creamish yellow and in the other chestnut brown; at the pharyngeal region the median line widens to double its ordinary width, and a slight thickening also occurs over the genital region. The lateral lines, narrower than the median, cease at the 'neck,' while the median one expands into a knob-like termination on the head. The whole of the upper side of the head has a deeper shade than the rest of the body

The eyes are not numerous and are placed round the edge of the head lobe rather more to the ventral side.

Ventrally, the ground colour is similar to that of the dorsal side; the ambulacral surface is pale yellow, and on each side of it is a diffused black line, extending from the 'neck' to the extreme posterior, the under side of the head is a little darker towards the outer edge.

***Pelmatoplana himalayense*, n. sp.**

(Plate XI, figs. 32-34).

Indian Museum Collection No. ZEV $\frac{6749}{7}$; ZEV $\frac{6667}{7}$; ZEV $\frac{6694}{7}$; ZEV $\frac{6715}{7}$; ZEV $\frac{6717}{7}$.

This species is represented by three specimens, only one of which, collected by Dr. F. H. Gravely, is well preserved; the other two were the first to be found, on 15th July 1907, at Kurseong, E. Himalayas, while Dr. Gravely's specimen was taken in the same district between Darjiling and Soom on 14th June 1914. All were taken at an altitude of 5,000-7,000 ft.

The animal is a comparatively fragile creature, beautifully marked in black and brown stripes and of the usual Geoplanid form. The measurements are approximations only, since the animal is much coiled and liable to break if uncoiling were attempted.

Length of body	123 mm.
Breadth of body	4 mm.
Breadth of ambulacral surface	1 mm.
Position of the mouth, about half-way along the body.	
Position of the genital opening, from mid-way to two-thirds the distance from the mouth to the posterior extremity.	

The colour pattern consists of five jet black longitudinal bands alternate with four narrow stripes of a median brown colour; of the black bands, the median is the broadest, the inner lateral somewhat narrower, while the outer lateral, at the edge of the body, is but a thin line. All the brown stripes are of similar width. As the anterior end is reached, the black bands gradually acquire a more or less equal strength and end abruptly and evenly at the posterior border of a brown collar encircling the neck region. From the collar forwards the head is of a dark grey colour, sufficiently dark as to make it impossible to distinguish the presence or absence of eyes.

Ventrally, the colour is similar to the brown of the dorsal side, except for the ambulacral surface, which is white and slightly protuberant.

***Bipalium sylvestre*, n. sp.**

(Plate XI, fig. 35 and 36).

Indian Museum Collection No. ZEV $\frac{6695}{7}$ B.

This planarian, of which one specimen only was taken in the Cochin State near the Forest Tramway is a very dark form and

only at the anterior portion can the markings be followed. The measurements are:—

Length of the body	50 mm.
Breadth of the body	5 mm.
Breadth of the head lobe	6 mm.
Breadth of the ambulacral surface	2 mm.
Position of the mouth from anterior end	28 mm.
Position of the genital opening	not visible.

The colour of the dorsal surface is a very dark brown; three longitudinal black lines are present, a median thin line reaching to the 'neck' and a pair of broader lateral lines at the edge of the body. These laterals are continued round the contour of the head a little removed from the edge and thickest near the lappets. On the head and alongside the lateral bands is a black mottling.

Ventrally, the colour is a warm brown at the outer edge, gradually becoming paler as the ambulacral surface is reached; the latter is pale with a brown central line throughout its length, and it ends abruptly at the 'neck.' The under side of the head is darker than the rest of the ventral surface.

Pelmatoplana maculosa, n. sp.

(Plate XI, figs. 37 and 38).

Indian Museum Collection No. ZEV $\frac{67.0.5}{7}$ B.

One specimen only of this planarian was found by Dr. Gravely at Pattipola, Ceylon. Its measurements are:—

Length of the body	45 mm.
Breadth of the body	5 mm.
Breadth of ambulacral surface, about	75 mm.
Position of mouth from anterior end	23 mm.
Position of genital opening from anterior end	31 mm.

The ground colour of both the dorsal and ventral sides must, strictly speaking, be regarded as a warm brown with heavy black mottlings on the dorsal surface. The mottling, however, is so dense as to make the dorsal colouring more easily described as black with irregular small brown splashes; these markings are dendritic, with a tendency to parallel arrangement with numerous cross connections. Extending from one extremity to the other is a median thin brown line, that is, a narrow portion of the ground colour uninterrupted by black pigment. The black marking is practically continuous on each side of the median stripe and also at each side of the body where the colouring of the dorsal and ventral surfaces is sharply marked off. No eyes can be distinguished.

The ambulacral surface is pale and narrow, about one-fifth the width of the body, extending to both extremities; it is grooved throughout its length, with a darker pigment at the bottom of the

groove, though it is difficult to say how much this may be due to the effect of the preservative.

***Pelmatoplana striata*, n. sp.**

(Plate XI, figs. 39-41).

Indian Museum Collection No. ZEV⁶⁷⁰⁹B.

Two specimens of this planarian were taken by Dr. Annandale at Maddathoray in Travancore from beneath rotten wood in the jungle in October 1908; both specimens are of about equal size, measuring 42 mm. in length and 5 mm. in breadth; the ambulacral surface is very narrow being less than a millimetre broad. Neither the mouth nor the genital opening can be seen probably owing to the fact that there is a groove running along the middle of the ambulacral area, and the apertures being situated at the bottom are invisible. However, the pharyngeal swelling, 20 mm. from the anterior end would place the mouth at about half way along the ventral side, with the genital opening not far away. No eyes can be distinguished.

The general colour is a rather pale grey brown; six longitudinal dark stripes run from end to end; (1) a pair of closely approximated lines separated only by an extremely thin pale line; they are jet black and prominent; (2) an inner lateral, and (3) an outer lateral line on each side of equal strength and not much darker than the ground colour. Between the middle pair and the inner laterals is a pale creamy white area. Ventrally the colour is similar to the general colour of the dorsal side, except for the pale narrow ambulacral surface, which extends to both extremities.

***Bipalium indica*, n. sp.**

(Plate XI, figs. 42 and 43.)

Indian Museum Collection Nos. ZEV⁶⁶⁰²; ZEV⁶⁶⁶⁵; ZEV⁶⁷⁰⁵; ZEV⁶⁷¹⁸; ZEV⁷²³¹.

This planarian has been found in Calcutta and at Coimbatore in Southern India; it appears to be the commonest land planarian in the Calcutta district, and it will no doubt be found to have a somewhat extensive distribution in this country.

From the number of specimens collected, the length of the body may be put down as from 30 mm. to 40 mm. and the breadth from 3 mm. to 5 mm.; the head lobe is a little wider than the trunk; the mouth is situated about half the distance along the body, and the genital opening roughly half way between the mouth and the posterior extremity.

The dorsal colouration varies in different animals and in different parts of the same animal from a pale biscuit brown to a darkish dull brown; sometimes the body is distinctly patchy but usually the colour is even. There is an indication of a median pale stripe, but it is usually no more than an indication, except in

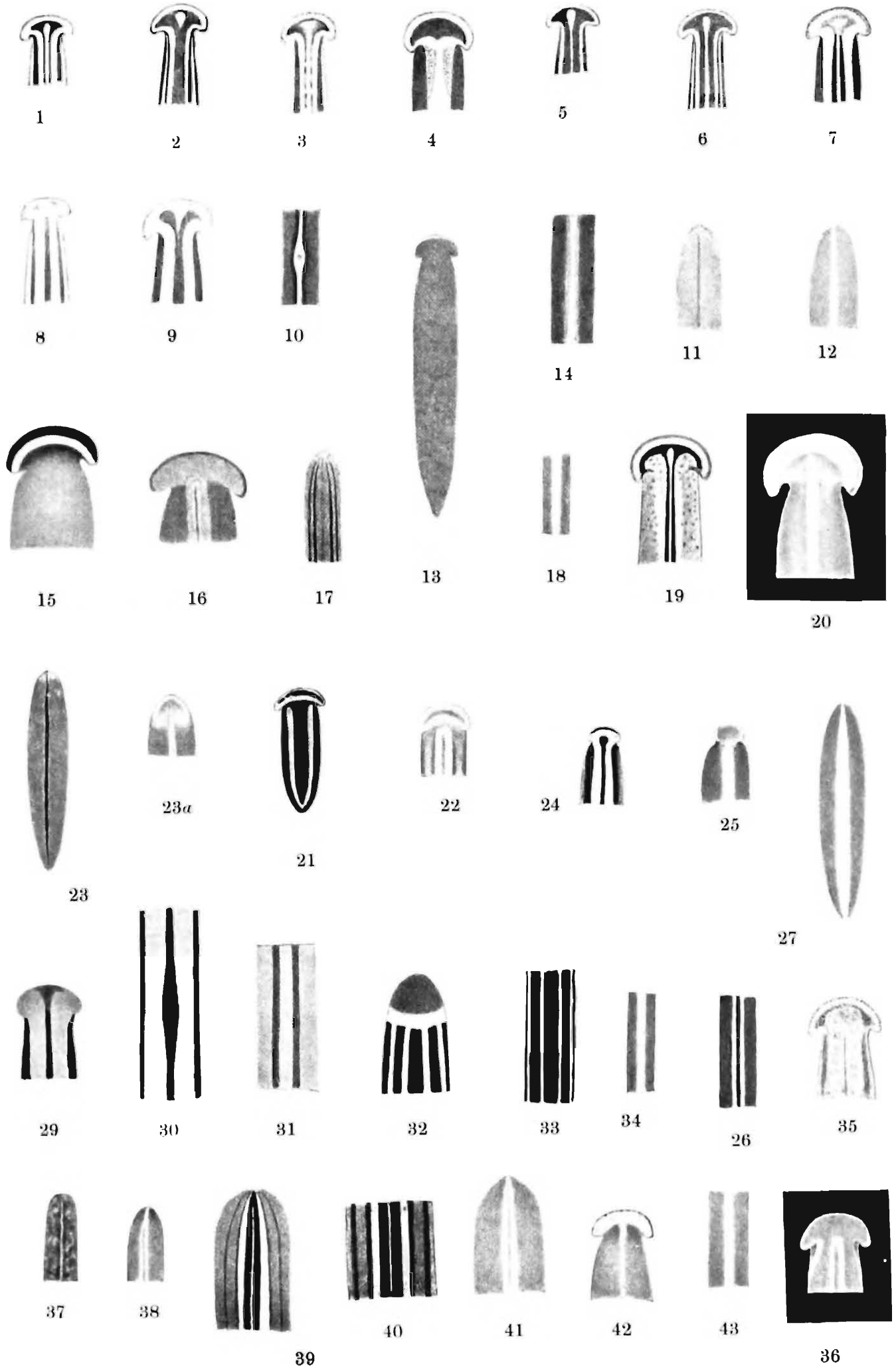
dark specimens, since it becomes lost in the general colour ; at the ' neck ' however it is always well marked owing to the presence in this region of dark pigment in the form of an indefinite band with which the median stripe contrasts strongly. The dorsal side of the head is pale and numerous eyes can easily be distinguished along the edge ; the eyes are also crowded at the ' neck.'

Ventrally, the colour is similar to the dorsal side, though usually paler ; the ambulacral surface is white



EXPLANATION OF PLATE XI.

- FIGS. 1-9.—*Bipalium proserpina*. Variations in head and trunk markings; Fig. 1 typical pattern.
- FIG. 10.—*Bipalium proserpina*. Ventral surface in the region of the mouth. The dark edge to the central pale ambulacral surface is not always marked.
- „ 11.—*Pelmatoplana sarasinorum*, × 2. Dorsal view of the anterior end.
- „ 12.—*Pelmatoplana sarasinorum*, × 2. Ventral view of the anterior end.
- „ 13.—*Bipalium smithi*, nat. size. Dorsal view of the entire animal.
- „ 14.—*Bipalium smithi*, nat. size. Ventral view of a portion of the trunk. Ambulacral surface cream, bordered with pale transparent green; rest rusty brown.
- „ 15.—*Bipalium floweri*, × 2. Dorsal view of the anterior end.
- „ 16.—*Bipalium floweri*, × 2. Ventral view of the anterior end.
- „ 17.—*Dolichoplana feildeni*, × 2. Dorsal view of the anterior end.
- „ 18.—*Dolichoplana feildeni*, × 2. Ventral view of a portion of the trunk.
- „ 19.—*Bipalium diana*, × 2. Dorsal view of the anterior end. The lighter area round the median lines is not always present.
- „ 20.—*Bipalium diana*, × 2. Ventral view of the anterior end.
- „ 21.—*Bipalium andrewesi*, × 2. Dorsal view of the entire animal.
- „ 22.—*Bipalium andrewesi*, × 2. Ventral view of the anterior end.
- „ 23.—*Cotyloplana nilgiriense*, × 2. Dorsal view of the entire animal.
- „ 23a. *Cotyloplana nilgiriense*, × 2. Ventral view of the anterior end.
- „ 24.—*Bipalium brunneus*, nat. size. Dorsal view of the anterior end.
- „ 25.—*Bipalium brunneus*, nat. size. Ventral view of the anterior end.
- „ 26.—*Bipalium brunneus*, nat. size. Dorsal pattern of the trunk.



- FIG. 27.—*Pelmatoplana rotunda*, × 2. Ventral view of the entire animal.
- „ 29.—*Bipalium splendens*, × 2. Dorsal view of the anterior end.
- „ 30.—*Bipalium splendens*, × 2. Dorsal pattern of the trunk in the region of the pharynx.
- „ 31.—*Bipalium splendens*, × 2. Ventral view of the trunk.
- „ 32.—*Pelmatoplana himalayense*, × 3. Dorsal view of the anterior end.
- „ 33.—*Pelmatoplana himalayense*, × 2. Dorsal pattern of the trunk.
- „ 34.—*Pelmatoplana himalayense*, nat. size. Ventral view of part of the trunk.
- „ 35.—*Bipalium sylvestre*, × 2. Dorsal view of the anterior end.
- „ 36.—*Bipalium sylvestre*, × 2. Ventral view of the anterior end.
- „ 37.—*Pelmatoplana maculosa*, nat. size. Dorsal view of the anterior end.
- „ 38.—*Pelmatoplana maculosa*, nat. size. Ventral view of the anterior end.
- „ 39.—*Pelmatoplana striata*, nat. size. Dorsal view of the anterior end.
- „ 40.—*Pelmatoplana striata*. Details of the dorsal pattern of the trunk.
- „ 41.—*Pelmatoplana striata*, nat. size. Ventral view of the anterior end.
- „ 42.—*Bipalium indica*, × 2. Dorsal view of the anterior end.
- „ 43.—*Bipalium indica*, × 2. Ventral view of the portion of the trunk.

IV STUDIES ON INFUSORIA.—II

ON TWO NEW SPECIES OF *HOLOPHRYA*, EHRBG.

By EKENDRANATH GHOSH, *M.Sc., M.D.*

The genus *Holophrya*, Ehrbg. may be briefly diagnosed as follows:—Infusoria with cylindrical to spherical body entirely and uniformly covered with cilia arranged in close meridional rows. Cytostome antero-terminal or rarely slightly lateral, rounded or rarely slit-like. Cytopharynx generally present and without rod-apparatus, absent in a few species. Macronucleus one, sometimes two or numerous macronuclei. C.V. one or more, then either scattered or arranged in longitudinal rows. Division by transverse fission. Free-swimming, freshwater and marine.

The above diagnosis does not include the species *H. multifiliis* considered by Schewiakoff (5) to belong to this genus. Being parasitic and having a complicated life-history, it is left in a genus of its own under the name *Ichthyophthirius multifiliis*, Fouquet.

***Holophrya bengalensis*, sp. nov.**

The species may be diagnosed thus:—Cylindrical with rounded ends, slightly stouter posteriorly; the cilia are long. Cytostome small and circular, at anterior end; cytopharynx absent; macronucleus broadly fusiform and placed in the middle of the body near one side; C.V. single, subterminal, placed close to one side. Length 0·075 mm.; breadth 0·037 mm.

A single specimen was found in vegetable infusion.

***Holophrya annandalei*, sp. nov.**

The species may be diagnosed as follows:—Cylindrical, rounded at both ends, three times longer than broad; cytostome antero-terminal and circular in outline; cytopharynx a slight depression; ciliary striae faint; macronuclei two in number and spherical in shape, one placed in the middle on one side and the other towards the anterior end. C.V. single, placed at the junction of the anterior and middle third of the body on one side. Length 0·15 to 0·22 mm.

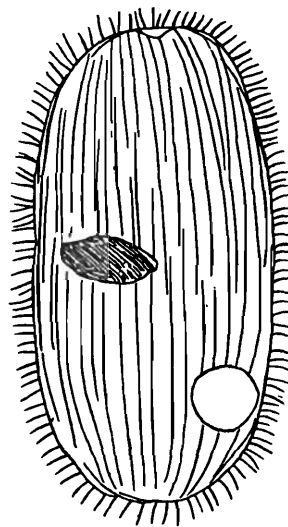


FIG. 1.—*Holophrya bengalensis*, sp. nov.

Several specimens were found in a vegetable infusion. Unfortunately the drawing of the animal is lost.

The species of *Holophrya* may be tabulated in the following synopsis:—

- a. Numerous C.V., one postero-terminal and others in 1-2 longitudinal rows.
- a¹. 2 longitudinal rows of C.V.; macronucleus oval. *H. lieberkuhnii*, Schout.
- b¹. One longitudinal row of C.V.; macronucleus ribbon-shaped; body oval *H. coleps*, Schout. (6)
- b. C.V. one or 2, postero-terminal or not.
- a¹. C.V. one.
- a². C.V. central; a tuft of long cilia round the mouth; macronucleus elongated and curved ? *H. pogonias*, Smith.
- b². C.V. placed at the junction of the anterior and middle thirds of the body on one side; macronuclei two, spherical; body cylindrical; cytopharynx a slight depression *H. annandalei*, n. sp.
- c². C.V. posterior.
- a³. Ciliary striae oblique; body ovate; macronucleus ovate and subcentral. *H. ovum*, Ehrbg.
- b³. Ciliary striae parallel to the long axis of the body.
- a⁴. Cytostome slit-like and lateral near the anterior pole; body rounded in front and pointed behind *H. heterostoma*, Beardsley.
- b⁴. Cytostome circular in outline and terminal or subterminal.
- a⁵. Cytostome wide and occupying the entire truncate anterior end of the body.
- a⁶. Body elongately oval; anterior end obliquely truncate; cytopharynx indistinct, with a few rods; macronucleus elongated and curved *H. tarda*, Quenn.
- b⁵. Body oval; macronucleus long, cylindrical and twisted *H. curvilata*, Smith.
- b⁶. Cytostome not so.
- a⁶. No cytopharynx.
- a⁷. Body elliptical.
- a⁸. Macronucleus elliptical or spherical; body length 0.035 mm.; C.V. posterior and terminal *H. simplex*, Schew.
- b⁸. Macronucleus horseshoe-shaped; body length 0.105 mm. *H. indica*, Bhatia (2)
- b⁷. Body cylindrical; macronucleus fusiform in the middle of the body and lateral; C.V. near the posterior end and lateral *H. bengalensis*, n. sp.
- b⁶. With cytopharynx.
- a⁷. Circumoral cilia always directed forwards; macronucleus with a "binnenkorper" *H. atra*, Svec.
- b⁷. Circumoral cilia not so.
- a⁹. Body elliptical or spherical; longitudinal striae connected by transverse lines; macronucleus elliptical, with trichocysts *H. nigricans*, Lauterb.

- b*⁸. Body cylindrical; no trichocysts; no transverse lines.
*a*⁹. Cytostome terminal; cytopharynx short and funnel-shaped.
*a*¹⁰. Numerous macronuclei; length = 5 times the breadth ... *H. oblonga*, Maupas.
*b*¹⁰. Single oval macronucleus; length > breadth. *H. marina*, Quenn.
*b*⁹. Cytostome lateral, near anterior pole; cytopharynx extending to middle of the body; a single elliptical macronucleus ... *H. edentata*, Schout.
*b*¹. C.V. 2, postero-lateral; macronucleus big and oval; cytopharynx absent; body spherical to elliptical *H. haplostoma*, Andre.

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2. Bhatia.—*Rec. Ind. Mus.* Vol. XII, p. 177 (1916).
3. Hamburger and Buddenbrock.—*Nordisches Plankton*, 1911.
4. Kent.—*A Manual of Infusoria*, 1880-1882.
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V CONTRIBUTIONS TO A KNOWLEDGE
OF THE CHILOPODA GEOPHILI-
MORPHA OF INDIA

By F. SILVESTRI (*Portici, Italy*).

(With 39 text-figures.)

The Chilopoda Geophilomorpha described up to date from India (including Burma) are the following :—

- Lamnonyx spissus*, Wood. Burma.
,, *castaneiceps*, Haase. Andamans.
,, *punctifrons* (Newp.), from many localities.
Orphnaeus brevilabiatus (Newp.), from many localities.
Eucratonyx meinertii (Pocock). Mergui Archipelago; Burma,
etc.
Himantosoma typicum, Pocock. Mergui Archipelago; Burma.
,, *porosum*, Pocock. Burma.
Disargus striatus (Pocock). Madras.
Polyporogaster indicus (Mein.). Kulu.
,, *insignis* (Mein.). Kulu.
? *Himantaricun doriae*, Pocock. Burma.

In the collection of the Indian Museum kindly sent me for examination by the Director of the Zoological Survey of India I have found specimens of 19 species or varieties, which are described in this paper with some others of the same genera or related genera of the Oriental and Malaysian regions preserved in my collection.

The rich material of the genus *Lamnonyx* has permitted me to make a revision of the species and related genera of the group, and has shown that *L. punctifrons*, Newp. from India, or at least the form considered as such by me, is restricted so far as we know to the East of South India; *L. insularis* (Lucas), which is distributed through tropical Africa, extends its range to W India and in a varietal form to South India and Malaysia; *L. maxillaris* (Gerv.) is a cosmopolitan species in tropical and subtropical regions and has also been introduced into hot-houses of Europe. The remainder of the species of the genus *Lamnonyx* have a restricted area of distribution.

The genus *Lamnonyx* is represented in India by nine forms (species and varieties) out of 22 described up to date, and is a prevalent genus both for number of species and frequency of specimens.

After *Lamnonyx* the genera *Polyporogaster* and *Mesocanthus* have respectively three and four species in India, while the first

has a species in North Africa and two in North-West Asia, and the second has a species in North Africa and one variety of the same represented in East Africa and West India.

The genus *Himantosoma* is known up to date only from India and Malaysia and *Eucratoryx* from India and New Britain.

Subfam. DICELLOPHILINAE.

Geophili maxillares ex p. Gervais, *Ann. Sc. nat.* (2), VII, p. 178 (1837);
Id., *Ins. Apt.* IV, p. 308 (1847).

Dicellophilidae, O. F. Cook, *Proc. U.S. Nat. Mus.* XVIII, p. 61 et
p. 73.

Mecistocephalinae, Attems, *Zool. Jahrb. Syst.*, XVIII, p. 207 (1903).

Placodesmata, *Mecistocephalidae*, Verhoeff, *Bronn's Klass. u. Ord.*
Chilopoda, pp. 270, 271 (1908).

Mecistocephalidae, Brölemann, *Arch. Zool. exp.* (5) III, p. 307 et seq.
(1909); Ribaut, *Chilopoda*, in *Voyage Alluaud et Feannel en Afrique*
or. (1911-1912), p. 17 (1914).

Lamina cephalica longior quam latior, pedes maxillares magna pro parte haud tegens sutura frontali discreta. Antennae plus minusve attenuatae; labrum tripartitum parte media quam laterales multo minore plus minusve bene unidentata, partibus lateralibus margine nudo vel ciliato (setis instructo). Mandibulae laminis pectinatis in plerisque generibus numerosis, in gen. *Arrup*, Chamb. duabus, instructae. Maxillae primi paris subcoxis coalitis vel linea mediana divisae, malis utrimque duabus subaequalibus, integris parte distali attenuata, plus minusve arcuata, subhyalina. Maxillae secundi paris subcoxis coalitis vel linea mediana divisae, palpo (praeter subcoxas) 4-articulato articulo quarto unguiformi vel 3-articulato ungue nullo.

Lamina basalis subtrapezoidea, angusta, partim quam lamina cephalica plus minusve angustior; lamina praebasalis indistincta. Pedes maxillares longi, bene armati, subeoxarum lineis chitineis nullis.

Segmenta pedifera suprascutellis nullis, praescutello magno, sterna antica parte postica sat longa, gradatim angustiore in segmento sequenti intromissa et interne a margine postico usque ad medium sternum spissitudine longitudinali chitinea antice bifurcata vel non fulcro *entosternali* vel *furca* appellata, instructa sunt; sterna omnia poris ventralibus destituta.

Segmentum ultimum pediferum subcoxis plus minusve inflatis et poris numerosis instructis, pedibus (subcoxis exclusis) 6-articulatis, elongatis, ungue nullo.

Appendices genitales plus minusve distincte biarticulatae.

Pori anales duo.

Segmentorum numerus uniusquisque speciei constans.

Pulli ex ovo segmentorum numero adulti nascunt, segmenti praegenitalis subcoxis poris destitutis vel poro uno instructis, poris analibus magnis vel permagnis.

Familiae huic genera haec pertinent: *Dicellophilus*, O. F. Cook; *Lamnonyx*, O. F. Cook; *Megethmus*, O. F. Cook; *Arrup*,

Chamb.; *Prolamnonyx*, Silv. (*Tygarrup*, Chamb. forsan = *Dicel-
lophilus*, O. F. Cook.).

CONSPECTUS GENERUM.

1. Subcoxae segmenti praegenitalis (ultimi pediferi) per-
magnae segmentum praecedente amplectentes ... *Megethmus*.
Typus: *M. microporus* (Haase). Luzon.
2. Subcoxae segmenti praegenitalis ad latera segmenti
praecedentis haud vergentes.
3. Palpi maxillares ungue distincto instructi.
 5. Lamina cephalica spina antica infera sub-
lateralis instructa ... *Lamnonyx*.
Typus: *L. punctifrons* (Newp.). India.
 6. Lamina cephalica spina antica infera sub-
lateralis destituta ... *Dicellophilus*.
Typus: *D. limatus* (Wood).
4. Palpi maxillares ungue nullo.
 7. Mandibulae laminis pectinatis numerosis in-
structae; maxillae primi paris subcoxis coal-
itis ... *Prolamnonyx*.
Typus: *P. holstii*, Poc. China; Japan.
 8. Mandibulae laminis pectinatis duabus in-
structae; maxillae primi paris subcoxis mediis
divisis ... *Arrup*.
Typus: *A. pylorus*, Chamb. California.

ON THE FAMILY NAME HERE USED.

Newport in 1842 described the genus *Mecistocephalus* basing it upon the following species: (i) *Mecistocephalus ferrugineus* (C. Koch); (ii) *M maxillaris* (Gerv.); (iii) *M punctifrons*, Newp. etc. Newport did not indicate the type species of the genus, but O. F. Cook proposed to consider the first, viz. *Mecistocephalus ferrugineus* as the type, notwithstanding the fact that C. L. Koch in 1847 erected the genus *Pachymerium* for this species. Following this rule O. F. Cook founded in 1895 the genus *Lamnonyx* for the reception of *M. punctifrons* and allied forms and the genus *Dicellophilus* for *M. limatus* (Wood) of California. On the basis of this arrangement O. F. Cook named the family Dicellophilidae from *Dicellophilus*. Pocock in 1898 considered *M punctifrons* as the type of *Mecistocephalus*, after C. Koch had taken out *M ferrugineus*. Attems in 1903 refused in part to follow Cook and Pocock and considered, very wrongly, the species *M carniolensis* as the type of the genus *Mecistocephalus*. This species was unknown to Newport, at any rate when he proposed the genus *Mecistocephalus*. Attems accepted the genus *Lamnonyx* with *L. punctifrons* as type species, and he therefore named the subfamily Mecistocephalinae. Verhoeff (1908), Brölemann (1909) and Ribaut (1914) followed Attems, but gave the group family rank.

Chamberlin (1914), with Pocock in 1898, noted that *M. ferrugineus* having been removed from *Mecistocephalus* as the type of *Pachimerium*, C. Koch (1847), *Mecistocephalus*, Newport must remain with the type species *M punctifrons* and not *M. carniolensis*, which was not included by Newport in the list.

I prefer in similar cases to follow the view of Cook, assuming as type of the genus the first species ascribed to it by the author of the genus; in my opinion, therefore, *Mecistocephalus*, Newport has *M. ferrugineus* as type species and cannot be included in this family, which takes its name from another genus proposed by Cook, viz *Dicellyphilus*.

ON THE CHARACTERS FOR DISTINCTION OF GENERA AND SPECIES.

In this family good characters for the distinction of the genera are the form of the maxillary palps, the presence or absence of a spine on the underside of the anterior sublateral region of the epicranium, and the development of the subcoxae of the pregenital segment. I could not find any basis for the distinction of genera in the form of the teeth of the pectinate laminae of the mandibles, nor in the presence or absence of setae on the lateral parts of the labrum. Such characters have been retained as of great importance in the distinction of species, together with that of the relative length of the head, the number and form of the teeth of the maxillipedes, the form of the sternal furca, of the sternum and the number of pori on the subcoxae of the pregenital segment.

I note that the relative length of the epicranium has its value, but not an absolute value, because it appears to me to be variable in some degree and sometimes very variable on account of mutation or aberration. I, therefore, think it is not to be considered of first importance and cannot serve for the distinction of species, if not observed in a good series of specimens. This view has been followed by me invariably and a case I consider as an aberration is briefly discussed in the description of *Lamnonyx maxillaris*.

The colour also is very variable in the genus *Lamnonyx* and has, therefore, not been used by me for the distinction of species or of varieties.

ON GEOGRAPHICAL DISTRIBUTION.

The genera of Dicellyphilinae known up to date are especially distributed from Japan and China to New Guinea, Malaysia and India.

Western North America has two genera with three species and Europe only one species, belonging to one of the North American genera, viz. *Dicellyphilus*.

Tropical Africa has a species, *L. insularis* (Lucas), which extends to India, and in some places *L. maxillaris* (Gerv.), which is actually tropocosmopolitan and has been introduced into the Canary Is. and into Madeira, Paris and Hamburg.

South America, if we exclude *Tygarrup intermedius*, Chamberlin, described as coming from British Guiana but collected in pots of plants in Washington, has only the tropocosmopolitan *L. maxillaris*.

The centre of formation and distribution of genera and species of Dicellyphilinae has certainly been somewhere between Japan, New Guinea and India.

Gen. *Lamnonyx*, O. F. Cook.

(Figs. I—XXIII).

Mecistocephalus ex p. Newport, *Proc. Zool. Soc. London*, 1842, p. 178; *Id.*, *Trans. Linn. Soc. London*, XIX, p. 429 (1844); Wood, *Tr. Amer. Phil. Soc. Philad.* XIII, p. 176 (1829); Meinert, *Nat. Tidsskr.* VII, p. 92 (1870); *Id.*, *Pr. Amer. Phil. Soc.* XXXIII, p. 212 (1885); Chamberlin, *Bull. Mus. comp. Zool. Cambridge, Mass.* LVIII, p. 209 (1914).
Lamnonyx, O. F. Cook, *Proc. U.S. Nat. Mus.* XVIII, p. 61 et 74 (1895); Attems, *Zool. Jahrb. Syst.* XVIII, p. 210 (1903); Verhoeff, *Bronn's Klass. u. Ord. Chilopoda*, p. 273 (1908); Ribaut, *Chilopoda*, in *Voyage Alluaud et Feannel en Afrique or.* (1911-1912), p. 17 (1914).

Corpus postice attenuatum.

Lamina cephalica longior quam latior, sutura frontali discreta, genarum angulo antico interno ad labrum in processum acutum producto, superficie antica infera sublaterali externa in spinam producta. Antennae attenuatae.

Labrum tripartitum parte mediana angustiore, margine cetero nudo vel ciliato; mandibulae laminae pectinatis numerosis instructae superficie externa nuda; maxillae primi paris subcoxosterno medio diviso, mala externa et interna subaequalibus simplicibus, parte proximali bene chitinea et setosa, parte distali curvata, incolori, nuda; maxillae secundi paris subcoxosterno integro, palpo (ungue incluso) 4-articulato, ungue parvo vel perparvo.

Lamina basalis subtrapezoidea, angusta, haud multo postice latior quam longior.

Pedes maxillares flexi marginem frontalem superantes, subcoxis et articulis 2-4 plerumque armatis.

Tergita longitudinaliter bisulcata, praetergito segmenti primi pediferi perparvo oblecto, praetergitis ceteris magnis.

Sterna antica sulco mediano a parte postica usque parum ante medium sternum pertinente integro vel antice bifurcato. Praescutellum (paratergitum) quam scutellum spiraculiferum majus, scutellis ceteris vide fig I, 9.

Segmentum ultimum pedigerum sterno bene evoluto, subcoxis poris numerosis instructis, pedibus (subcoxis exclusis) 6-articulatis, inermibus.

Pori anales duo.

Species typica: *Mecistocephalus punctifrons*, Newport.

Habitat.—Regiones tropicales et subtropicales; in hemisphaero australi etiam regiones temperatae.

Praeter species hic a me descriptae, generi huic pertinent etiam: *Lamnonyx angusticeps*, Ribaut, Africa or.; *L. japonicus* (Mein.), Japonia.

CONSPECTUS SPECIERUM HIC DESCRIPTARUM.

A. Pedum paria 49.

1. Sterna antica sulco mediano postico c. ad dimidium sternum bifurcato impressa.

3. Sternorum anticorum furca (semper in segmento decimo considerata) angulum acutum formans

... .. *L. punctifrons* (Newp.).

- a. Mandibularum laminae pectinatae dentibus proximalibus quam distalibus parum diversis (a laminae dimidia parte ad basim gradatim parum minoribus).
- c. Mandibularum margo internus integer, capite longiore quam latiore c. ut 75:45; segmenti ultimi sternum trapezoideum *L. punctifrons*, s. str.
- d. Mandibularum margo internus brevi spatio serrato, caput, servata proportione, parum latius et segmenti ultimi pedigeri sterni latera minus convergentia *L. punctifrons* v. *sulcicollis* (Tom.).
- b. Mandibularum laminae pectinatae dentibus proximalibus quam distales multo minoribus *L. punctifrons* v. *heteropus*, Humb.
4. Sterna antica furca angulum subrectum vel obtusum formante.
5. Sterna antica furca angulum subrectum vel parum obtusum formante.
7. Labri margo nudus; mandibularum margo internus ad laminam primam integer vel subinteger; laminarum pectinatarum dentes proximales sat magni quam distales gradatim parum minores *L. insularis*, Lucas.
- var. Pedes primis paris quam idem formae typicae c. $\frac{1}{4}$ longiores *L. insularis* v. *orientalis*, nov.
8. Labri margo totus breviter ciliatus; mandibularum laminae tantum in apice dentatae, margine cetero setis brevissimis instructo.
9. Pedes maxillares ungue terminali valde uncinato et dentibus articularum 2-4 etiam uncinatis *L. uncifer*, sp. nov.
10. Pedes maxillares ungue terminali moderate arcuato et dentibus articularum 2-4 haud uncinatis *L. subgigas*, sp. nov.
6. Sterna antica furca angulum valde obtusum formante.
11. Labri margo submedianus setis brevibus instructus.
13. Segmentum ultimum pediferum sterno ante apicem paululum angustiore; mandibulae lamina prima 11-dentata *L. superior*, sp. nov.
14. Segmentum ultimum pediferum sterno ante apicem multo angustiore; mandibulae lamina prima 16-dentata *L. superior* subsp. *pallida*, nov.
12. Labri margo submedianus nudus.
15. Mandibularum laminae pectinatae dentibus proximalibus perparvis *L. cephalotes*, Mein.
16. Mandibularum laminae pectinatae dentibus proximalibus quam distales parum minores.

17. Corporis longitudo ad mm. 40 *L. maxillaris* (Gerv.).
18. Corporis longitudo quam dicta (mm. 40) major *L. cephalotes* v. *subinsularis*, nov.
2. Sterna antica sulco mediano antice haud bifurcato impressa.
19. Corpus ad mm. 50; sternum segmenti ultimi pediferi subtrapezoideum postice parum angustiore; subcoxae ejusdem segmenti poris numerosis instructae *L. rubriceps* (Wood).
20. Corpus ad mm. 20; sternum segmenti ultimi pediferi ante apicem angustiore; subcoxae ejusdem segmenti poris paucis (c. 15) instructae *L. modestus*, sp. nov.
- B. Pedum paria minus quam 49.
21. Pedum paria 45.
23. Pedum maxillarium articulus secundus dentibus duobus armatus; sternum segmenti ultimi pediferi trapezoideum sat latum *L. spissus* (Wood).
24. Pedum maxillarium articulus secundus dente uno apicali armatus sternum segmenti ultimi pediferi angusto, lateribus gradatim parum convergentibus *L. diversidens*, sp. nov.
22. Pedum paria 47 *L. tahitiensis* (Wood)
- C. Pedum paria magis quam 49.
25. Pedum paria 51 *L. gigas* (Haase).
26. Pedum paria 57 *L. diversisternus*, sp. nov.
27. Pedum paria 59 *L. smithi* (Poc.).
28. Pedum paria 65 *L. mirandus* (Poc.).

Lamnonyx punctifrons (Newp.).

(Fig. I).

Mecistocephalus punctifrons, Newport, *Proc. Zool. Soc.* 1842, p. 179; *Id.*, *Tr. Linn. Soc.* XIX, p. 429, pl. xxxiii, fig. 17 (1845); Gervais, *Ins. apt.* IV, p. 310 (1847); nec auctorum.

♀ Corpus supra latericium plus minusve fusco variegatum, subtus testaceum, capite rufo, antennis pallide rufis et pedibus ochraceis vel melleis.

Lamina cephalica c. 3/7 (75 : 45) longior quam latior, sat grosse et sparse punctata lateribus postice parum convergentibus.

Antennae gradatim attenuatae, articulo sexto duplo longiore quam ad apicem latiore, articulo ultimo etiam duplo longiore quam latiore, articulis 1-5 setis brevioribus et brevibus, articulis ceteris a sexto gradatim setis magis numerosis et brevioribus instructis.

Labrum medium incisum unidentatum margine cetero integro vel vix lobulato; mandibulae lamina pectinatis 9-10, quarum prima 6-7-dentata, mediana 20-30-dentata dentibus proximalibus gradatim parum minoribus, externe ad laminam ultimam processibus duobus plus minusve profunde bifidis, margine interno ad laminam primam integro, angulatim aliquantum producto; maxillae primi et secundi paris vide fig. I, 7-8.

Pedes maxillares flexi marginem frontalem spatio sat magno superantes, subcoxis coalitis parum latioribus quam longioribus,

antice incisione profunda et dentibus duobus obtusis instructis, articulo secundo externe c. $1/3$ quam interne longiore dentibus duobus obtusis, quorum inferior parum minor est, instructo, articulis duobus sequentibus dente parvo obtuso, ungue terminali longo bene arcuato, integro, ad basim tuberculi obtusi instar parum producto.

Sterna furca typica angulo acutum formante et setis brevissimis numerosis instructa.

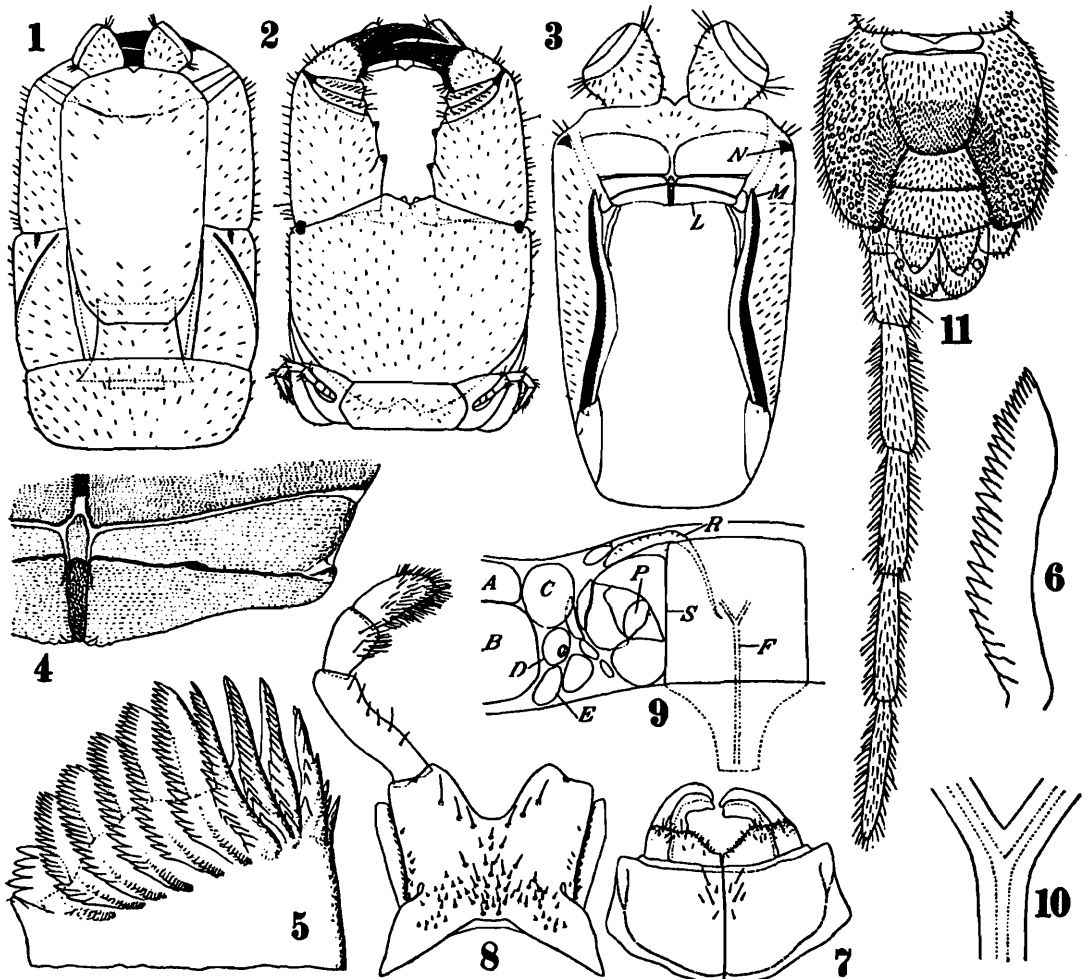


FIG. 1.—*Lamnonyx punctifrons*: 1. caput et trunci segmenta primum et secundum prona; 2. eadem supina; 3. caput, praeter appendices, supinum; 4. labrum; 5. mandibulae pars distalis; 6. ejusdem lamina pectinata submediana; 7. maxillae primi paris; 8. maxillae secundi paris; 9. sterni decimi latera cum tergiti parte et sterno; 10. ejusdem furca; 11. feminae pars postica supina.

A = praetergitum, B = tergitem, C = praescutellum (paratergitem), D = scutellum spiraculiferum, E = postscutellum, F = furca sternalis, L = labrum, M = processus angularis genarum, N = spina infera antica sublateralis externa, P = pedis basis, R = praesternum, S = sternum.

Pedes primi quam secundi parum minus quam dimidium breviores; pedes ambulatorii ungue terminali longo attenuato.

Segmentum ultimum pediferum sternito trapezoideo, postice setis brevissimis instructo, subcoxis poris numerosis sat magnis et aliis sparsis parvis instructis, pedibus gradatim attenuatis, quam paris precedentis parum minus quam duplo longioribus. Pori anales sat magni.

Pedum paria 49.

Long. corporis ad mm. 80, lat. segmenti primi 2.

Mas feminae similis, pedibus ultimi paris quam idem feminae parum crassioribus et parum magis setosis.

Habitat.—India: Trichinopoli (*Newton*); Rangamati, Chittagong Hill Tracts, Bengal (*R. Hodgart*).

On the nomenclature of L. punctifrons.—Newport described this species on specimens from Madras; from his time to the present day there have been referred to the same species specimens from other parts of Asia, Malaysia, New Guinea, Africa and America, but after an examination of many specimens I have been brought to consider as *L. punctifrons*, Newport, only the specimens

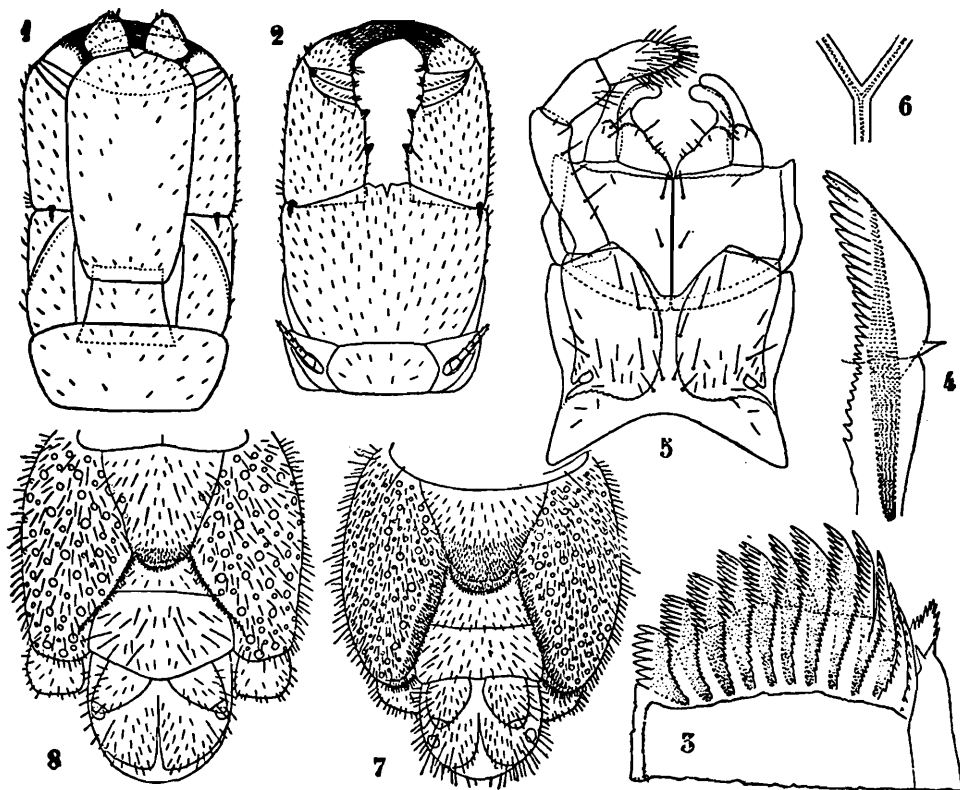


FIG. II.—*Lamnonyx punctifrons* v. *heteropus*: 1. caput et segmenta primum et secundum trunci supra inspecta; 2. pedes maxillares et segmentum primum pediferum subtus inspecta; 3. mandibulae pars distalis; 4. ejusdem lamina mediana; 5. pedes maxillares primi et secundi paris; 6. sterni decimi furca; 7.-8. feminae corporis pars postrema supina.

from Trichinopoli, a locality not far from Madras, and from a few other Indian localities.

Specimens from some parts of India and from Malaysia, Africa and New Guinea appear different from that considered by me to be *L. punctifrons* and are here described as distinct varieties or species. As Gervais, Lucas, Meinert and Humbert described species of *Lamnonyx*, incorrectly retained by Pocock, Haase and others as synonyms of *L. punctifrons*, I have revived the greater number of these species, giving their names to specimens from the localities from which the types were obtained. I note that this method is not correct without the examination of the type specimens, but I

think that it is preferable, when it is impossible to obtain the types for examination, to refer to old species of the same locality the specimens which appear to agree with them in the light of the descriptions than to propose new names.

Lamnonyx punctifrons (Newp.) var. **heteropus**, Humb.

(Fig. II).

Mecistocephalus heteropus, Humbert, *Mem. Soc. Phys. Genève*, XVIII, p. 19, pl. ii, fig. 4 (1865).

Corpus ferrugineo-ochraceum dorso fusco marmorato, capite latericio.

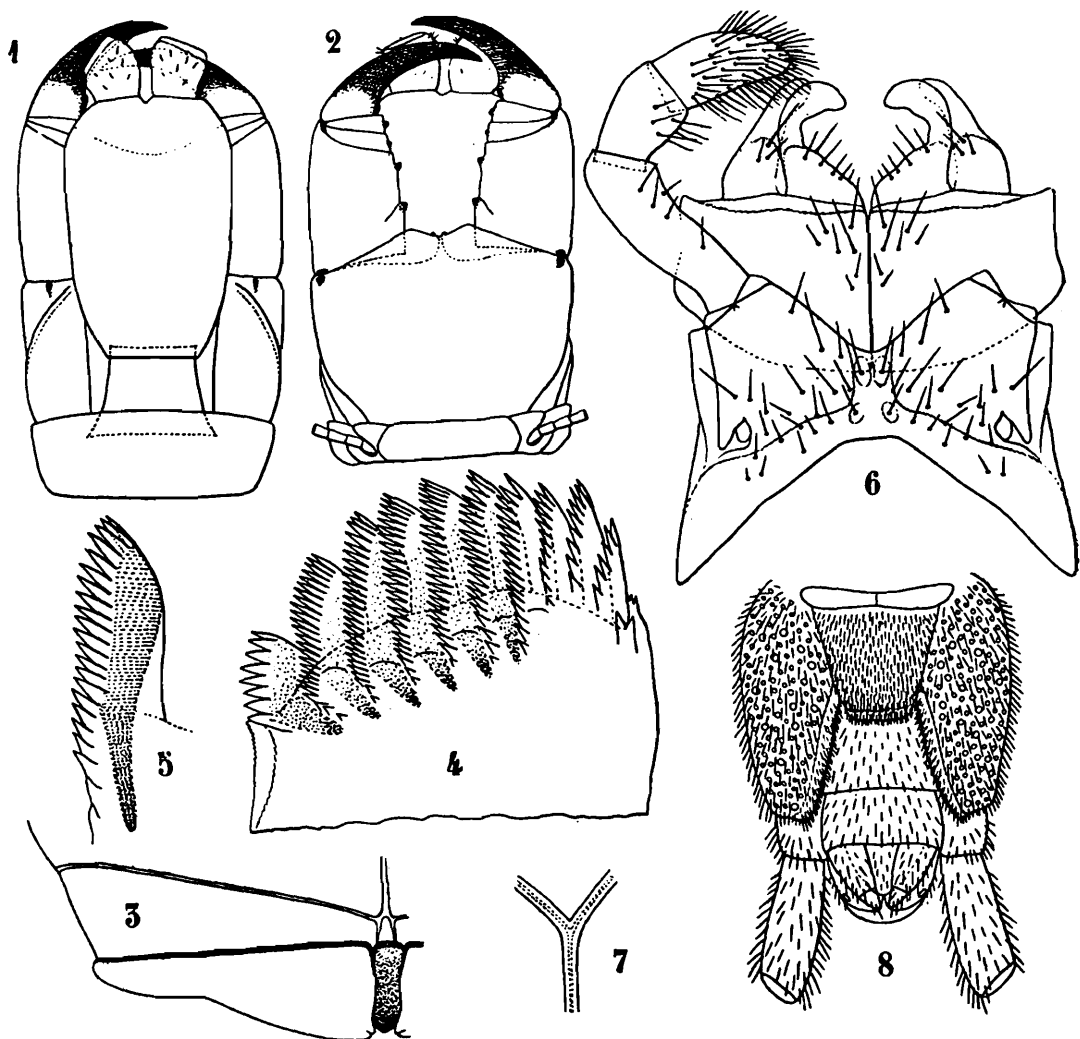


FIG. III.—*Lamnonyx punctifrons* v. *sulcicollis*: 1. caput et segmenta primum et secundum prona; 2. eadem supina; 3. labri dimidia pars; 4. mandibula; 5. ejusdem laminae mediana; 6. maxillae primi et secundi paris; 7. sterni decimi furca; 8. maris corporis pars postrema supina.

Lamina cephalica parum minus quam duplo longior quam latior, superficie punctis parvis parum numerosis impressa.

Pedes maxillares subcoxis aliquantum antice latioribus quam longioribus, dentibus typicis bene evolutis.

Labrum unidentatum margine submediano convexo integro; mandibulae margine interno ad laminam primam serrato, laminis

pectinatis 12, quarum prima 7-dentata, ceterae dentibus proximalibus quam distales multo minoribus, medianae dentibus 25-30 instructae.

Notae ceterae ut in *L. punctifrons*, Newp.

Long. corporis ad mm. 85, lat. segmenti primi 3.

Habitat.—Ceylon: Pattipola (*Gravelly*); Horton Plains, 7,000 ft. (*Kemp*).

Observatio.—Species haec a *L. punctifrons* (Newp.) mandibularum forma et a *L. cephalotes* (Mein.) sternitorum furca angulum acutum formante distincta est.

L. punctifrons (Newp.) var. *sulcicollis* (Tömösvary).

(Fig. III).

Mecistocephalus sulcicollis, Tömösvary, *Termész. Füzet.* VI, p. 162, tab. iii, fig. 3-4 (1882).

Corpore luride ochraceum capite testaceo.

Lamina cephalica et pedes maxillares parum latiora quam in forma typica ex Trichinopoli, mandibularum margo internus parum serratus, segmenti ultimi sternum lateribus parum minus convergentibus.

Long. corp. ad mm. 58, lat. 2.6.

Habitat.—Borneo: Irusau (*coll. Silvestri*).

Observatio.—Exemplum unum vidi, quod mihi aliquantum diversum ab exemplis ex Trichinopoli videtur et ut varietas considerandum.

Lamnonyx insularis (Lucas).

(Fig. IV).

Geophilus insularis, Lucas, *Myriapodes*, in Maillard, *Note sur l'île de la Réunion*, ed. 2, Paris 1863, Annex N, pl. xxi, fig. 1.

Mecistocephalus heros, Meinert, *Proc. Am. Phil. Soc.* XXIII, p. 214 (1886).

Mecistocephalus punctifrons, Porat, *Bihang Sv. Vet.-Ak.* XX, Afd. IV, No. 5, p. 20 (1894); Silvestri, *Ann. Mus. Genova* XXXV, p. 484 (1895); Broelemann, *Mem. Soc. Zool. France* VIII, p. 528 (1895); Saussure & Zehntner, *Abh. Senckenb. nat. Ges.* XXVI, p. 433 (1901); Saussure, *Myr. Madagascar*, p. 328, pl. xiv, fig. 14-14b (1902); Broelemann, *Boll. Soc. ent. Ital.* XXXV, p. 118 (1903); Attems, ex p. *Zool. Jahrb. Syst.* XVIII, p. 211 (1903); Silvestri, *Mir.* in "*Il Ruvenzori*" *Relaz. scientif.* I, p. 322 (1909); Attems, in "*Voeltzkou*", *Reise in Ostafrika* 1903-1905, *Wiss. Ergeb.* III, p. 80 (1910); Ribaut, *Myr.* I, *Chilopoda*, p. 117, pl. i, fig. 9-12 et pl. ii, fig. 13-15 in "*Voyage Alluaud et Fean- nel en Afrique or.* (1914)".

Lamnonyx togensis, O. F. Cook, *Brandtia*, p. 39 (1896) *Pullus!*

Mecistocephalus punctifrons v. *glabridorsalis*, Attems, *Zool. Jahrb. Syst.* XIII, p. 138 (1900).

Corpus luride ochraceum vel ochraceo-testaceum, capita latericio dorso et lateribus immaculatis vel fusco plus minusve marmoratis, rare corpus totum cremeum capite fulvo-ferrugineo vel ferrugineo-latericio, antennis fulvo-ferrugineis, pedibus ochraceis vel cremeis.

Lamina cephalica parum minus quam duplo (12 : 7 vel 10 : 5·8) longior quam antice latior, lateribus postice parum convergentibus, superficie praesentim postice grosse punctata.

Antennae gradatim attenuatae, articulorum longitudine et forma variabili, articulo sexto tam longo atque lato vel plerumque

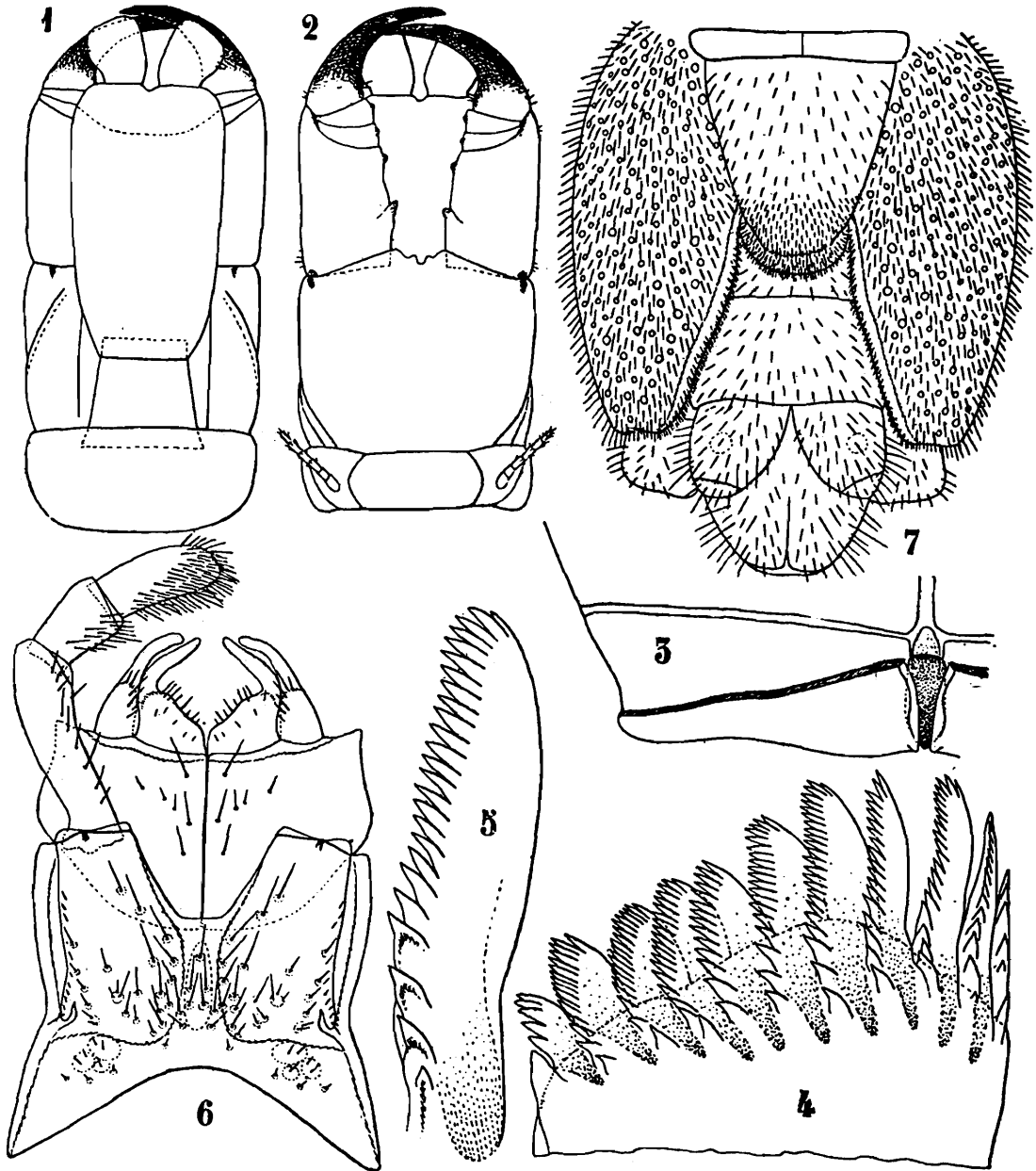


FIG. IV.—*Lamnonyx insularis*: 1. caput et segmenta primum et secundum prona; 2. eadem supina; 3. labri dimidia pars; 4. mandibulae pars distalis; 5. ejusdem lamina mediana; 6. maxillae primi et secundi paris; 7. feminae corporis pars postrema supina (figuras omnes exempli ex Africa occidentali: ins. Annobom).

longiore (usque duplo) quam ad apicem latiore, articulo ultimo c. duplo longiore quam latiore, articulis 1-4 setis brevibus, articulis ceteris setis brevibus et setis brevioribus gradatim magis numerosis instructis.

Pedes maxillares flexi marginem frontalem spatio sat magno superantes, subcoxis coalitis parum (antice) latioribus quam longio-

ribus, dentibus typicis bene evolutis, ungue terminali attenuato, acuto, bene arcuato.

Labrum medium unidentatum margine cetero aliquantum convexo nudo; mandibulae laminis pectinatis 10 praeter laminam externam obsoletam, quarum prima 6—7-dentata, mediana, 20-dentata, maxillae primi et secundi paris vide fig. IV, 6.

Sterna furca angulum subrectum vel parum obtusum formante et setis numerosis brevissimis instructa.

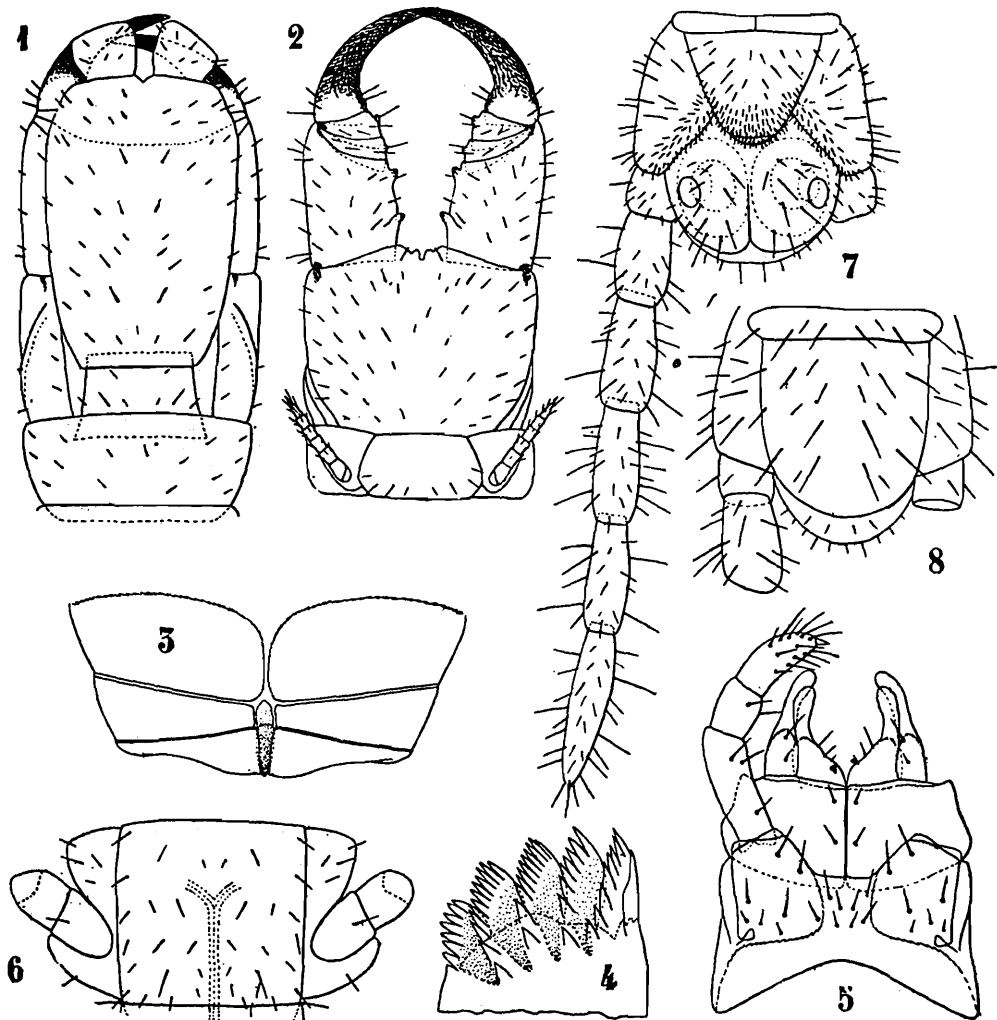


FIG. V.—*Lamnonyx insularis*, pullus: 1. caput et segmenta primum et secundum prona; 2. eadem supina; 3. labrum; 4. mandibulae pars distalis; 5. maxillae primi et secundi paris; 6. sternum decimum; 7. corporis pars postrema supina; 8. eadem prona.

Pedes primi paris quam secundi dimidio breviores (long. maxima mm. 1.20); pedes omnes hirtelli, ungue terminali robusto.

Segmentum ultimum sternito trapezoideo postice ante apicem parum angustiore setis brevissimis praesertim postice pernumeris instructo, subcoxis poris numerosis parvis et aliis magis numerosis perparvis instructis, pedibus parum attenuatis quam paris praecedentibus c. $\frac{1}{3}$ longioribus brevissime setosis.

Pori anales sat magni, sub appendicibus genitalibus obtectis.

Pedum paria 49; long. corp. mm. 40-90, lat. segmenti primi ad 3.6.

Mas segmento ultimo pedifero, pedibus inclusis, quam idem feminae magis piloso.

Pullus (fig. V) iam coloratus long. corp. mm. 13, lat. segmenti primi 0.68. Corpus ochraceum capite ferrugineo. Caput forma eidem adulti simile, pedum maxillarum dentibus omnibus evolutis; segmentum ultimum pediferum subcoxis poris nullis; pori anales magni.

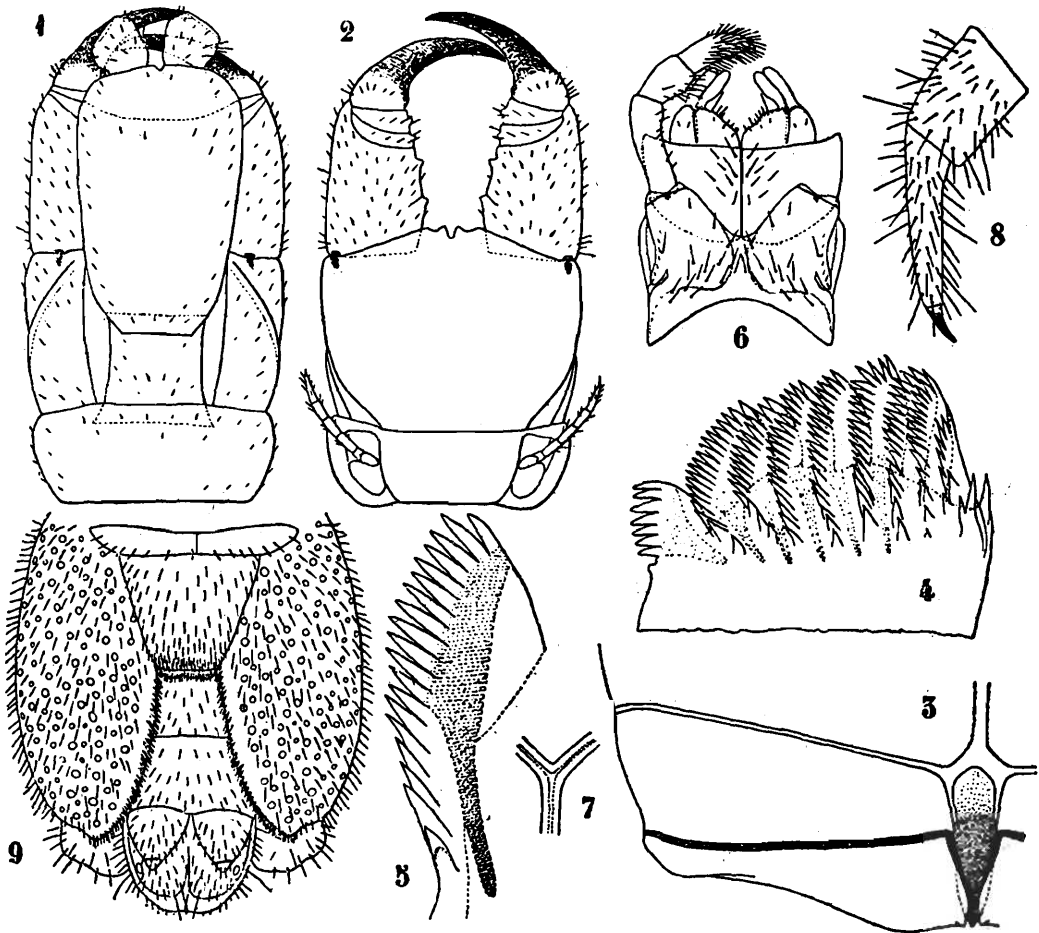


FIG. VI.—*Lamnonyx insularis* var. *orientalis*: 1. caput et segmenta primum et secundum prona; 2. eadem supina; 3. labri dimidia pars; 4. mandibulae pars distalis; 5. ejusdem lamina pectinata submediana; 6. maxillae primi et secundi paris; 7. furca sterni decimi; 8. pedis decimi pars distalis; 9. feminae pars postrema supina (figurae exempli ex Kavalai).

Mandibulae laminis pectinatis 6, quarum prima 6-dentata, mediana 10-dentata, maxillarum setis vide fig. V, 5.

Habitat.—Africa tropicalis tota et insulae adiacentes. Exempla vidi ad Olokemeji (Nigeria), Aburi (Auris Costa), Segboroue (Dahomey), Victoria (Camerum), Quifangondo (Angola), Boma (Congo), Asmara (Erythrea), Somalia et Toro (Africa orientalis); Ins. S. Thomè; Vista Alegre, Ribeira, Palma, Ins. Fernando Poo; Ins. Annobon.

Exemplum typicum a Lucas descriptum ex ins. Réunion.

Exempla ex India: Parambiculam, Cochin State, 1700-3200 ft.

(*Gravelly*); Foot of the Nellampathies, Cochin State (*G. Matthai*): cum exemplis ex Africa notis omnibus bene congruunt.

Observatio.—Species haec a *L. punctifrons* furca antica sternali angulum subrectum, vel parum obtusum (haud acutum) formante, poris subcoxarum segmenti ultimi pediferi minoribus bene distincta est.

***Lamnonyx insularis* (Lucas) var. *orientalis*, nov.**

(Fig. VI).

Mecistocephalus punctifrons ex p. Haase, *Abh. Zool. u. Anthr. Mus. Dresden* I, N. 5, p. 104 (1887); Silvestri, *Ann. Mus. Genova* XXXIV, p. 134 et 719 (1895).

Varietas haec a forma typica differt pedibus primi paris quam idem *L. insularis* c. $1/4$ longioribus (long. ad mm. 1.60), poris sub-

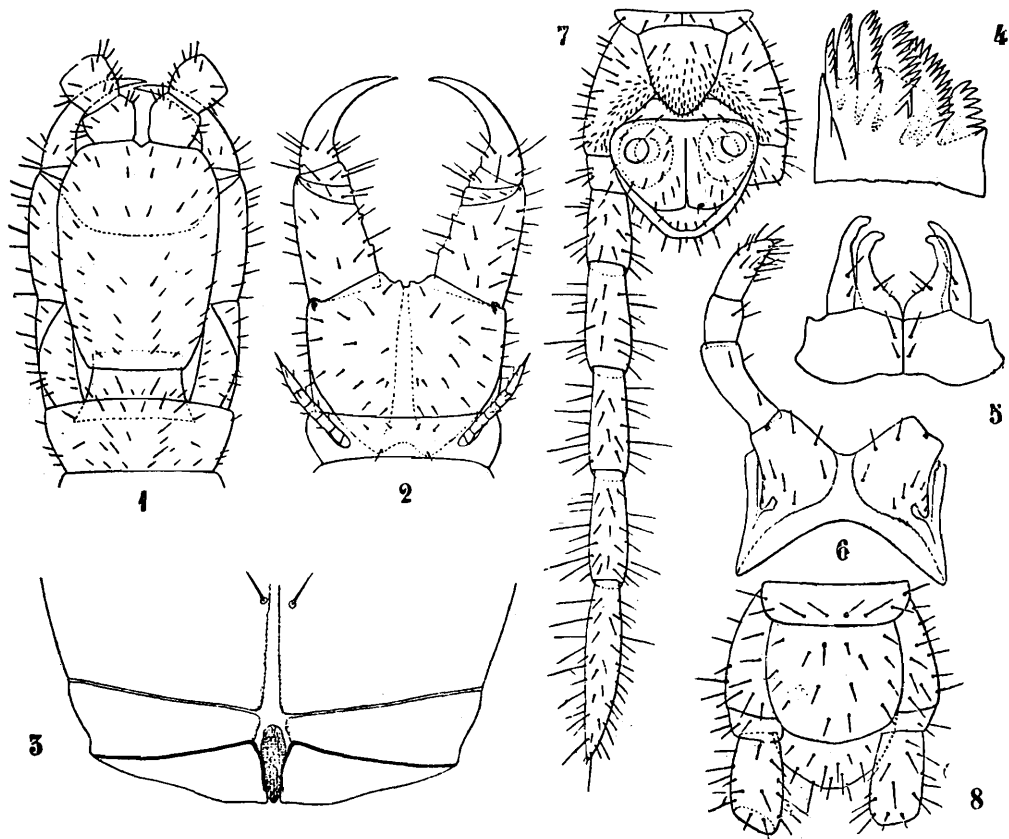


FIG. VII.—*Lamnonyx insularis* var. *orientalis*, pullus: 1. caput et segmenta primum et secundum prona; 2 eadem supina; 3. labrum; 4. mandibulae pars distalis; 5. maxillae primi paris; 6. maxillae secundi paris; 7. corporis pars postrema supina; 8. eadem prona.

coxarum segmenti ultimi pedigeri parum majoribus (cfr. fig. VI, 9).

Pullus (cum matre ex Kavalai collectus) cremeus capite ochroleuco, long. corp. mm. 13, segmenti primi lat. 0.70 eodem formae typicae similis (cfr. fig. VII).

Habitat.—India: Kavalai (♀ cum pullis 15), Cochin State (*Gravelly*); Kobo, 400 ft. (Abor Expedition); Ootacamund, S. India

et Anamalais (*Fletcher*); Mergui; Port Blair, Andamans; Sumatra: Si-Rambè (*Modigliani*).

Lamnonyx cephalotes (Mein.)

(Fig. VIII).

Mecistocephalus? pilosus, Wood, *Œ. Ac. Nat. Sci.* 1863, p. 43.

Mecistocephalus cephalotes, Meinert, *Nat. Tidsskr.* VII, p. 100 (1871).

Mecistocephalus? punctifrons, Attems, *Mitt. Naturh. Mus. Hamburg* XXIV, p. 96 (1907).

♀ Corpus testaceo-ochraceum vel plus minusve dilute ochroleucum capite fulvo vel latericio.

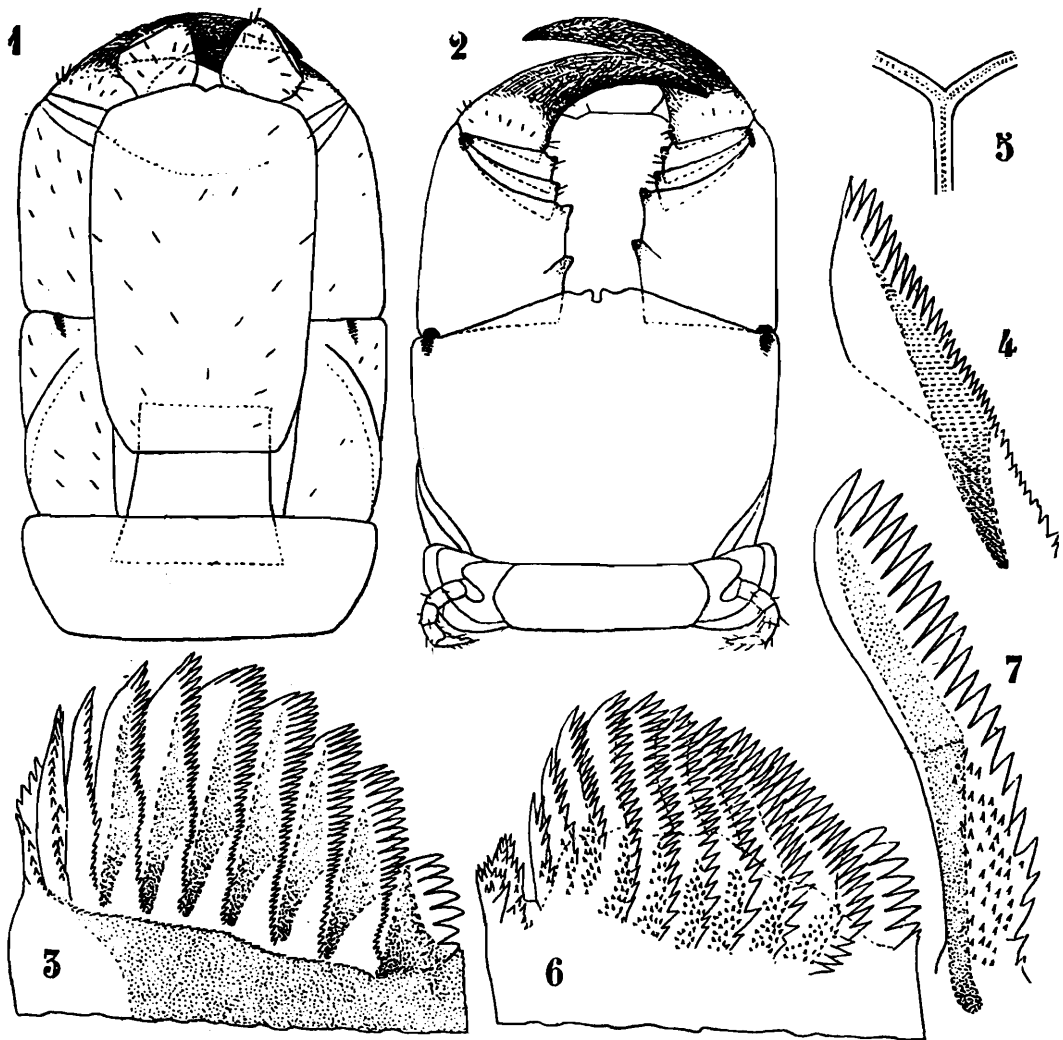


FIG. VIII.—*Lamnonyx cephalotes*: 1. caput et segmenta primum et secundum prona; 2. eadem supina; 3. mandibulae pars distalis; 4. ejusdem lamina mediana; 5. sterni decimi furca.

Lamnonyx cephalotes var. *multispinata*: 6. mandibulae pars distalis; 7. ejusdem lamina submediana.

Lamina cephalica c. $\frac{3}{8}$ longior quam latior, lateribus postice parum convergentibus. Antennae gradatim attenuatae, articulo sexto c. $\frac{1}{5}$ longiore quam ad apicem latiore, articulo ultimo c. $\frac{3}{5}$ longiore quam latiore, articulis 1-6 setis brevibus, articulis ceteris etiam setis brevioribus gradatim magis numerosis instructis.

Pedes maxillares flexi marginem frontalem spatio sat brevi superantes subcoxis coalitis parum antice latioribus quam longioribus, dentibus typicis bene evolutis, unguo terminali bene arcuato.

Labrum medium unidentatum margine cetero convexo nudo; mandibulae laminis pectinatis 10, quarum prima 7-dentata, mediana c. 40-dentata, dentibus usque ad basim sistentibus et gradatim ab apice ad basim minoribus instructa; maxillae primi et secundi paris eisdem speciei pracedenti similes.

Sterna antica furca angulum obtusum formante.

Pedes primi paris quam secundi c. dimidio breviores; pedes omnes hirsutelli, ungue terminali longo, robusto, attenuato.

Segmentum ultimum sternito trapezoidali, postice parum angustiore, brevissime psetoso, subcoxis poris sat numerosis et sat parvis, pedibus quam paris precedentis duplo vel parum magis quam duplo longioribus, postice parum attenuatis, hirtellis.

Pedum paria 49; long. corp. ad mm. 60, lat. segmenti primi 2.6.

Habitat.—Exemplum descriptum in monte Tengger, Java (*Frühstorfer*) collectum fuit. Exempla minora ex eodem loco corpore ochroleuco. Exempla alia vidi ad Gedè Java (*Frühstorfer*) collecta et ad Kalimpong, Darjiling, E. Himalaya, 600-4,500 ft (*F. H. Gravely*); ad Darjiling, 6,000-7,000 ft. (*Id.*); ad Singla, Darjiling, 1,500 ft (*Lord Carmichael*); ad Hanoi (*V Demange*); ad Tan-Moi, Tonkin (*Frühstorfer*).

Observatio.—Species haec a *L. punctifrons* et a *L. insularis* furca sternorum anticorum angulum obtusum formante bene distincta est.

Lamnonyx cephalotes (Mein.) var. **subinsularis**, nov.

Varietas haec a forma typica mandibularum laminis pectinatis dentibus proximalibus quam distales parum minoribus differt.

Habitat.—Ceylan: Madatugama (*Madarasz*); Sumatra: M. Singalan (*Beccari*); Mergui (*Mus. Calcutta*); Tonkin: Hanoi (*Demange*).

Lamnonyx cephalotes (Mein.) var. **multispinata**, nov.

Varietas haec a forma typica mandibularum (fig. VIII, 6, 7) laminarum partis proximalis superficie spinis minimis numerosis instructa distinguenda.

Corpus ochroleucum vel ochraceum capite latericio.

Long. corp. ad mm. 52, lat. segmenti primi 2.4.

Habitat.—India: Rotung, 1,400 ft. et Upper Rotung, Abor Exped. (*Kemp*).

Lamnonyx maxillaris (Gerv.).

(Fig. IX).

Geophilus maxillaris, Gervais, *Ann. Sci. nat.* (2) VII, p. 52 (1837); *Id.*, *Atlas de zoologie* pl. 55, fig. 4 (1844); *Id.*, *Ins. apt.* IV p. 309, pl. 39, fig. 5 (1847).

Mecistocephalus guildingii, Newport, *Tr. Linn. Soc.* XIX, p. 429 (1845); Meinert, *Nat. Tidsskr.* (3) VII, p. 97 (1871).

Mecistocephalus gulliveri, Butler, *Ann. Nat. Hist.* (4) XVII, p. 446 (1876); *Id.*, *Phil. Trans.* CLXVIII, p. 500 (1879).

Mecistocephalus punctifrons ex p. Haase, *Abh. Mus. Dresden* I, N. 5, p. 104 (1887); ex p. Pocock, *Ann. Mus. Genova* XXX, p. 423 (1891); Latzel, *Fahrb. Hamb. Wiss. Anst.* XII, p. 5 (1895); Broelemann, *Bull. Soc. ent. France* 1897, p. 136.

Lamnonyx leonensis, O. F. Cook, *Brandtia*, p. 39 (1896).

Mecistocephalus parvus, Chamberlin, *Psyche* XXI, p. 85 (1914).

♀ Corpus plus minusve dilute ochraceum capite latericio vel rufo-ferrugineo, antennis rufo-ferrugineis, pedibus corpori concoloribus.

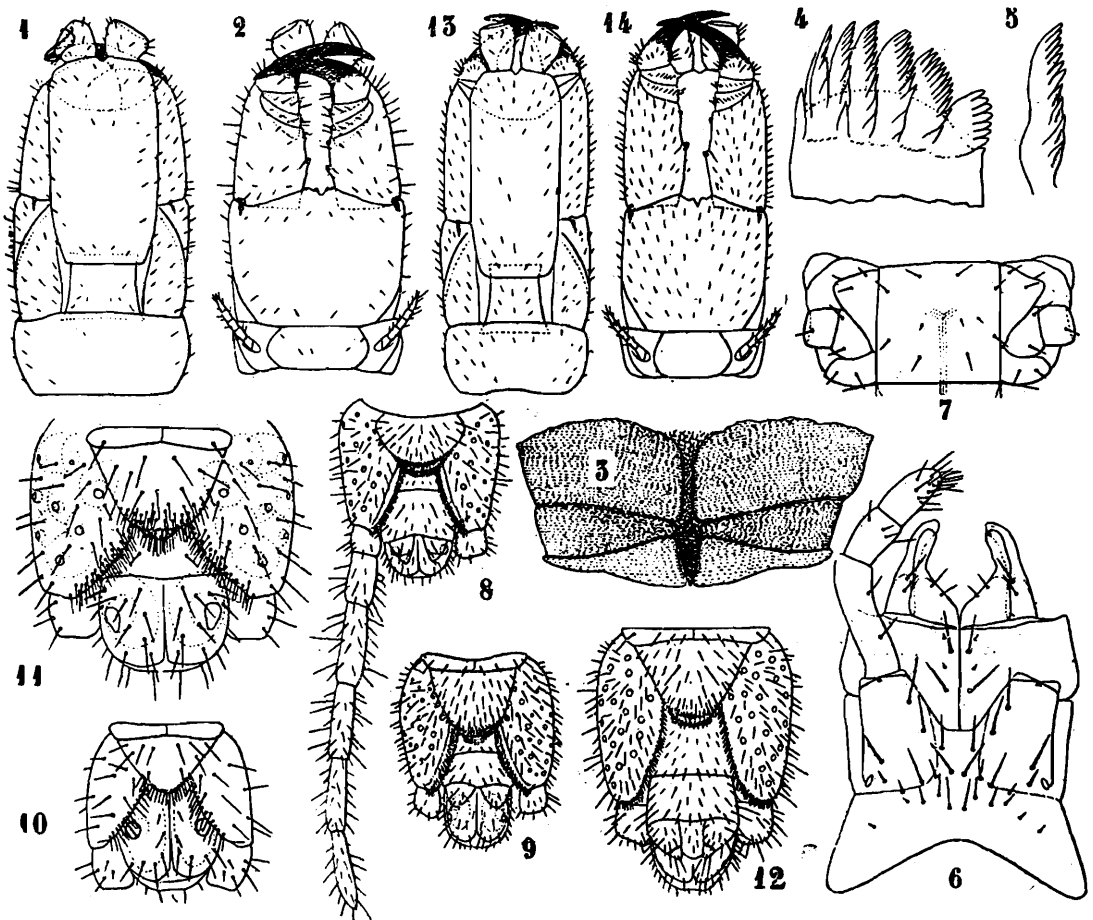


FIG. IX.—*Lamnonyx maxillaris*: 1. caput et segmenta primum et secundum prona; 2. eadem supina; 3. labrum; 4. mandibulae pars distalis; 5. ejusdem lamina submediana; 6. maxillae primi et secundi paris; 7. sternum decimum; 8. feminae corporis pars postrema supina (fig. 1-8 exempli ex Kierpur); 9. feminae corporis pars postrema supina (exempli ex Hawaii); 10. eadem pulli et 11. eadem juvenis (exemplorum ex Hawaii); 12. maris pars postrema supina; 13. caput et segmenta primum et secundum; 14. eadem supina (figurae 12-14 exempli ex Andaman).

Lamina cephalica parum minus quam duplo longior quam latior (63 : 34), lateribus postice parum convergentibus.

Antennae gradatim attenuatae, articulo sexto c. $\frac{1}{3}$ longiore quam ad apicem latiore, articulo ultimo fere duplo longiore quam latiore, articulis 1-6 setis brevibus, articulis ceteris etiam setis brevioribus gradatim parum magis numerosis instructis.

Pedes maxillares flexi marginem frontalem spatio brevi superantes, subcoxis coalitis parum latioribus quam longioribus, margine antico dentibus duobus sat parvis, articulo secundo dentibus duobus brevibus, articulo tertio et quarto dente perparvo, ungue terminali longo, attenuato, sat arcuato. Labrum medium incisum unidentatum utrimque integro, convexo; mandibulae laminae pectinatis 5-6, quarum prima dentibus 6, quarta dentibus 9 subaequalibus et dente parvo basali instructa, nec non appendici externa longa, plus minusve manifeste bifida, et appendici brevi apice varie partito compositae; maxillae primi et secundi paris vide fig. IX, 6.

Sterna furca ramis brevibus angulum obtusum formante et setis brevibus, praesertim postice, et setis brevioribus sat numerosis instructa. Pedes primi paris quam secundi parum magis quam dimidium minores; pedes omnes hirsutelli, ungue terminali attenuato, sat longo.

Segmentum ultimum sternito subtrapezoideo postice parum constricto setis pluribus brevissimis instructo, subcoxis poris parvis et aliis perparvis sat numerosis (subtus c. 20) instructis, pedibus gradatim parum attenuatis, quam paris praecedentis c. $\frac{1}{3}$ longioribus, hirtellis.

Pedum paria 49. Pori anales sat magni. Long. corp. ad mm. 38, lat. segmenti primi 1.05.

Mas feminae similis.

Habitat.—Species haec in regionibus tropicalibus orbis terrarum sparsa est et etiam in Ins. Canarie et in Parisiorum et Hamburg calidariis. Exempla vidi ex India: Kierpur, Purnea distr. (femina long. mm. 28 cum pullis 18); Sadiya, N.E. Assam (*Kemp*); Samagooting, Assam; Puri, Orissa (*Kemp*); Mahè; Trichinopol (Newton).

Nuova Guinea: Simbang et Sattelberg (*Birò*).

Ins. Philippine: Manila.

Samoa: Pago Pago (*Silvestri*).

Hawaii: Hilo (*Silvestri*).

S. America: Cuba, Cuyaba, Brazil (*Silvestri*).

Africa: S. Paolo de Loanda, Angola et Lagos, Nigeria (*Silvestri*); S. Nikola, Ins. Capo Verde (*Fea*).

Aberratio.—Exemplum vidi ad Andaman collectum lamina cephalica (fig. IX, 13) magis quam duplo longiore quam latiore; idem ut exemplum aberrans "dolichocephalum" considero.

Lamnonyx superior, sp. n.

(Fig. X).

♀ Corpus supra testaceum fusco dense marmoratum, subtus ochraceo-testaceum fuseo parum marmoratum, capite latericio, antennis pallide latericiis pedibus testaceis, segmento ultimo pedigero testaceo.

Lamina cephalica c. $\frac{4}{9}$ longior quam latior grosse et sparse punctata (postice praesertim). Antennae gradatim attenuatae,

articulo sexto c. $\frac{1}{3}$ longiore quam ad apicem latiore, articulis 1-4 setis brevibus, a quinto setis etiam brevioribus gradatim magis numerosis instructis.

Pedes maxillares flexi marginem frontalem spatio sat longo superantes, subcoxis parum antice latioribus quam longioribus, dentibus typicis brevibus, ungue terminali bene arcuato. Labrum medium obtuse unidentatum, margine cetero per partem submedianam breviter setoso et angulo interno acute producto; mandibulae laminis pectinatis 14, quarum prima 11-dentata, mediana 55-dentata, dentibus basim attingentibus et ab apice gradatim

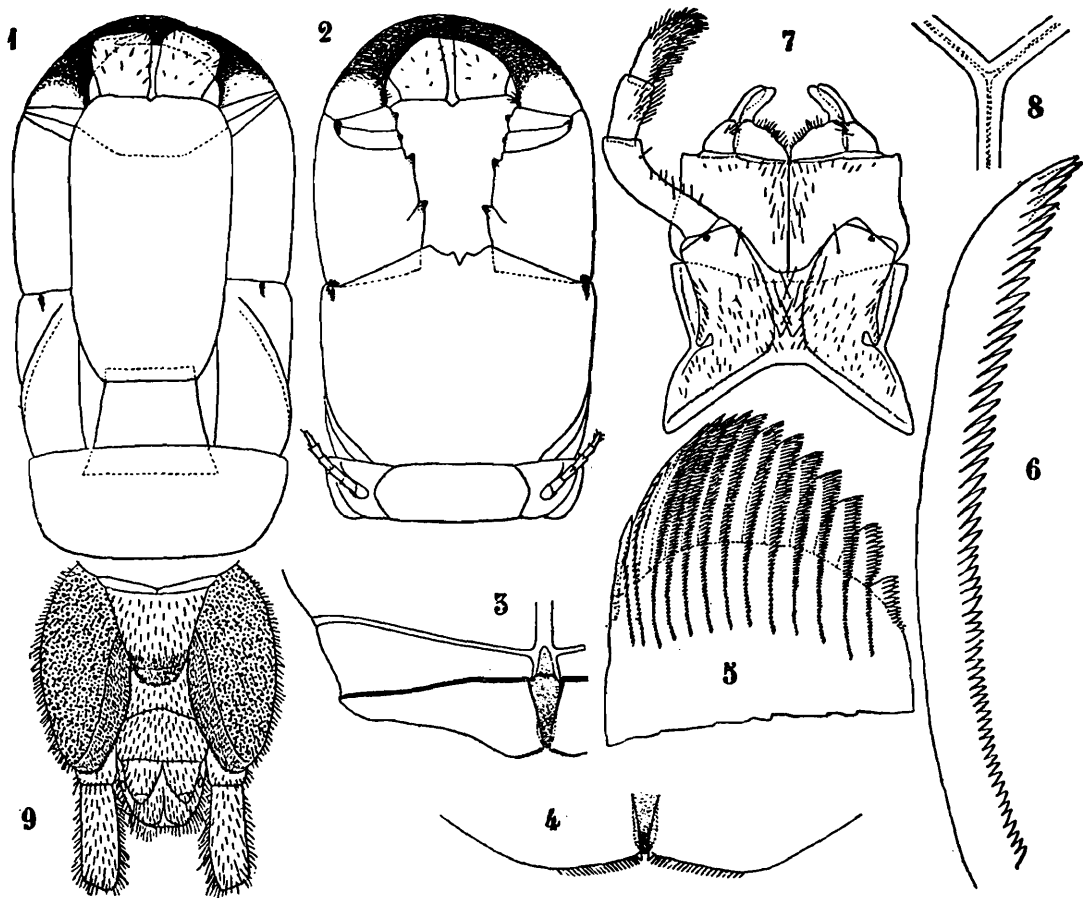


FIG. X. — *Lamnonyx superior*: 1. caput et segmenta primum et secundum prona; 2. eadem supina; 3. labrum; 4. ejusdem pars mediana et submediana magis ampliata; 5. mandibulae pars distalis; 6. ejusdem lamina pectinata submediana magis ampliata; 7. maxillae primi et secundi paris; 8. sterni decimi furca; 9. feminae corporis pars postrema supina.

minoribus, mandibulae margine interno irregulariter et parum profunde serrato, margine externo ad laminam 14^{mam} appendicibus duobus dentatis acuto; maxillae primi et secundi paris setis vide fig. X, 7.

Sterna antica furca angulum obtusum formante instructa.

Pedes primi paris quam secundi c. dimidio breviores; pedes ambulatorii setis numerosis brevioribus et nonnullis brevibus instructi, ungue terminali sat longo, robusto, attenuato.

Segmentum ultimum sterno trapezoideo, postice praesertim brevissime persetoso, ante apicem paullum angustiore, subcoxis

bene inflatis poris parvis et poris perparvis numerosis instructis, pedibus quam praecedentes magis quam duplo longioribus, tenuibus et attenuatis, hirtellis.

Pedum paria 49; long. ad mm. 110, lat. segmenti primi ad 4.5.

Habitat.—Nechal, W. Ghats, c. 2,000 ft.; Taloshi, Koyna Valley, c. 2,000 ft., E side of Koyna Valley et Helvak, Koyna Valley, c. 2,000 ft., Satara dist. (*F. H. Gravely*); Palgad, Ratnagiri dist.

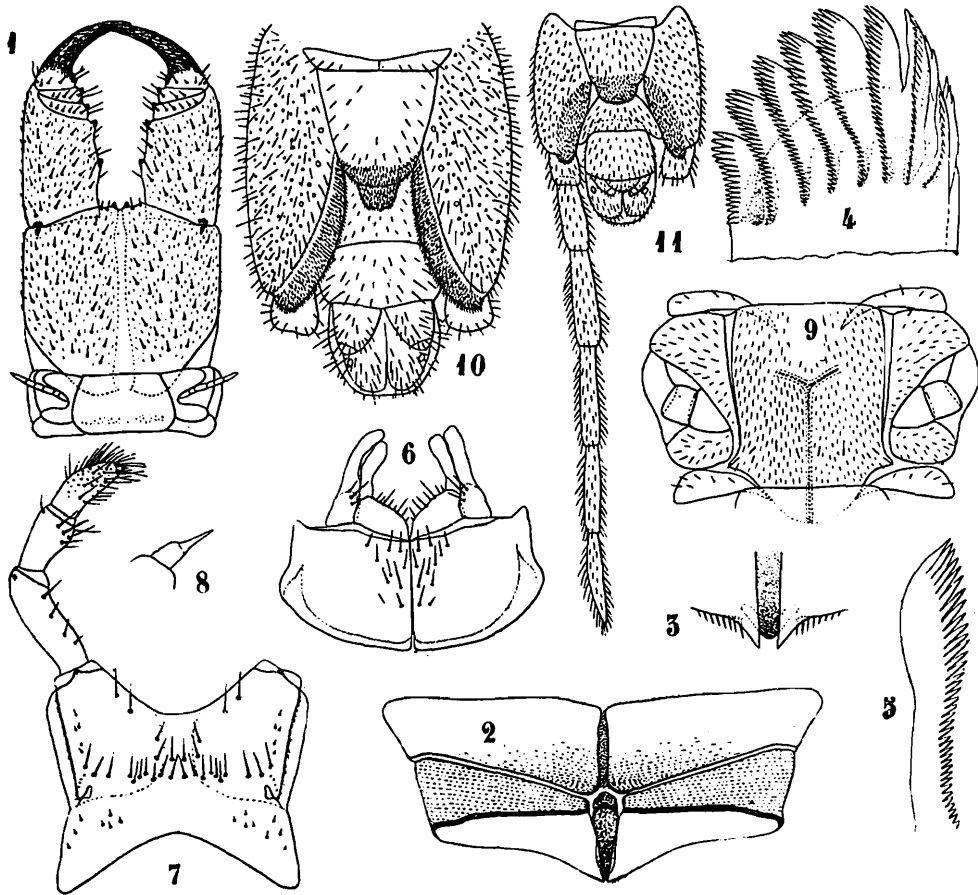


FIG. XI.—*Lamnonyx superior* subsp. *pallida*: 1. pedes maxillares et segmentum primum pediferum supina; 2. labrum; 3. ejusdem pars mediana et submediana magis ampliatae; 4. mandibulae pars distalis; 5. ejusdem lamina pectinata submediana; 6. maxillae primi paris; 7. maxillae secundi paris; 8. palpi apex; 9. sternum decimum; 10. feminae corporis pars postrema supina; 11. maris corporis pars postrema supina.

***Lamnonyx superior*, Silv. subsp. *pallida*, nov.**

(Fig. XI).

Corpus pallide flavum vel ochroleucum capite latericio antennis fulvis, pedibus corpore concoloribus.

Lamina cephalica parum minus quam duplo longior quam latior, punctis grossis praesertim in fovea mediana postice impressa.

Antennae attenuatae, articulo sexto c. $\frac{1}{3}$ longiore quam ad apicem latiore, articulis 1-6 setis brevibus, articulis ceteris setis brevioribus gradatim magis numerosis instructis.

Pedes maxillares marginem frontalem spatio sat magno super antes, subcoxis coalitis subaeque antice latis quam longis, dentibus typicis robustioribus. Labrum medium obtuse unidentatum, margine cetero per partem submedianam setis brevibus instructo et angulo interno acute bene producto; mandibulae lamina pectinata 9, quarum prima 16-dentata, ceterae dentibus ab apice ad basim gradatim minoribus, mediana dentibus c. 37 instructa; maxillae primi et secundi paris setis vide fig. XI, 6-7.

Sterna antica furca angulum obtusum formante.

Pedes primi paris quam secundi c. dimidio breviores, pedes ambulatorii hirtelli, ungue terminali elongato, attenuato, acuto.

Segmentum ultimum pediferum sterno trapezoideo parum ante apicem angustiore, postice breviter persetoso, subcoxis poris parvis et praesertim perparvis numerosis nec non setis brevibus et brevioribus, numerosis brevioribus praesertim per marginem instructis; pedibus quam praecedentes c. duplo longioribus, aliquantum attenuatis.

Pedum paria 49; long. corp. ad mm. 45, lat. segmenti primi 1.70.

Habitat.—Parambikulam, 1,700-3,200 ft., Cochin State (*F. H. Gravely*); Base of hills, Chakardharpur, Singbhoom dist., Chota Nagpur (*F. H. Gravely*); Kalka, Simla; Purulia, Manbhum dist., Chota Nagpur (*Gravely*); Dinapore, Bihar; Medha, Yenna Valley, Satara dist., 2,500-3,500 ft. (*Gravely*); Bababudin Hills, Mysore (*Fletcher*); Khondmal Hills, Angul dist., interior of Orissa, c. 1,500 ft. (*J. Taylor*).

Observatio.—Subspecies haec a forma typica magnitudine, colore et mandibularum lamina pectinata prima longiore et magis dentata et segmenti ultimi pediferi sterno ante apicem angustiore bene distincta est.

Lamnonyx rubriceps, Wood.

(Fig. XII).

Mecistocephalus rubriceps, Wood, *J. Ac. Nat. Sci. Philad.* 1863, p. 42.
Geophilus tenuiculus, C. Koch, *Verh. zool.-bot. Ges. Wien* XXVII, p. 794 (1878).

Mecistocephalus tenuiculus, Haase, *Abh. Mus. Dresden* I, N. 5, p. 103 (1887).

Corpus ochroleucum medio dorse parum infuscato, capite fulvo-ferrugineo vel latericio.

Lamina cephalica parum minus quam duplo longiore quam latiore, superficie sparse et grosse punctata praesertim postice.

Antennae attenuatae articulis 1-6 setis brevibus nonnullis, articulis ceteris setis brevioribus gradatim magis numerosis instructis, articulo sexto c. $\frac{1}{3}$ longiore quam latiore, articulo ultimo duplo longiore quam latiore.

Labrum medium unidentatum margine cetero integro, nudo; mandibulae laminis pectinatis 9, quarum prima 6-dentata, mediana 23-dentata dentibus ab apice ad basim gradatim parum minoribus; maxillae primi et secundi paris setis vide fig. XII, 5. Pedes maxillares flexi marginem frontalem spatio sat longo superantes, subcoxis parum antice latioribus quam longioribus margine antico parum sinuato dentibus submedianis destituto, articulis ceteris dentibus typicis sat parvis, ungue terminali longo, bene arcuato dente basali infero parvo, supero sat magno conico.

Sterna antica sulco longitudinali postico exarata, furcae brachii brevissimis, subnullis.

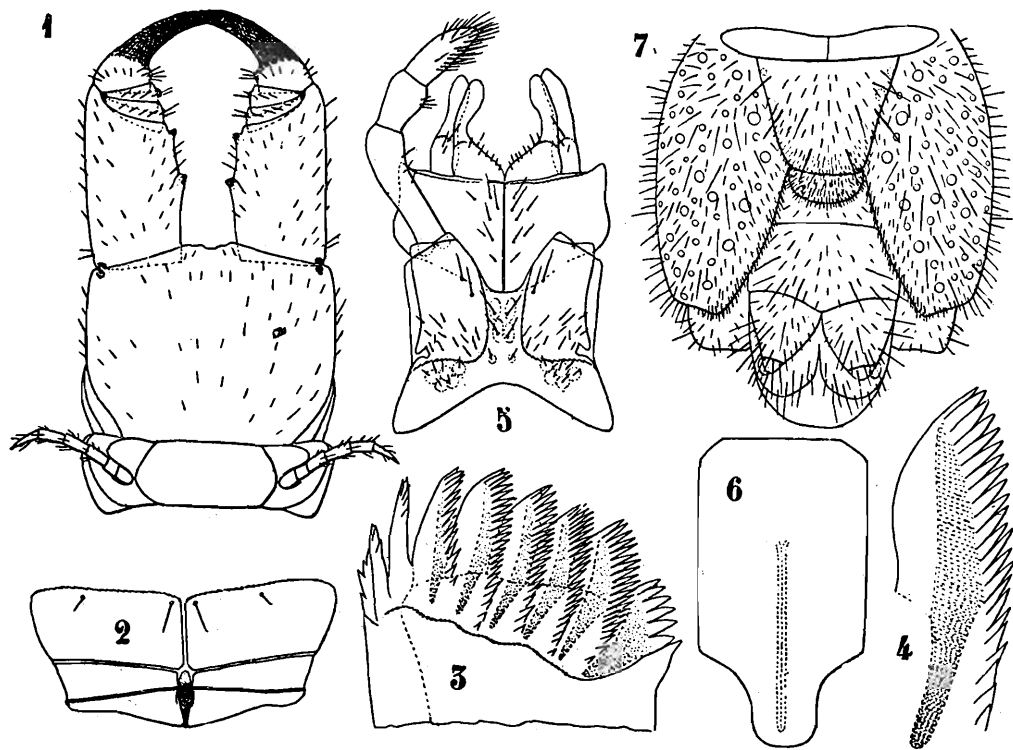


FIG. XII.—*Lamnonyx rubriceps*: 1. pedes maxillares et segmentum primum pediferum supina; 2. labrum; 3. mandibulae pars distalis, 4. ejusdem lamina submediana; 5. maxillae primi et secundi paris; 6. sternum decimum; 7. feminae corporis pars postrema supina.

Pedes primi paris quam secundi aliquantum minus quam dimidium breviores ungue terminali sat longo; pedes ceteri hirtelli ungue terminali sat longo, robusto.

Segmentum ultimum pedigerum sternito trapezoidali ante apicem parum angustiore parte postica setis brevissimis vestita, subcoxis per superficiem internam parum latam brevissime setosis, cetero poris sat magnis et poris parvis numerosis undique instructis, pedibus quam praecedentes c. duplo longioribus, hirtellis.

Mas corporis parte postrema quam eadem feminae magis setosa.

Pedum paria 49; long. corp. ad mm. 50, lat. segmenti primi 2.

Habitat.—Japan. Ins. Bonin (*Univ. Tokio*).

Variatio.—Exempla numerosa ad Kosempo (Ins. Formosa) a Cl. H. Sauter collecta vidi, quae notis omnibus cum exemplis ex Ins. Bonin congruunt corporis colore excepto, qui melleus vel luride melleus est per dorsum fusco variegatus et per caput testaceo-latericius vel latericius.

Long. corp ad mm. 60.

Observatio.—Species haec a *L. sectionis L. insularis*, Lucas sternis tantum sulco postico mediano impressis facile distinguenda est.

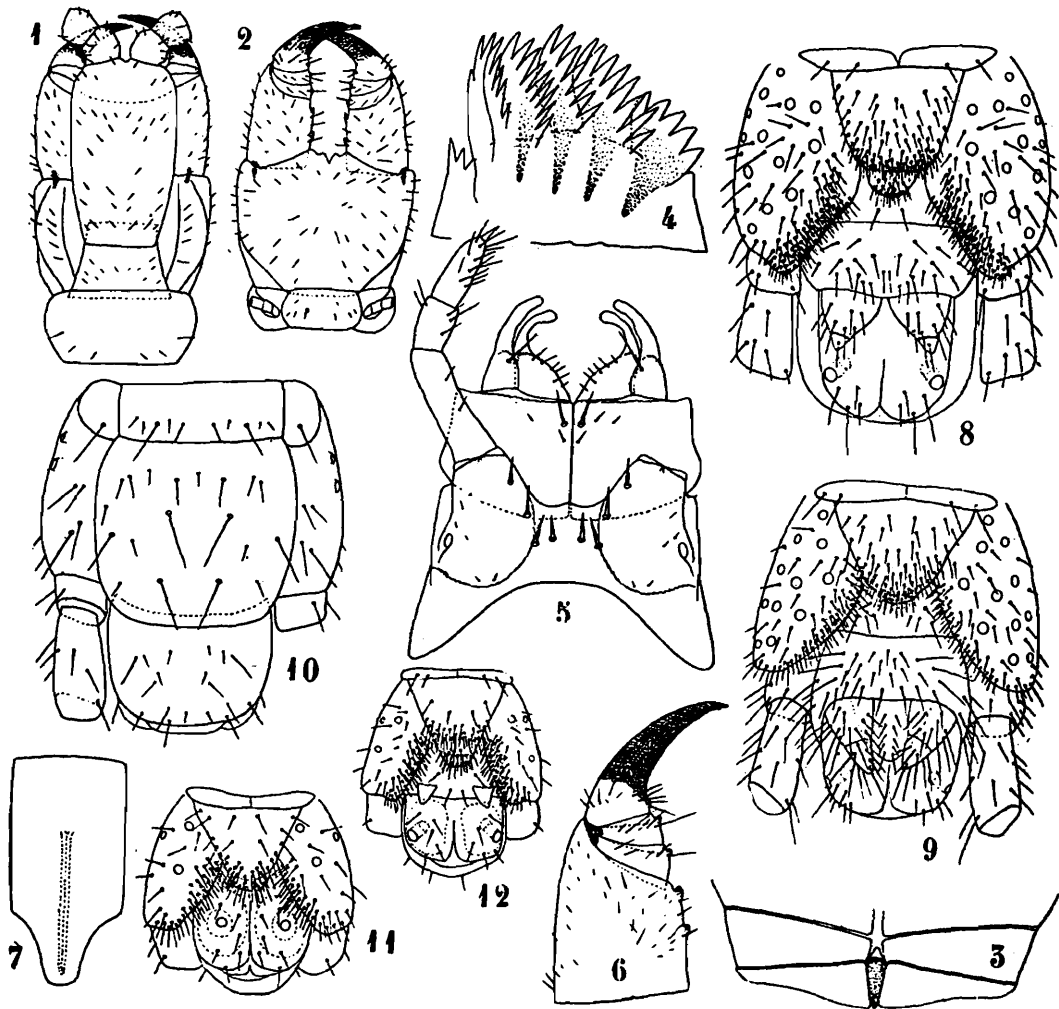


FIG. XIII.—*Lamnonyx modestus*: 1. caput et segmenta primum et secundum prona; 2. eadem supina; 3. labrum; 4. mandibulae pars distalis; 5. maxillae primi et secundi paris; 6. pedis maxillaris articali 2-5; 7. sternum decimum; 8. feminae corporis pars postica supina 9. maris corporis pars postica supina; 10. eadem prona; 11. et 12. juvenum corporis pars postica supina.

Lamnonyx modestus, sp. n.

(Fig. XIII).

Corpus melleum capite fulvo-testaceo.

Lamina cephalica parum minus quam duplo (80:45) longior quam latior, superficie sparse et grosse punctata. Antennae aliquantum attenuatae, articulis 1-6 setis brevibus, a septimo grada-

tim setis parum magis numerosis et brevioribus instructis. Pedes maxillares flexi marginem frontalem parum superantes, subcoxis parum antice latioribus quam longioribus margine antico sinuato, dentibus submedianis parvis, articulis ceteris dentibus typicis sat parvis, ungue terminali sat arcuato, sat attenuato, acuto, haud longo.

Labrum medium unidentatum, margine cetero integro; mandibulae lamina pectinatis 5-6, lamina mediana 7-dentata, dentibus subaequalibus; maxillae primi et secundi paris vide fig. X II, 5.

Sterna antica sulco mediano postico antice haud bifurcato exarata.

Pedes primi paris quam secundi parum minus quam dimidium breviores, pedes ceteri hirtelli ungue terminali robusto, brevi.

Segmentum ultimum pediferum sternito trapezoideo postice parte mediana valde angustiore, dimidia parte postica setis brevioribus numerosis vestita, subcoxis facie interna postica spatio sat angusto setis numerosis brevioribus vestita, poris inferis et lateralibus c. 15 instructis, pedibus quam praecedentes c. 2/7 longioribus, parum attenuatis hirtellis.

Pedum paria 49; long. corp. ad mm. 20, lat. segmenti primi 1.

Habitat.—Sattelberg, Nova Guinea, exempla nonnulla Cl. L. Birò in arboribus putrescentibus et sub foliis legit.

Observatio.—Species haec ad *L. rubescens*, Wood proxima est, sed statura minore, sterniti ultimi forma et poris subcoxalibus segmenti ultimi pedigeri minus numerosis facile distinguenda est.

Lamnonyx gigas (Haase).

(Fig. XIV).

Mecistocephalus gigas, Haase, *Abh. Mus. Dresden* I, N. 5, p. 105, taf. vi, fig. iii.

Corpus melleum supra fusco variegatum capite testaceo-latericio; superficie dorsuali brevissime setosa.

Lamina cephalica parum minus quam duplo (8:4.5) longior quam latior sparse et sat grosse punctata. Pedes maxillares flexi, marginem frontalem spatio longo superantes subcoxis parum antice (c. 1/8) latioribus quam longioribus, margine mediano anguste sinuato dentibus duobus parvis limitato, dentibus ceteris typicis sat parvis, ungue terminali bene arcuato attenuato acuto, tuberculo basali parvo. Labrum medium unidentatum, parte submediana aliquantum producta margine toto usque ad latera brevissime setoso. Mandibulae lamina prima pectinata parva 4-dentata, lamina aliis 26 apice dentibus 10-15 armato cetero margine setis brevissimis instructo. Maxillae primi et secundi paris setis vide fig. XIV, 6.

Sterna antica furca angulum sat acutum formante instructa.

Pedes primi paris quam secundi c. 1/3 (vel parum magis) breviores. Pedes ceteri hirtelli.

Segmentum praegenitale lamina ventrali trapezoidea ante apicem paullum angustiore, brevissime setosa, subcoxis multo in-

flatis poris parvis et perparvis obsessis, pedibus quam praece-
dentes duplo longioribus, attenuatis, breviter setosis, poris anali-
bus sat magnis.

Pedum paria 51; long. corp. ad mm. 87, lat. segmenti primi
3·8.

Habitat.—Feminas duas vidi a Cl. J Steel ad Fife Bay, Nova
Guinea Britannica, collectas.

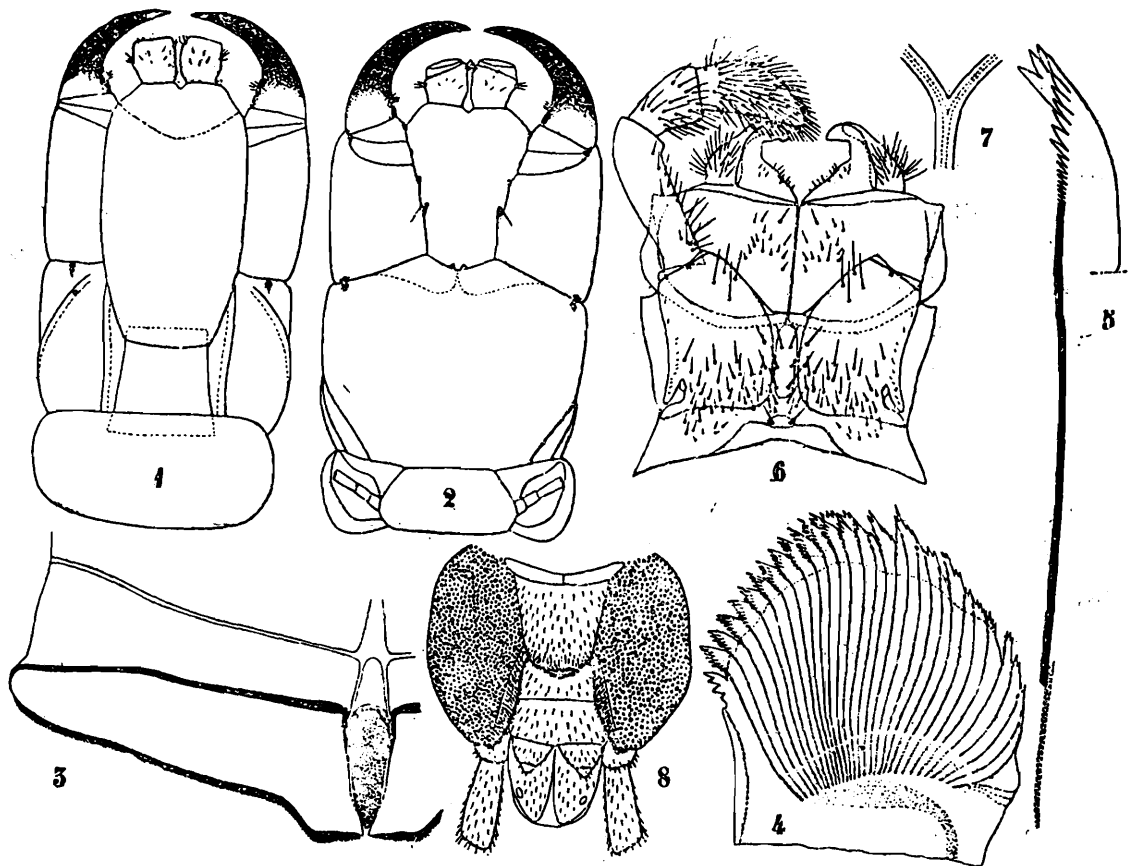


FIG. XIV.—*Lamnonyx gigas*: 1. caput et segmenta primum et secundum
prona; 2. eadem supina; 3. labrum; 4. mandibulae pars distalis; 5. ejusdem
lamina submediana; 6. maxillae primi et secundi paris; 7. sterni decimi furca;
8. feminae corporis pars postica supina.

Lamnonyx subgigas, sp. n.

(Fig. XV).

Corpus luride testaceum dorso infuscato, capite testaceo-late-
ricio.

Lamina cephalica parum minus quam duplo longior quam
lterior (8:4·5), superficie sparsissime et grosse punctata, postice
magis punctata. Antennae attenuatae articulis 1 6 setis brevibus,
articulis ceteris setis gradatim magis numerosis et brevioribus
instructis. Pedes maxillares flexi marginem frontalem spatio sat
magno superantes, subcoxis parum antice latioribus quam longio-
ribus, margine antico medio anguste sinuato, dentibus submedianis
sat parvis, dentibus typicis articularum ceterorum bene evolutis,
ungue terminali attenuato, acuto, bene arcuato.

Labrum medium unidentatum margine cetero setis brevioribus toto vestito; mandibulae laminis 15-20, quarum prima 6-7-dentata, ceterae parte apicali tantum dentata, parte proximali tota setis marginalibus minimis vestita; maxillae primi et secundi paris vide fig. XV, 5.

Sterna antica furca angulum obtusum formante impressa.

Pedes primi paris quam secundi parum minus quam dimidium breviores, pedes ceteri hirtelli ungue terminali elongato, attenuato.

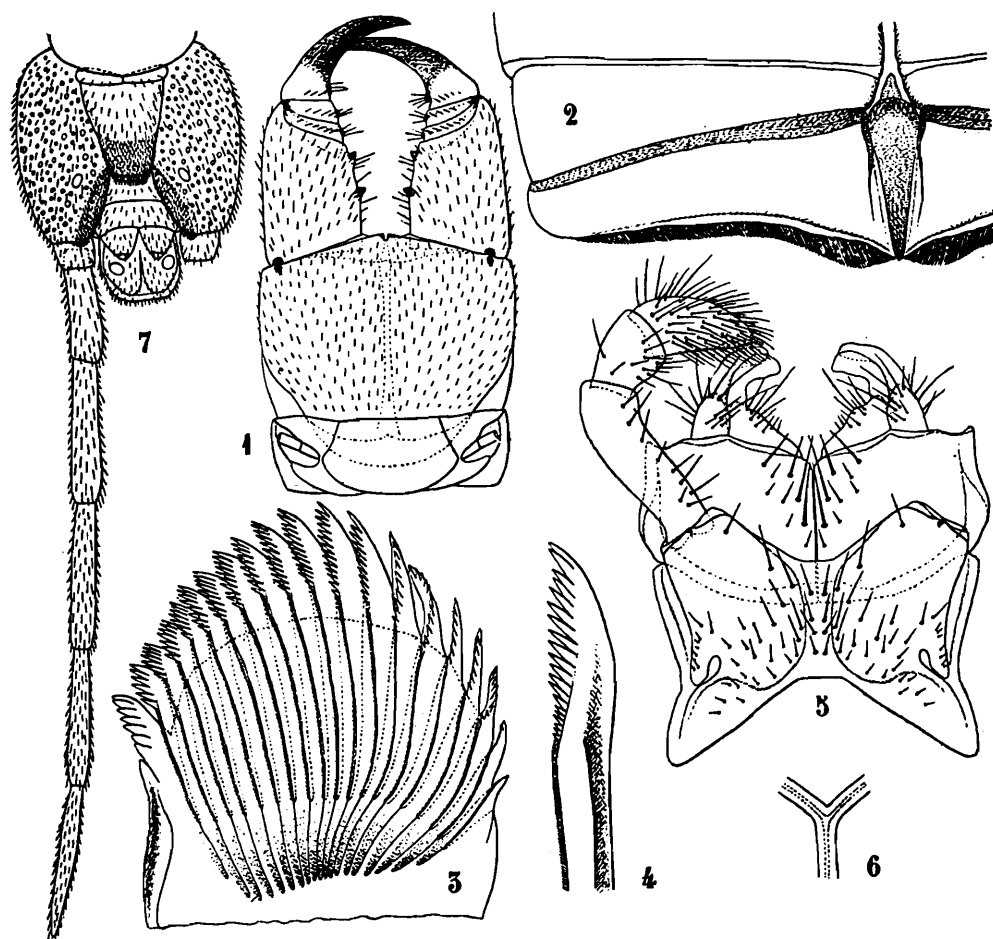


FIG. XV.—*Lamnonyx subgigas*: 1. pedes maxillares et segmentum primum pediferum supina; 2. labrum; 3. mandibulae pars distalis; 4. ejusdem laminae submedianae pars distalis; 5. maxillae primi et secundi paris; 6. sterni decimi furca; 7. feminae corporis pars postica supina.

Segmentum praegenitale sternito longo, trapezoido, ante apicem parum angustiore, parte postica magis setosa, subcoxis poro subpostico ventrali magno, nec non poris numerosis parvis et perparvis undique instructis, pedibus quam praecedentes duplo vel parum magis quam duplo longioribus, setis brevioribus vestitis.

Pedum paria 49; long. corp. ad mm. 60, lat. segmenti primi 2.5.

Pullus (fig. XVI) long. corp. 17, lat. segmenti primi 0.90.

Corpus luride melleum capite substestaceo. Mandibulae laminis pectinatis 13, eisdem adulti similibus sed dentibus apicalibus

minus numerosis; pedum maxillarum unguis quam idem adulti aliquantum magis arcuatus. Segmenti praegenitalis subcoxae poris nullis vel poro uno magno instructae. Pori anales magni.

Habitat.—Nova Guinea: Simbang, Sattelberg.

Observatio.—Species haec ad *L. gigas* (Haase) perproxima est, sed segmentorum numero, statura, poro magno subcoaxarum posticarum, saltem ut species vel subspecies distinguenda est.

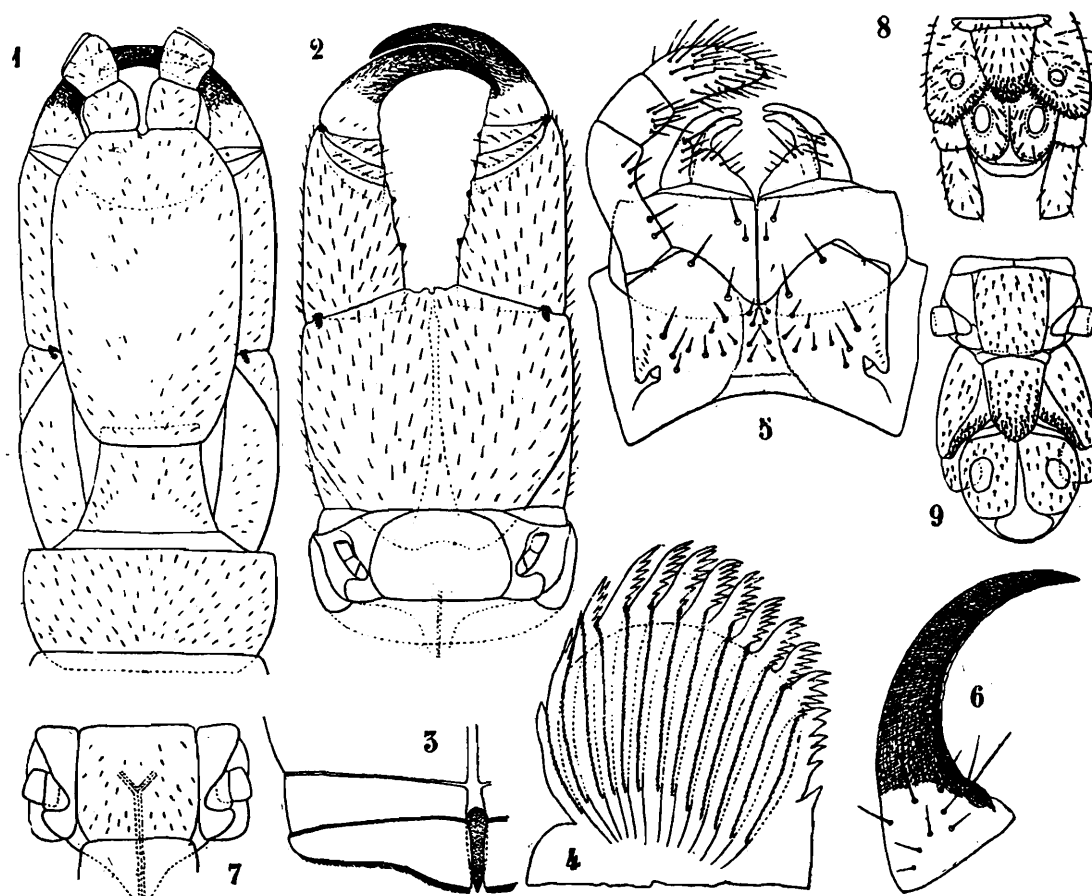


FIG. XVI.—*Lamnonyx subgigas*, pullus: 1. caput et segmenta primum et secundum prona; 2. pedes maxillares et segmentum primum pediferum supina; 3. labrum; 4. mandibulae pars distalis; 5. maxillae primi et secundi paris; 6. pedum maxillarum unguis terminalis; 7. sternum decimum cum pedum pars proximalis; 8. corporis pars postica supina; 9. exempli alii corporis pars postica supina.

Lamnonyx uncifer, sp. n.

(Fig. XVII).

Corpus melleum dorso multo infuscato, capite fulvo-ferrugineo.

Lamina cephalica parum minus quam duplo (100 : 57) longior quam latior, superficie punctis paucis impressa; lamina basalis puncto magno mediano antico impressa.

Labrum, mandibulae et maxillae eisdem speciei praecedentis similia sunt. Pedes maxillares subcoxis parum antice latioribus quam longioribus, margine antico medio anguste sed sat profunde sinuato dentibus submedianis magnis acutis, articulo secundo dentibus duobus magnis acutis uncinatis, articulo tertio dente un-

cinato parvo, articulo quarto dente uncinato sat magno armato, ungue terminali longo, attenuato, multo arcuato, acuto.

Pedes primi paris quam secundi parum minus dimidium breviores; pedes ceteri hirtelli, ungue terminali longo, robusto.

Sterna antica furca angulum subrectum vel parum obtusum formante impressa.

Segmentum praegenitale sternito longo, trapezoideo, postice vix angustiore, fere dimidia parte postica setis brevissimis vestita; subcoxis bene inflatis et poris numerosis magnis et parvis undique instructis, pedibus quam praecedentes parum magis quam duplo longioribus, parum attenuatis et breviter setosis.

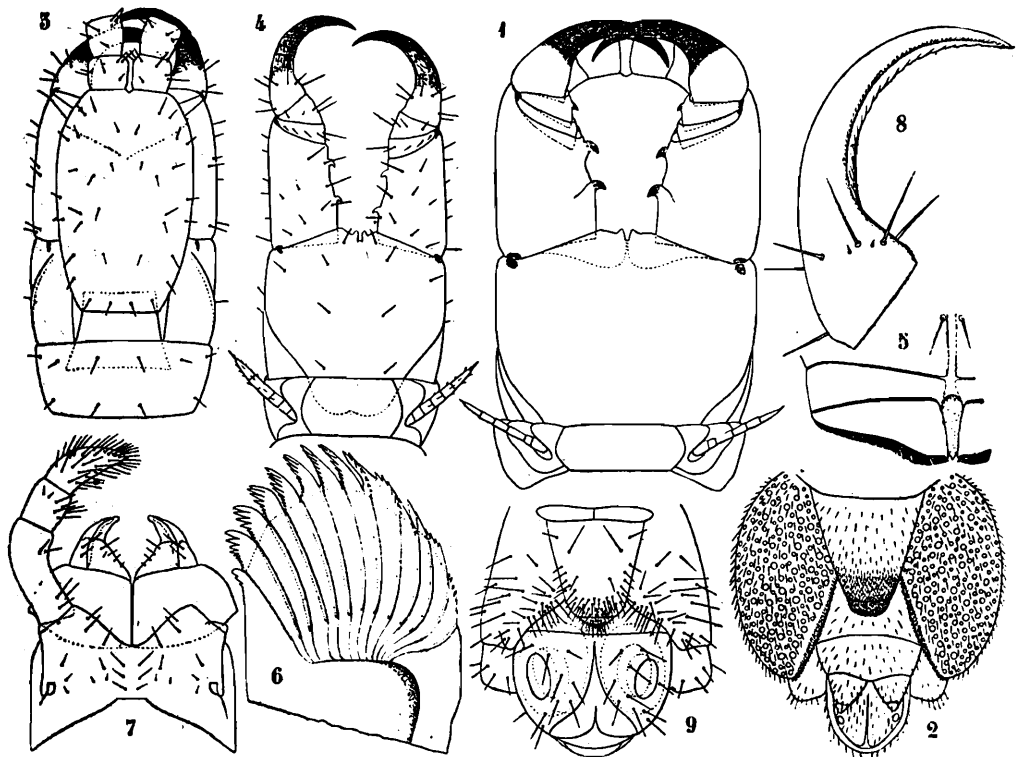


FIG. XVII.—*Lamnonyx uncifer*: 1. caput et segmentum primum pediferum supina; 2. feminae pars postica supina; 3. pulli caput et segmenta primum et secundum prona; 4. eadem supina; 5. pulli labrum; 6. pulli mandibulae pars distalis; 7. maxillae primi et secundi paris; 8. pedem maxillarium unguis terminalis; 9. corporis pars postica supina.

Pedum paria 49; long. corp. mm. 65, lat. segmenti primi 2.6.

Pullus (fig. XVII, 3-9) long. corp. mm. 18, lat. segmenti primi 0.78. Ab adulto differt mandibulis laminis pectinatis 13 instructis, pedibus maxillaribus ungue terminali magis arcuato, vix crenulato et articulis tertio et quarto dentibus destitutis, segmenti ultimi pediferi subcoxis poris destitutis, poris analibus permagnis.

Habitat.—Nova Guinea: Moroka (m. 1,300); feminam cum pullis vidi a Cl. L. Loria collectam.

Observatio.—Species haec a *L. subgigas* pedibus maxillaribus ungue magis arcuato, dentibus articulorum 2-4 uncinatis bene distincta est.

Lamnonyx tahitiensis, Haase.

(Fig. XVIII).

Mecistocephalus tahitiensis, Wood, *Ź. Ac. Nat. Sci. Philad.* (2) V, p. 43 (1863); Haase, *Abh. Mus. Dresden* I, N. 5, p. 101, taf. vi, fig. 108 (1887).

Lamnonyx tahitiensis, Attems, *Zool. Jahrb. Syst.* XVIII, p. 212 (1903).

Corpus luride testaceum dorso fusco parum variegato, capite badio vel corpus ochraceum capite latericio.

Lamina cephalica parum minus quam duplo (75 : 43) longior quam latior, sparse et grosse punctata praesertim postice. Antennae attenuatae articulis 1-7 setis brevibus, articulis ceteris

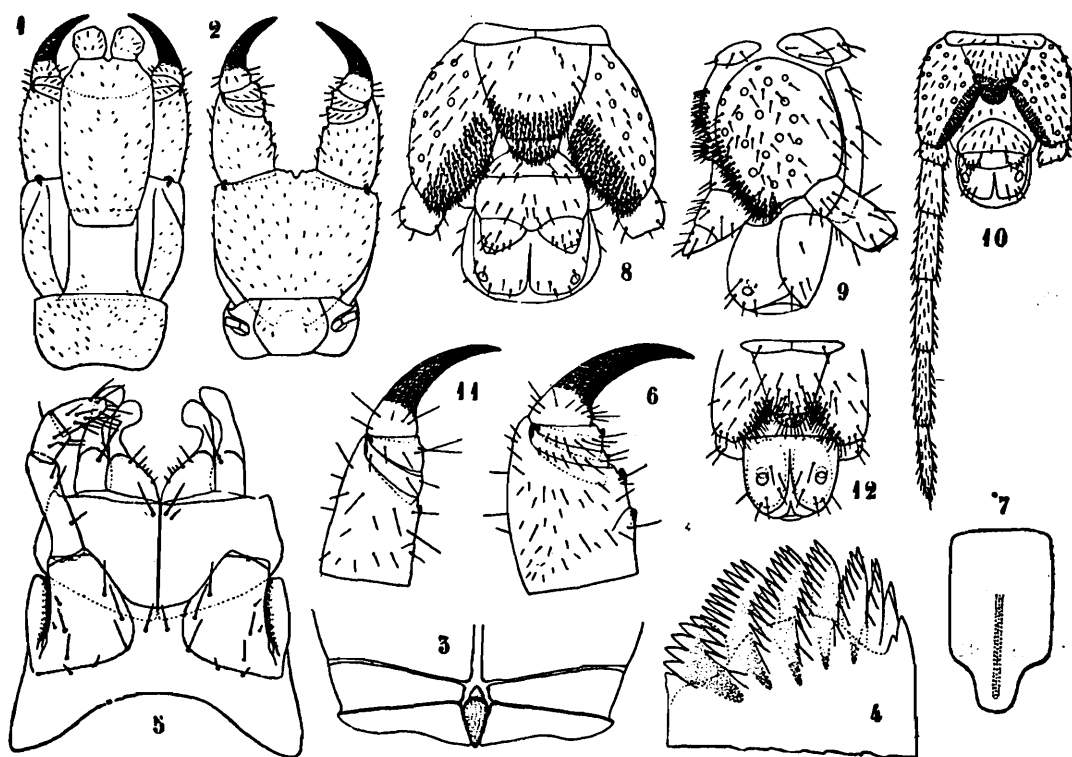


FIG. XVIII.—*Lamnonyx tahitiensis*: 1. caput et segmenta primum et secundum prona; 2. eadem supina; 3. labrum; 4. mandibulae pars distalis; 5. maxillae primi et secundi paris; 6. palpi maxillares articuli 2-5; 7. sternum decimum; 8. feminae pars postica supina; 9. eadem lateraliter inspecta; 10. juvenis pars postica supina; 11. pulli pedis maxillaris articuli 2-5; 12. pulli pars postica supina.

etiam setis brevioribus numerosis instructis. Pedes maxillares flexi marginem frontalem spatio parvo superantes, subcoxis parum antice latioribus quam longioribus, margine antico medio sinuato, dentibus submedianis acutis parvis, articulis ceteris dentibus typicis bene evolutis, ungue terminali attenuato, sat arcuato, acuto.

Labrum medium unidentatum margine cetero simplici, nudo; mandibulae laminis pectinatis 7, quarum prima 5-dentata, mediana 10—12-dentata dentibus parum diversis, externa 3—4-dentata; maxillae primi et secundi paris setis vide fig. XVIII, 5.

Sterna antica sulco longitudinali mediano postico, antice haud vel vix bifurcato, instructa. Pedes primi paris quam secundi fere

dimidio breviores; pedes ceteri hirtelli ungue terminali brevi, robusto.

Segmentum praegenitale trapezoideo, postice aliquantum angustato et dimidia superficie postica setis numerosis brevibus vestita, subcoxis poris inferis et lateralibus 15-20 parvis et sat parvis, facie interna per spatium latiusculum setis brevioribus vestita, pedibus parum attenuatis quam praecedentes parum minus quam duplo longioribus.

Mas postice quam femina parum magis setosus.

Pedum paria 47; long. corp. ad mm. 30 (secundum Haase ad 50), lat. segmenti primi 1.15.

Pullus (fig. XVIII, 11-12) long. mm. 7, lat. segmenti primi 0.55. Corpus pallide testaceum capite sublatericio, pedum maxillarium articulus tertius et quartus dentibus nullis; segmenti praegenitalis subcoxae poris nullis; pori anales sat magni.

Habitat.—Exempla nonnulla vidi ad Sattelberg, Nova Guinea, a L. Birò collecta (*Mus. Budapest*) et alia a me ipso ad Loftus, N. S. Wales, Australia.

Observatio.—Species haec a *L. castaineiceps*, Haase saltem statura, pororum numero subcoaxarum segmenti ultimi pedigeri distincta est; a *L. modestus* segmentorum numero, ungue pedum maxillarium longiore, sterniti segmenti ultimi pedigeri minus angustata bene distincta est.

Lamnonyx spissus, Wood.

(Fig. XIX).

Mecistocephalus spissus, Wood, *J. Ac. Nat. Sc. Philad.* (2) V, p. 43 (1863); Haase, *Abh. Mus. Dresden* I, N. 5, p. 101 (1887); Silvestri, *Fauna Hawaiensis* III, p. 326, pl. xi, fig. 5-7 (1904).

Corpus melleum vel umbrinum dorso medio praesertim plus minusve fusco variegato, capite fulvo-ferrugineo vel testaceo.

Lamina cephalica parum minus quam duplo (76:42) longior quam latior, superficie punctis numerosis impressa. Antennae attenuatae articulis 1-6 setis brevibus et brevioribus, articulis ceteris setis gradatim magis numerosis et brevioribus instructis. Labrum medium unidentatum margine cetero simplici nudo; mandibulae lamina pectinatis 8, quarum prima 7 dentata, submediana 14-dentata dentibus ab apice ad basim parum minoribus; maxillae primi et secundi paris setis vide fig. XIX, 5.

Pedes maxillares subcoxis parum, antice, latioribus quam longioribus margine antico medio parum profunde sinuato, dentibus submedianis parvis, articulo secundo dentibus duobus subaequalibus sat magnis, articulis tertio et quarto dente singulo parvo, ungue terminali longo, sat arcuato, acuto, tuberculo basali sat distincto.

Sterna sulco mediano, aliquantum longe a margine antico incipiente, exarato.

Pedes primi paris quam secundi parum minus quam dimidium breviores; pedes ceteri hirtelli ungue terminali longo, acuto, parum arcuato.

Segmentum praegenitale sternito brevi latiusculo trapezoideo postice brevissime setoso, subcoxis poris parum numerosis sat magnis et parvis subtus et externe instructis, pedibus quam praecedentes c. $\frac{1}{4}$ longioribus, hirtellis.

Mas feminae similis.

Pedum paria 45; long. corp. ad mm. 56, lat segmenti primi 2.5.

Pullus long. corp. mm. 16, lat. segmenti primi 0.84. Corpus creneum postice stramineum capite ferrugineo. Pedes maxillares (fig. XIX, 9) articulo secundo tantum dente apicali instructo, ungue terminali vix crenulato.

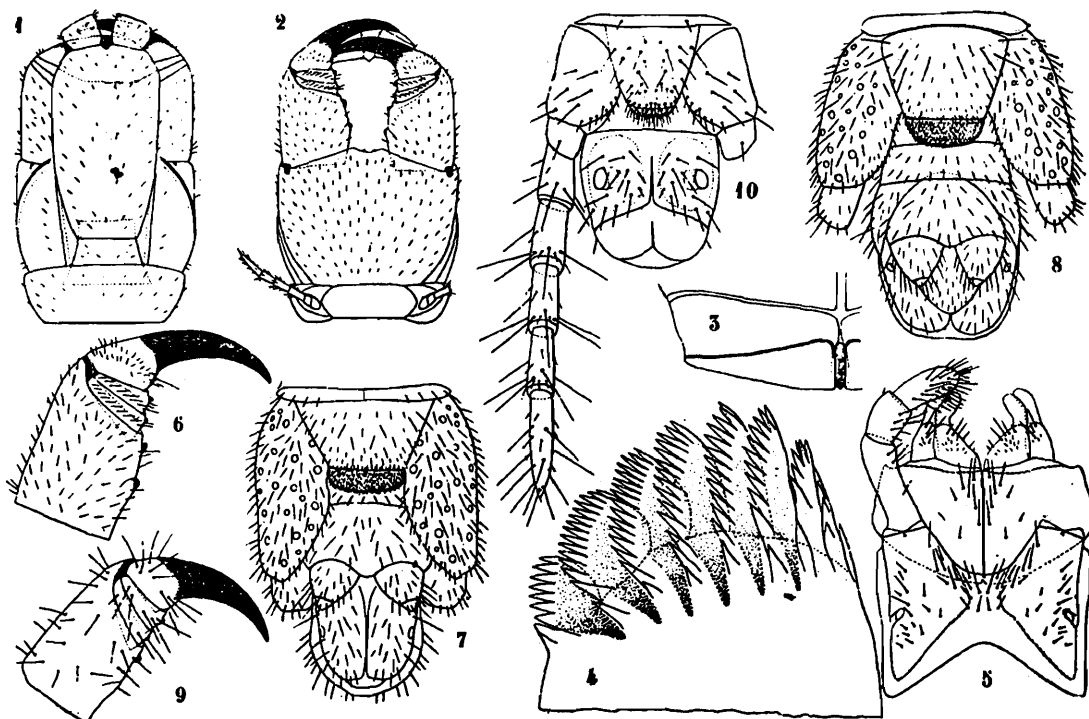


FIG. XIX.—*Lamnonyx spissus*: 1. caput et segmentum primum et secundum prona; 2. pedes maxillares et segmentum primum pediferum supina; 3. labrum; 4. mandibulae pars distalis; 5. maxillae primi et secundi paria; 6. pedis maxillaris articuli 2-5; 7. feminae pars postica supina; 8. maris pars postica supina; 9. pulli pedis maxillaris articuli 2-5; 10. pulli corporis pars postica supina.

Segmentum praegenitale (fig. XIX, 10) subcoxis poris nullis. Pori anales sat magni.

Habitat.—Is. Hawaii: Kilauea (♀, ♂ et pullum legi); Haleachala, Maui, 5,000 ft.

Lamnonyx diversidens, sp. n.

(Fig. XX).

Mecistocephalus spissus, Pocock, *Ann. Mus. Genova* XXX, p. 424 (1891); Silvestri, *Ann. Mus. Genova* XXXIV, p. 15 (1894); Attems, *Mtt. Naturh. Mus. Hamburg* XXIV, p. 95, fig. viii-ix (1907).

Corpus melleum vel isabellinum dorso fusco variegato, capite fulvo-ferrugineo vel testaceo.

Lamina cephalica c. $\frac{2}{7}$ longior quam latior, superficie mediana praesertim sparse et grosse punctata. Antennae attenuatae, setis ab articulo sexto gradatim magis numerosis et brevioribus.

Labrum medium unidentatum margine cetero integro, nudo; mandibulae laminis pectinatis 8-10, quarum prima 6-dentata, mediana dentibus 16 ab apice ad basim gradatim parum minoribus; maxillae primi et secundi paris vide fig. XX, 5.

Pedes maxillares flexi marginem frontalem spatio sat magno superantes, subcoxis parum antice latioribus quam longioribus, articulo secundo tantum dente magno (rare dente parvo) apicali armato, articulo tertio dente nullo vel subnullo, articulo quarto

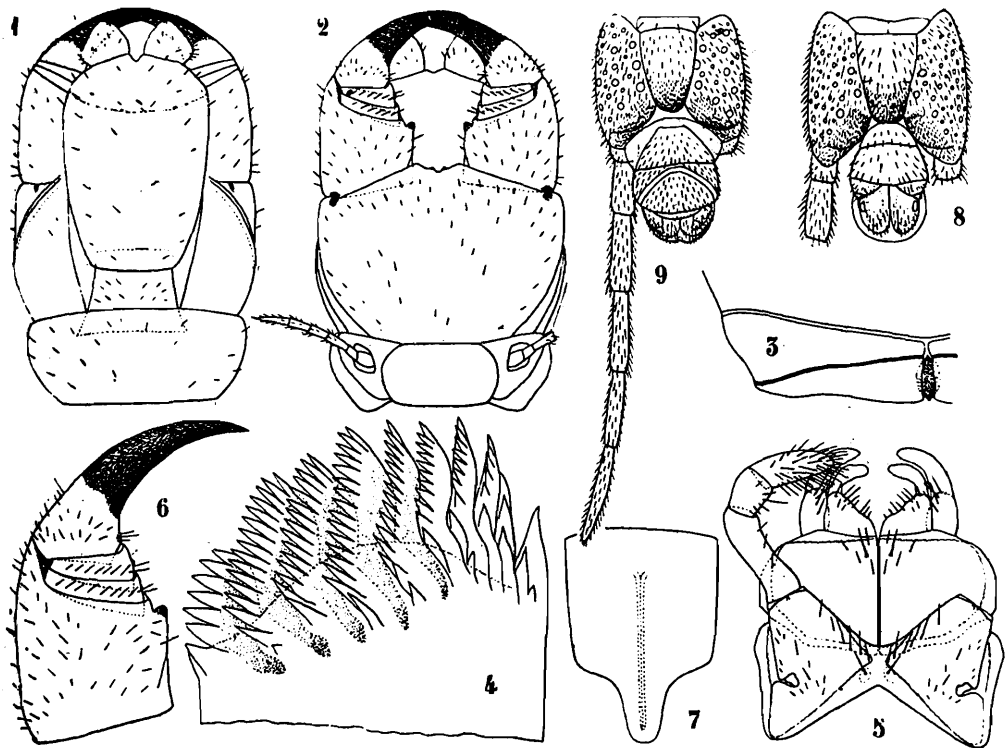


FIG. XX.—*Lamnonyx diversidens*: 1. caput et segmenta primum et secundum prona; 2. pedes maxillares et segmentum primum pediferum supina; 3. labrum; 4. mandibulae pars distalis; 5. maxillae primi et secundi paris; 6. pedis maxillaris articuli 2-5; 7. sternum decimum; 8. feminae pars postica supina; 9. maris pars postica supina.

dente parvo tuberculiformi, ungue terminali bene arcuato acuto, basi inermi.

Sterna sulco longo mediano parum longe a margine antico incipiente impressa. Pedes paris primi quam secundi fere $\frac{1}{3}$ breviores, pedes ceteri hirtelli ungue terminali robusto.

Segmentum praegenitale sternito longo lateribus aliquantum convergentibus, ante apicem paullum angustato, parte postica setis numerosis instructa, subcoxis poris numerosis sat magnis et nonnullis parvis undique instructis et per superficiem internam posticam setis numerosis brevissimis, pedibus quam praecedentes c. $\frac{1}{3}$ longioribus, attenuatis, breviter setosis.

Mas feminae similis.

Pedum paria 45; long. corp. ad mm. 55, lat. segmenti primi 2.8.

Habitat.—India: Bagarkote, 8,000 ft., Kumaon, W Himalayas (*Tytler*); Darjiling distr., 7,000-8,000 ft., E. Himalayas (*Lord Carmichael*); Painsur, above Lohba, 3,000 ft., Garhwal W. Himalayas (*Tytler*); Birch Hill, Darjiling, 6,000-7,000 ft. (*Lord Carmichael*); Senchal, Darjiling distr., 8,000 ft. (*Lord Carmichael*); Darjiling, 7,000 ft., E. Himalayas (*Gravelly*); by side of stream at Nagabevar, 10,000-10,500 ft., Kashmir (*H L. Bion*); Dungagali, 8,000 ft., Hazara distr. (*Fletcher*); Assam-Bhutan Frontier, Mangaldai distr. (*S. W Kemp*); Simla, W Himalayas, 7,000 ft. (*N. Annandale*); Theog, Simla hills, 5,000 ft. (*N Annandale*); Katmandu, Nepal; Kobo, 400 ft., Abor Expedition, in rotten wood (*Kemp*); Rotung, 1,400 ft., Abor Expedition (*M de Courcy*); Renging, 2,100 ft., Abor Expedition.

Observatio.—Species haec a *L. spissus*, Wood pedum maxillarium articulo secundo dente uno (nec duobus) apicali plerumque magno armato, segmenti ultimi pediferi sternito longiore, nec non capite parum brevior et latiore facile distinguenda est.

Lamnonyx mirandus (Poc.)

(Fig. XXI).

Mecistocephalus mirandus, Pocock, *Ann. Nat. Hist.* (6) XV, p. 352 (1895).

Corpus ochraceum capite testaceo-latericio.

Lamina cephalica duplo longior quam latior, superficie punctis sparsissimis perpaucis et perparvis, postice sulcis duobus submedianis brevissimis punctatis impressa. Antennae attenuatae ab articulo quinto setis gradatim magis numerosis et brevioribus instructae.

Labrum medium dentatum margine cetero ad dentem mediano acute aliquantum producto et toto setis brevissimis sat numerosis instructo, mandibulae laminis pectinatis 15, quarum prima perparva 5-dentata, ceterae dentibus proximalibus perparvis, mediana dentibus c. 35; maxillae primi et secundi paris vide fig. XXI, 5.

Pedes maxillares flexi marginem frontalem spatio sat magno superantes, subcoxis sublaevigatis parum antice latioribus quam longioribus, margine antico medio parum sinuato, dentibus submedianis parvis, articulo secundo dentibus duobus sat magnis instructo, articulis tertio et quarto dente perparvo tuberculiformi, ungue terminali attenuato, sat arcuato acuto ad basim inermi.

Sterna antica sulco mediano postico profundo impressa.

Pedes primi paris quam secundi c. 1/3 breviores, pedes omnes hirtelli ungue terminali robusto.

Segmentum praegenitale sterno trapezoideo parum pone medium aliquantum angustiore setis numerosis brevissimis instructum, subcoxis bene inflatis undique poris crebris sat parvis instructis, pedibus quam praecedentes c. duplo longioribus, crassiusculis setis brevissimis vestitis.

Pedum paria 65; long. corp. ad mm. 82 (secund. Pocock ad 99), lat. segmenti primi 3.

Habitat.—Mares duos vidi alterum ad Kankan, Formosa, alterum ad Shushu, a Cl. H. Sauter collectos.

Exempla a Cl. Pocock descripta ad Great Loo-Choo collecta erant.

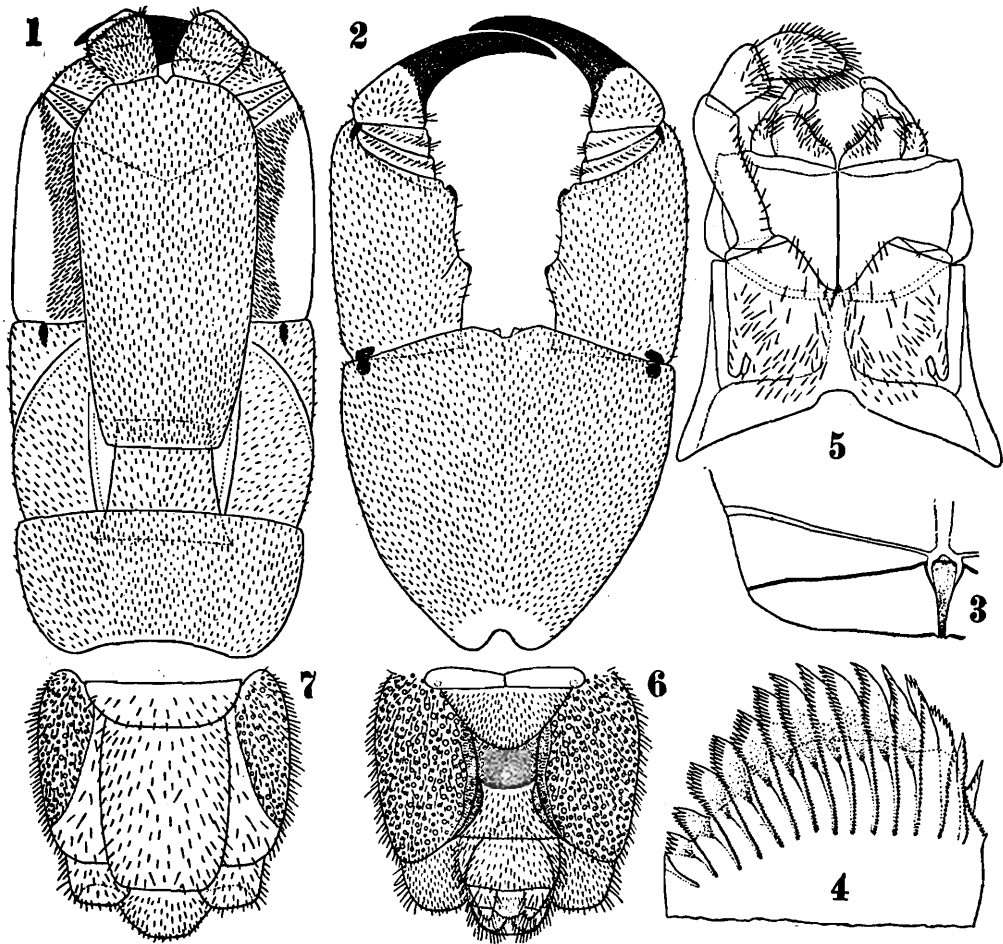


FIG. XXI.—*Lamnonyx mirandus*: 1. caput et segmenta primum et secundum prona; 2. pedes maxillares supini; 3. labrum; 4. mandibulae pars distalis; 5. maxillae primi et secundi paris; 6. maris corporis pars postica supina; 7. eadem prona.

Lamnonyx smithi (Poc.)

(Fig. XXII).

Mecistocephalus smithi, Pocock, *Ann. Nat. Hist.* (6) XV, p. 351 (1895).

Corpus ochroleucum capite testaceo-latericio.

Lamina cephalica c. 1/10 longior quam latior, superficie grosse et sparse punctata postice sulcis submedianis brevioribus punctatis impressa. Antennae attenuatae ab articulo sexto setis gradatim magis numerosis et brevioribus instructae.

Labrum medium unidentatum, margine cetero subrecto, nudo ad dentem medianum acute producto; mandibulae praeter laminam obsoletam externam lamina 6, quarum prima 5-dentata,

mediana 11-dentata dentibus proximalibus parum minoribus; maxillae primi et secundi paris vide fig. XXII, 5.

Pedes maxillares flexi marginem frontalem spatio magno superantes, subcoxis parum antice latioribus quam longioribus, superficie sparse et grosse punctata, margine antico medio anguste sinuato, dentibus submedianis acutis sat parvis, articulo secundo dentibus duobus obtusis sat magnis armato, articulis tertio et quarto dente parvo tuberculiformi instructis, ungue terminali bene arcuato, attenuato, acuto, basi vix inflata.

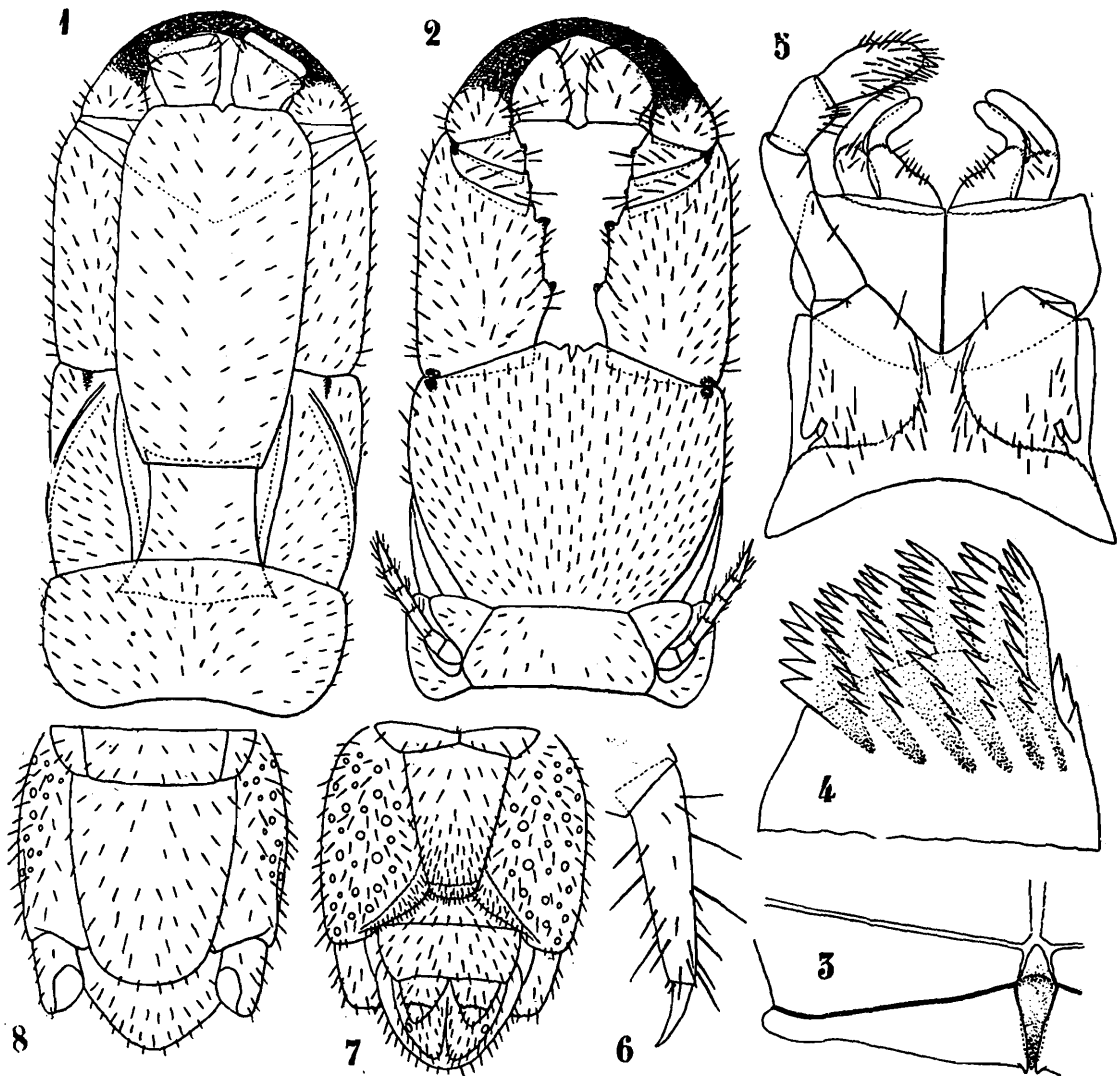


FIG. XXII.—*Lamnonyx smithi*: 1. caput et segmenta primum et secundum prona; 2. pedes maxillares et segmentum primum pediferum supina; 3. labrum; 4. mandibulae pars distalis; 5. maxillae primi et secundi paris; 6. pedis paris decimi pars distalis; 7. feminae pars postica supina; 8. eadem prona.

Sterna antica sulco profundo postico mediano impressa.

Pedes primi paris quam secundi c. $\frac{1}{3}$ breviores, pedes omnes ungue terminali longo, attenuato, acuto.

Segmentum praegenitale sterno longo, parum lato, trapezoideo, subcoxis poris sat numerosis parvis et perparvis, lateraliter et supra antice instructis, pedibus quam praecedentes c. duplo longioribus sat gracilibus, attenuatis, setis brevioribus numerosis instructis.

Pedum paria 59; long. corp. ad mm. 32 (secund. Pocock ad mm. 80) lat. segmenti primi 1.40.

Habitat.—Formosa: Kosempo (*H. Sauter*); exempla typica ex China ad Da-laen-Saen et Wo-Lee Lake, Ningpo.

Lamnonyx diversisternus, sp. n.

(Fig. XXIII).

♂ Corpus melleum capite latericio.

Lamina cephalica parum minus quam duplo longiore quam latiore, superficie sparse et grosse punctata postice sulcis duobus submedianis punctatis impressa.

Antennae attenuatae, ab articulo sexto setis gradatim magis numerosis et brevioribus.

Pedes maxillares flexi marginem frontalem spatio magno superantes, subcoxis parum antice latioribus quam longioribus superficie punctis parvis sparsis impressa, margine antico medio anguste sinuatum, dentibus submedianis parvis, articulo secundo dentibus duobus sat magnis armato, articulis tertio et quarto dente parvo tuberculiformi instructis, ungue terminali attenuato, sat arcuato, acuto. tuberculo parvo basali acuto.

Sterna antica sulco profundo postico impressa.

Pedes primi paris quam secundi c. $\frac{1}{3}$ breviores, pedes omnes hirtelli ungue terminali longo attenuato.

Segmentum praegenitale trapezoideo valde angustato, subcoxis bene inflatis, interne postice spatio sat lato breviter setoso, cetera superficie poris sat parvis numerosis sed haud crebris subtus et lateraliter instructa, pedibus quam praecedentes duplo longiores, attenuatis, setis brevibus numerosis instructis.

Pedum paria 57; long. corp. ad mm. 34, lat. segm. primi 1.30.

Habitat.—Japonia: Kamatura (*coll. Silvestri*).

Observatio.—Species haec a *L. smithi* segmentorum numero et segmenti ultimi pedigeri sterniti forma praesertim bene distincta est.

Gen. Dicelophilus, O. F. Cook.

(Fig. XXIV).

Clinopodes ex p. C. Koch, *Syst. Myr.* p. 184 (1847).

Mecistocephalus ex p. Meinert, *Nat. Tidsskr.* VII, p. 92 (1870).

„ Latzel, *Die Myr. Öst.-Ung. Mon.* I, p. 160.

Dicelophilus, O. F. Cook, *Pr. U.S. Nat. Mus.* XVIII, p. 61 et 74 (1895).

Mecistocephalus, Attems, *Zool. Jahrb. Syst.* XVIII, p. 208 (1903).

„ Verhoeff, *Bronn's Klass. Philop.* p. 272 (1908).

„ Chamberlin, *Pomona J. Ent.* IV, p. 653 (1912).

? *Tygarrup*, Chamberlin, *Bull. Mus. Zool. Cambridge, Mass.* LVIII, p. 210.

Corpus postice attenuatum.

Lamina cephalica aliquantum longior quam latior, sutura

frontali discreta, genarum angulo antico interno ad labrum in processum acutum producto, superficie infera antica sublateral externa spina destituta.

Labrum tripartitum parte mediana angustiore, acuta; mandi-

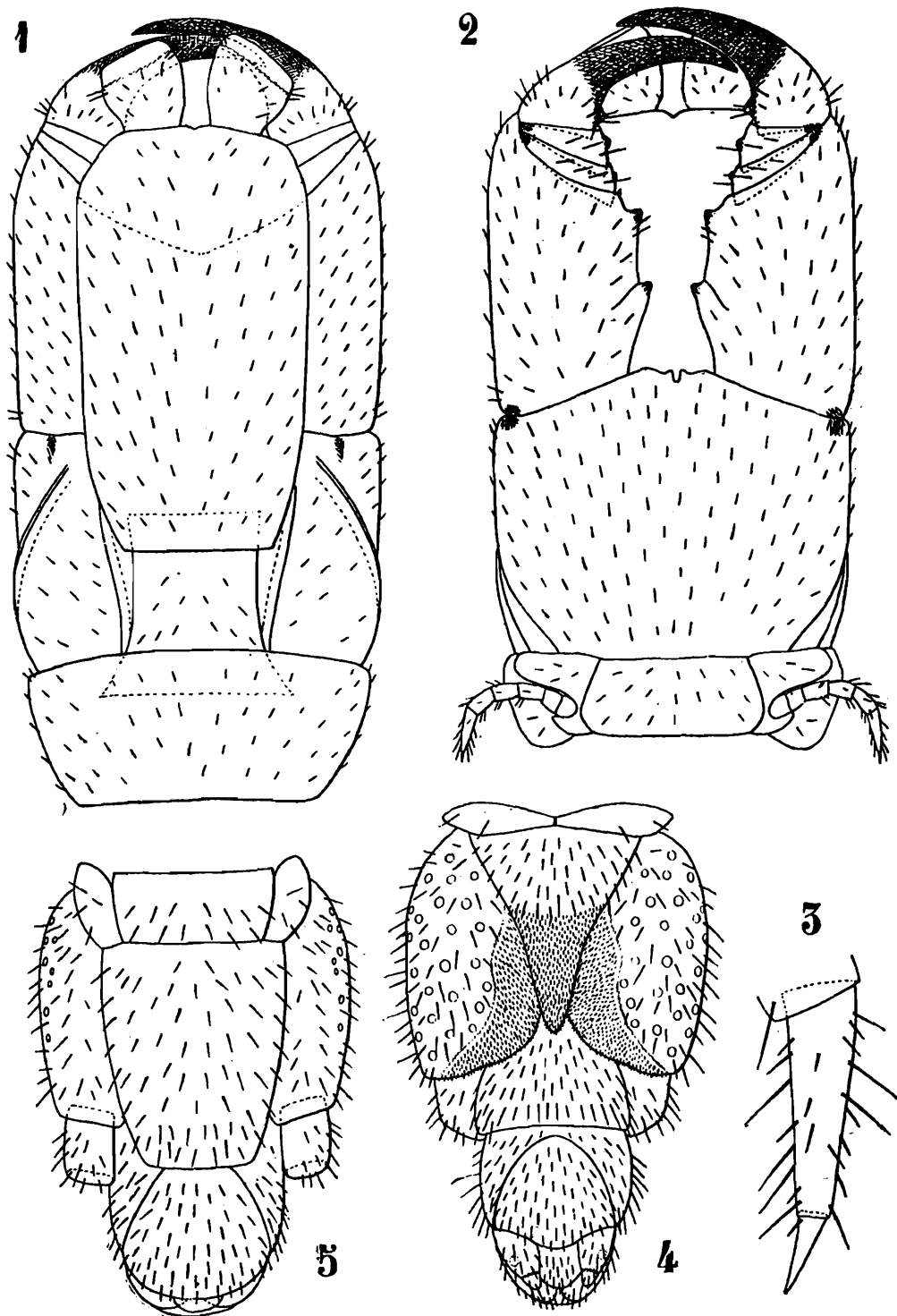


FIG. XXIII.—*Lamnonyx diversisternus*: 1. caput et segmenta primum et secundum prona; 2. eadem supina; 3. pedis decimi pars distalis; 4. corporis pars postica supina; 5. eadem prona.

bulae lamina pectinatis nonnullis, superficie externa laterali pilosa; maxillae primi et secundi paris ut in gen. *Lamnonyx*, palpi ungue terminali brevior.

Lamina basalis subtrapezoidea ad basim longior quam latior.

Pedes maxillares flexi marginem frontalem superantes vel fere superantes.

Tergita longitudinaliter bisulcata, praetergita magna.

Sterna antica sulco mediano abbreviato instructa, praesterna media divisa et in segmentis anticis 2-15 spatio sat lato disjuncta; praescutellum (paratergitum) quam scutellum spiraculiferum multo majus.

Segmentum ultimum pedigerum sterno bene evoluto, subcoxis poris numerosis instructis, pedibus (subcoxis exclusis) 6-articulatis, inerimibus.

Pori anales duo.

Habitat.—Europa et America septentrionalis.

Species typica: *Mecistocephalus limatus*, Wood.

Observatio.—Genus hoc a gen. *Lamnonyx*, O. F. Cook lamina cephalica spina sublaterali infera antica destituta et lamina basali aliquantum latiore facile distinguendum est.

Generi huic species pertinent: *Mecistocephalus limatus*, Wood, Nord West America; *M. anomalus*, Chamberlin, Nord West America; *Clinopodes carniolensis*, C. Koch, Europa; forsan *Tygar-rup intermedius*, Chamberlin, British Guiana.

***Dicelophilus anomalus* (Chamb.)**

(Fig. XXIV).

Mecistocephalus anomalus, Chamberlin, *Pr. Ac. Nat. Sc. Philad.* 1904, p. 655; *Id.*, *Pomona Journ. Ent.* IV, p. 653 (1912).

Corpus ochroleucum capite latericio-ferrugineo.

Lamina cephalica c. $\frac{1}{3}$ longior quam latior, lateribus postice aliquantum convergentibus, superficie punctis sparsis postice secundum lineis submedianis subseriatis impressa. Antennae longiusculae, attenuatae, articulo sexto duplo longiore quam ad apicem latiore, articulo ultimo $\frac{5}{8}$ longiore quam latiore articulis 7^o ad ultimum setis gradatim magis numerosis et brevioribus instructis.

Labrum medium unidentatum, margine cetero breviter ciliato paullum sinuato; mandibulae laminis pectinatis 5, quarum prima 5-dentata, mediana 14-dentata, dentibus subaequalibus, margine interno ad laminam primam acute producto, margine externo ad laminam quintam processibus setiformibus 3-4 apice integro vel bifurcato aucto, superficie laterali externa setibus brevioribus vestita; maxillae primi et secundi paris vide fig. XXIV, 5.

Pedes maxillares flexi marginem frontalem spatio sat magno superantes, subcoxis parum antice latioribus quam longioribus superficie punctis perparvis sparsissimis, margine antico medio sinuato et dentibus duobus submedianis parvis instructo, articulo secundo dente apicali sat magno tantum armato, articulo tertio dente tuberculiformi perparvo, articulo quarto dente tuberculiformi parvo instructo, ungue terminali bene arcuato, attenuato, acuto et dente basali sat magno instructo.

Sterna antica sulco mediano postico impressa.

Pedes primi paris quam secundi c. $\frac{1}{3}$ breviores, pedes omnes hirtelli ungue terminali longo, attenuato.

Segmentum praegenitale sterno subtriangularem postice parum lato, rotundato, dimidia parte postica setis brevissimis vestita, subcoxis interne postice spatio latiusculo setis brevissimis vestito, superficie cetera subtus et lateraliter poris numerosis parvis et perparvis nec non poro sat magno infero submediano instructis; pedibus quam praecedentes c. $\frac{3}{7}$ longioribus, parum attenuati setis brevioribus numerosis instructis.

Mas pedibus ultimis parum crassioribus.

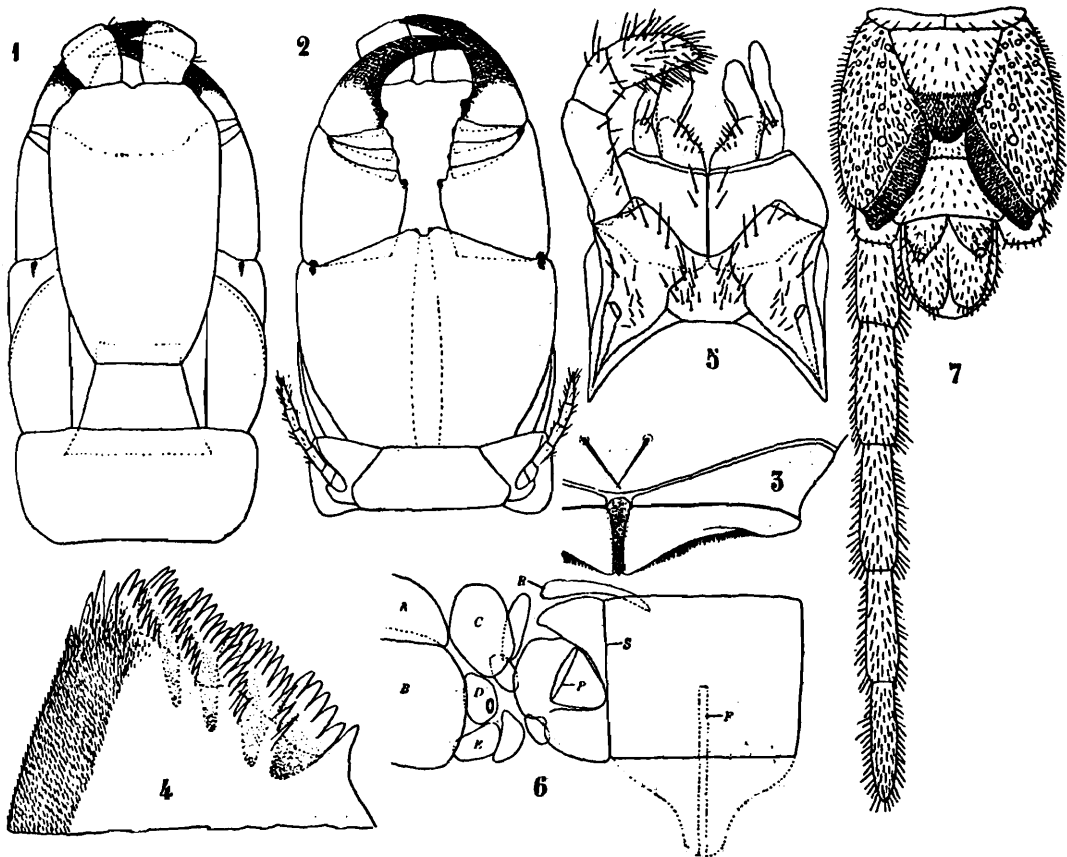


FIG. XXIV.—*Dicellyphilus anomalus*: 1. caput et segmenta primum et secundum prona: 2. eadem supina; 3. labrum; 4. mandibulae pars distalis; 5. maxillae primi et secundi paris; 6. tergiti decimi pars cum scutellis lateralibus et sterno: A = praetergitum, B = tergitum, C = praescutellum, D = scutellum spiraculiferum, E = postscutellum, F = furca, P = pes, R = praesternum, S = sternum; 7. feminae corporis pars postica supina.

Pedum paria 43; long. corp. ad mm. 60, lat. segmenti primi $2\frac{1}{4}$.

Habitat.—Exempla descripta a me ipso ad Lebanon, Oregon U.S.A., collecta fuerunt; Cl. Chamberlin ad Monterey Bay et Oroville, California, exempla typica legit.

Gen. *Prolamnonyx*, nov.

(Fig. XXV et XXVI).

Corpus postice parum attenuatum.

Lamina cephalica aliquantum longior quam latior sutura frontali reticulo microscopico, aliquantum minus distincto quam in

genere *Lamnonyx*, O. F. Cook, indicata, genarum angulo antico interno ad labrum in processum auctum producto, superficie antica sublaterali externa spina destituta.

Labrum tripartitum, parte mediana parum latiore quam in genere *Lamnonyx*; mandibulae laminis pectinatis nonnullis instructae; maxillae primi paris coxosterno integro malis simplicibus ut in *Lamnonyx*; maxillae secundi paris subcoxosterno medio linea diviso, palpo 3-articulato ungue destituta.

Lamina basalis ad basim latior quam longior, aliquantum minus lata quam eadem generis *Lamnonyx*.

Pedes maxillares flexi marginem frontalem superantes.

Tergita longitudinaliter bisulcata, praetergita sat magna, praetergito segmenti primi pediferi excluso quod perparvum est et inter latera laminae basalis postice vix manifestum.

Sterna antica sulco profundo postico impressa, praesterna media divisa et in segmentis 2-12 aliquantum disjuncta; praescutellum (paratergitum) magnum quam scutellum spiraculiferum majus, postscutellum scutello spiraculifero subaequali, scutella cetera vide fig. XXV, 8.

Segmentum ultimum pedigerum sterno bene evoluto, subcoxis poris numerosis instructis, pedibus, subcoxis, exclusis, 6-articulatis inermibus.

Pori anales duo.

Species typica: *Geophilus* (?) *holstii*, Pocock.

Observatio.—Genus hoc ad genus *Lamnonyx* proximum est, sed lamina cephalica brevior et spina antica sublaterali destituta, lamina basali aliquantum latiore, labri parte mediana parum latiore, palpo maxillari ungue destituta bene distinctum est; a gen. *Dicellogophilus* maxillae primi paris subcoxosterno integro, maxillae secundi paris subcoxosterno diviso et palpo maxillari ungue destituta; a gen. *Arrup*, Chamberlin mandibulis laminis pectinatis numerosis et maxillis primi paris subcoxis coalitis distinctum est.

Prolamnonyx holstii (Poc).

(Fig. XXV).

Geophilus (?) *holstii*, Pocock, *Ann. Nat. Hist.* (6) XV, p. 352, pl. xi, fig. 1, 1a (1895).

Mecistocephalus indecorus, Attems, *Zichy's Dritte asiat. Forschungsreise* II, p. 287, tab. ix, fig. 8-10 (1901).

Corpus ochroleucum capite ferrugineo.

Lamina cephalica c. 3/11 longior quam latior, superficie sparse punctata et postice sulcis duobus submedianis parum profundis impressa. Antennae attenuatae ab articulo septimo setis gradatim parum magis numerosis et brevioribus instructae.

Labrum medium unidentatum margine cetero integro nudo; mandibulae laminis pectinatis 7, quarum prima 5-dentata, mediana 14-dentata, dentibus ab apice ad basim subaequalibus; maxillae primi et secundi paris setis vide fig. XXV, 5. Pedes maxillares paullum antice latioribus quam longioribus, margine medio an-

guste sinuato, dentibus submedianis bene evolutis acutis, articulo secundo c. $\frac{2}{5}$ externe longiore quam ad basim latiore dente uno apicali magno armato, articulis tertio et quarto inermibus, ungue terminali attenuato, sat arcuato, subacuto, ad basim dente tuberculiformi aucto.

Sterna antica sulco mediano, aliquantum longe a margine antico incipiente, impressa, sparse et breviter setosa.

Pedes primi paris quam secundi c. $\frac{1}{4}$ breviores, pedes ambulatorii omnes hirtelli ungue terminali sat longo, robusto.

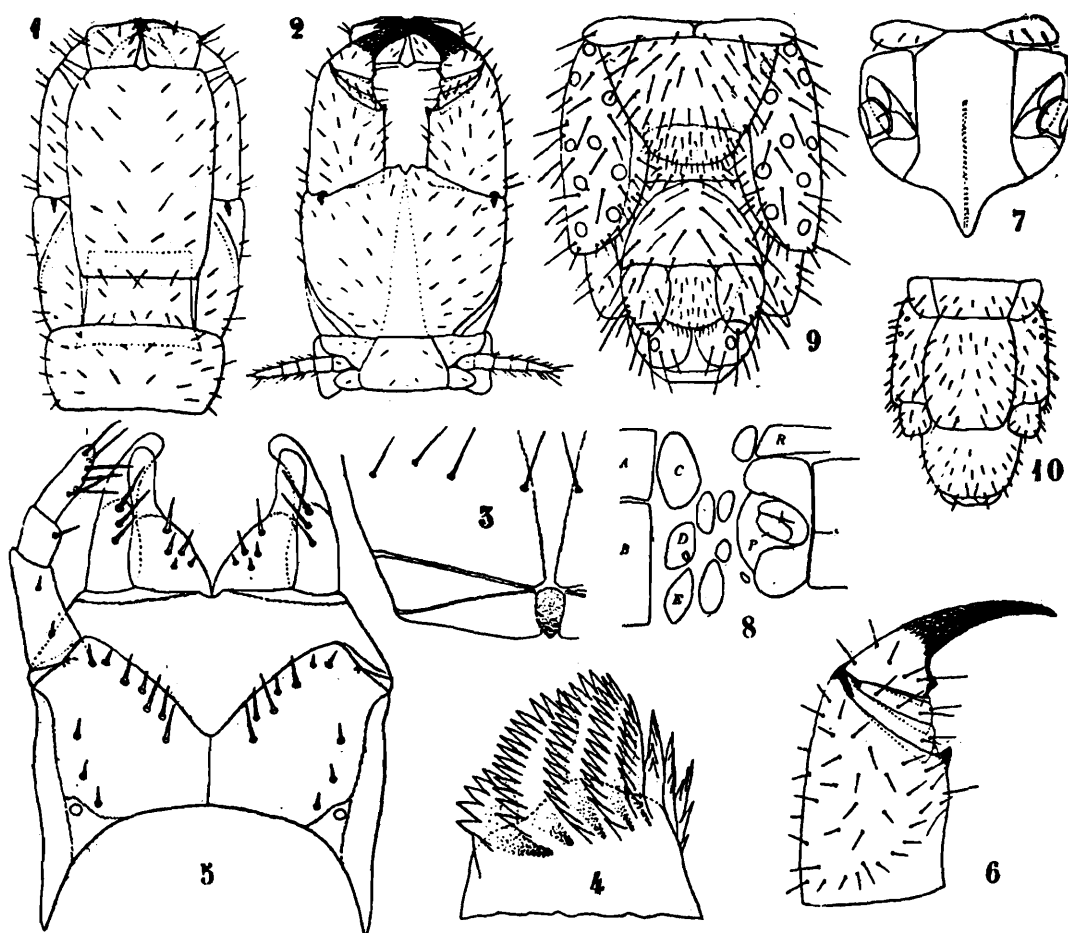


FIG. XXV.—*Prolamnonyx holstii*: 1. caput et segmenta primum et secundum prona; 2. eadem supina; 3. labrum; 4. mandibulae pars distalis; 5. maxillae primi et secundi paris; 6. pedis maxillaris articuli 2-5; 7. sternum decimum; 8. tergiti decimi pars cum scutellis lateralibus et sterni pars: litterae ut in figura praecedente; 9. maris pars postica supina; 10. eadem prona.

Segmentum praegenitale sternito trapezoideo, postice parum magis setoso, subcoxis poris c. 20-25 subtus et per latus externum instructis, pedibus quam praecedentes c. $\frac{2}{7}$ longioribus, crassiusculis, gradatim attenuatis.

Mas feminae similis.

Pedum paria 41; long. corp. ad mm. 19 (—33), lat. segmenti primi 0.8 (—1.5).

Habitat.—Japonia: Kamatura; exempla a me descripta haud bene adulta sunt. Exemplum typicum a Pocock descriptum ex Ashinoju, Japonia, et exemplum typicum ab Attems ut *Mecistoce-*

phalus indecorus descriptum (long. corp. mm. 32, lat. 1.5) ex Peking, China.

***Prolamnonyx sauteri*, sp. n.**

(Fig. XXVI).

Mecistocephalus smithi, Pocock, *Ann. Nat. Hist.* (6) XV, p. 251 (1895).

Corpus (capite incluso) ochraceo-testaceum.

Lamina cephalica fere $2/7$ longior quam latior, superficie sparse et sat grosse punctata, postice sulcis duobus submedianis parum profundis punctatis impressa. Antennae attenuatae ab

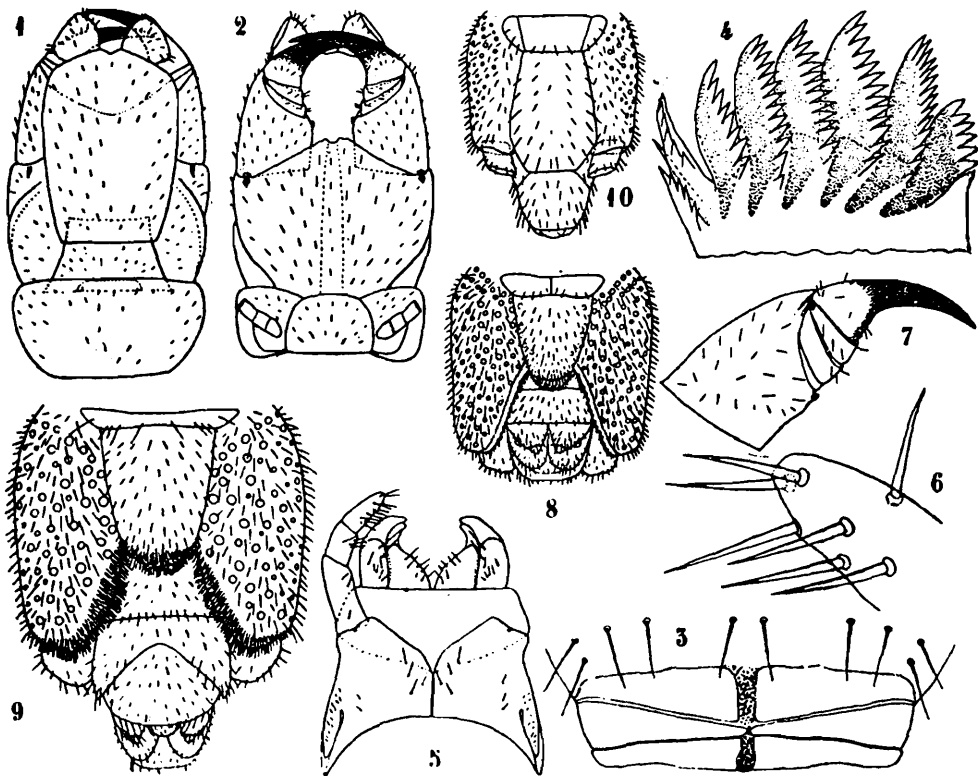


FIG. XXVI.—*Prolamnonyx sauteri*: 1. caput et segmenta primum et secundum prono; 2. eadem supina; 3. labrum; 4. mandibulae pars distalis; 5. maxillae primi et secundi paris; 6. palpi maxillaris apex; 7. pedis maxillaris articuli 2-5? 8. feminae pars postica supina; 9. maris pars postica supina; 10. eadem prona.

articulo quarto setis gradatim magis numerosis et brevioribus instructae.

Labrum medium edentatum (an semper?, exemplo uno observato) margine cetero subrecto, nudo; mandibulae laminae pectinatis 8, quarum prima 6-dentata, mediana 14-dentata, dentibus subaequalibus; maxillae primi et secundi paris vide fig. XXVI, 5.

Pedes maxillares flexi marginem frontalem parum superantes, subcoxis parum antice latioribus quam longioribus superficie punctis sat numerosis impressa, margine antico medio parum sinuato, dentibus submedianis perparvis, articulo secundo dente apicali

tantum armato, articulis tertio et quarto inermibus, ungue terminali sat arcuato, attenuato, acuto basi inermi.

Sterna antica sulco profundo postico instructa.

Pedes primi paris quam secundi c. $\frac{1}{4}$ breviores, pedes omnes hirtelli ungue terminali, brevi, robusto.

Segmentum praegenitale sterno longo trapezoideo, postice rotundato et setis magis numerosis brevioribus instructo, subcoxis undique poris numerosis sat magnis et nonnullis parvis instructis, pedibus quam praecedentes fere duplo longioribus, crassiusculis gradatim attenuatis, setis brevibus numerosis instructis.

Pedum paria 41; long. corp. ad mm. 47, lat. segmenti primi 2.

Mas feminae similis, segmento ultimo pedigero subtus parum magis setoso.

Habitat.—Formosa: Kosempo (*H. Sauter*).

Observatio.—Species haec a specie praecedenti magnitudine et praesertim pedum maxillarium unguis basi inermi et segmenti ultimi pedigero sterno longiore facile distinguenda est.

Subfam. *ORYINAE*.

Gen. *Pentorya*, O. F. Cook.

Pentorya indica, sp. n.

(Fig. XXVII).

Corpus antice et postice parum attenuatum, pallide fulvum.

Lamina cephalica subsemiliptica, aliquantum ad basim latior quam longior, minute et sparse punctata. Antennae breves, quam lamina cephalica minus quam duplo longiores, aliquantum depressae et attenuatae.

Labrum integrum margine serratim pectinato et lateraliter dentibus nonnullis magis attenuatis et inter sese aliquantum remotis instructo; mandibulae lamina dentata et laminis pectinatis 8 arnatae; maxillae primi paris subcoxis externe processu palpi-formi sat longo instructis, mala externa haud distincte divisa et processu palpi-formi brevi instructa, mala interna quam externa parum minori; maxillae secundi paris palpo, ungue incluso, 4-articulato, ungue margine interno et margine supero interno setis pectinis instar dispositis instructo.

Lamina basalis brevis perlata, lateribus parum convergentibus; lamina praebasalis indiscreta. Pedes maxillares flexi marginem frontalem attigentes, subcoxis latis et brevioribus, lineis chitineis nullis, margine antico vix sinuato, inermi, articulis sequentibus inermibus, ungue terminali longo, attenuato, bene arcuato.

Segmenta praetergito sat parvo, tergito (posttergito) poris nonnullis submedianis et aliis sublateralibus, ut fig. XXVII, 10 demonstrat, instructis, inter praescutellum et tergum parascutello

integro subrectangulari externo et parascutellis duobus internis, quorum anticum quam posticum minus est, instructa; praescutellum et scutellum spiraculiferum poris sat numerosis instructa; stigmata longa; sterna primo excluso, quod area parva porosa instructum est, areis quatuor anticis, quarum externae minores sunt et areis duabus posticis latis instructa; parasterna etiam antice et postice area porosa aucta; praesterna parva media valde angustata.

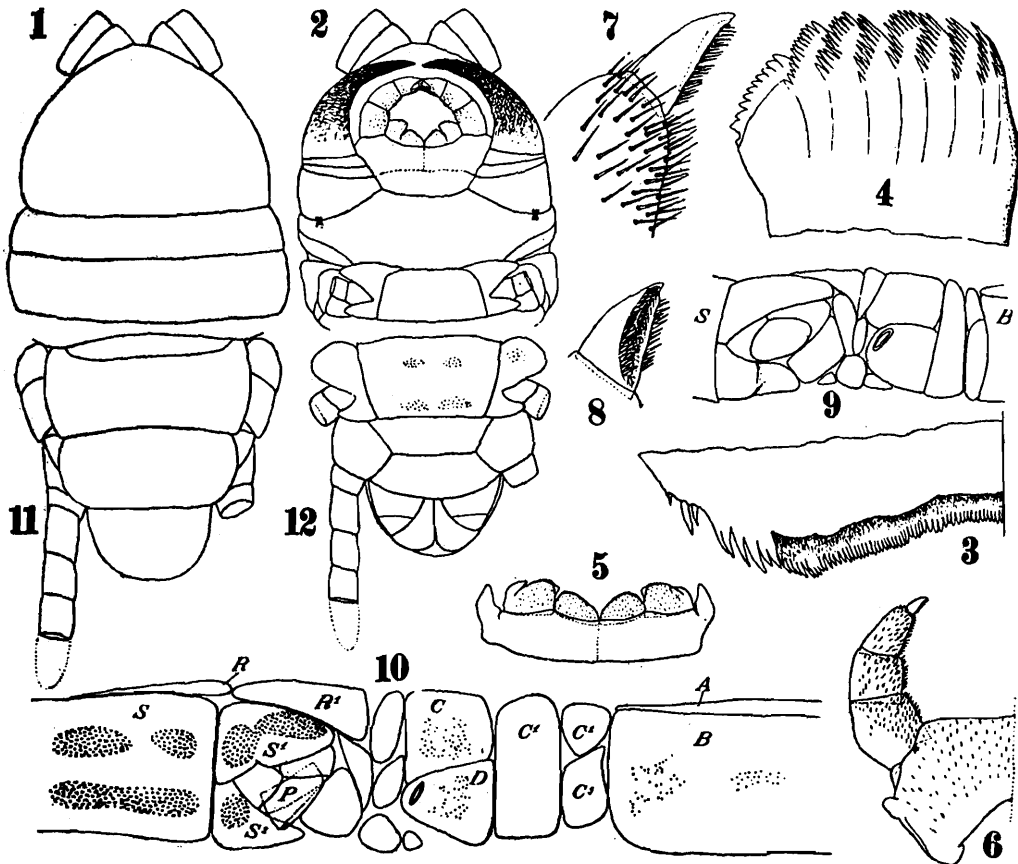


FIG. XXVII.—*Pentorya indica*: 1. caput et segmenta primum et secundum prona; 2. eadem prona; 3. labri dimidia pars; 4. mandibulae pars distalis; 5. maxillae primi paris; 6. maxillarum secundi paris dimidia pars; 7. palpi maxillaris pars apicalis subtus inspecta; 8. ejusdem unguis supra inspectus; 9. segmenti 40ⁱ pars lateralis; 10. segmenti 100ⁱ pars lateralis extensa cum dimidia pars tergalis et dimidia pars sternalis; 11. corporis pars postica prona; 12. eadem supina.

A = praetergitum, B = posttergitum, C = praescutellum, C¹-C³ = paratergita; D = scutellum spiraculiferum; P = pedis basis; R = praesternum; S = sternum; S¹-S² = parasterna.

Segmentum ultimum pediferum sterno brevior, lato, lateribus convergentibus, margine postico truncato, subcoxis parvis, poris nullis, pedibus in exemplo typico haud integris, subcoxis exclusis, articulis quatuor forsitan articulo ultimo tanto abrupto et a me verisimiliter 5-articulatis et inermibus consideratis, quare species haec ad genus *Pentorya*, O. F. Cook a me relata est.

Pedum paria 141; long. corp. mm 186; lat. corporis 5.5.

Habitat.—South India: Ootacamund, Nilgiri Hills (*Beddome*).

Subfam. *HIMANTARIINAE*.***Polyporogaster*, Verh.**

(Figs. XXVIII—XXX).

Polyporogaster, Verhoeff, *Zool. Anz.* XII, p. 364 (1899); Attems, *Zool. Jahrb.* XVIII, p. 182 (1903); Verhoeff, Bronn's *Klass. u. Ord. Chilopoda*, p. 291 (1908.)

Corpus antice et postice paullum attenuatum.

Lamina cephalica aliquantum latior quam longior sutura frontali haud distincta, pedes maxillares obtegens. Antennae plus minusve attenuatae.

Labrum integrum, sinuatum medium laeve, lateraliter parum profunde dentatum; mandibulae lamina dentata et laminis pectinatis tribus instructae; maxillae primi paris mala interna parva simplici, mala externa biarticulata processibus palpiformibus nullis; maxillae secundi paris palpo (praeter subcoxis) 4-articulato, articulo ultimo unguiformi, brevi subtus ad basim processibus duobus brevioribus setiformibus aucto.

Lamina basalis latior, perbrevis, lateribus parum convergentibus, lamina praebasalis obtecta. Pedes maxillares flexi marginem frontalem haud attingentes, subcoxis lineis chitineis manifestis antice inermibus, articulis sequentibus etiam inermibus, ungue terminali sat longo.

Tergita haud distincte sulcata praetergito sat magno, paratergito primario (praescutello) magno, secundario parvo, scutello spiraculifero quam praescutello (paratergito primario) minore, scutellis ceteris vide fig. XXVIII, 3. Sterna praeter sternum praegenitale area porosa instructa, praesterno medio plus minusve manifeste diviso.

Pedes ungue simplici, parum curvato, seta basali brevi instructo.

Segmentum praegenitale sterno sat parvo, subcoxis sat parvis, supra fovea interna, poris numerosis instructa, auctis, subtus et lateraliter poris nullis, pedibus, praeter subcoxas, 6-articulatis, ungue nullo; maris pedibus quam idem feminae crassioribus. Appendices genitales biarticulatae. Pori anales nulli.

Pedum paria ad 95.

Species typica: *P. tunetanus*, Verh. Tunisia.

Praeter speciem typicam species quatuor asiaticae mihi notae sunt, ita distinguendae:

1. Sternorum area porosa (ad medium corpus) c. $\frac{1}{3}$ sterni latitudinem aequans vel minor.
3. Area porosa dicta c. sterni dimidium latitudinem aequans *P. geminatus*,¹ Silv.
4. Area porosa dicta c. $\frac{1}{3}$ sterni latitudinem aequans.
5. Segmenti ultimi pediferi sternum parvum subtrapezoideum; pedum paria 69-75 ... *P. insignis* (Mein.)

¹ *Polyporogaster geminatus* = *Mesocanthus geminatus*, Silv., *Zool. Anz.* XVIII, p. 179 (1895), Transkaspien: Askabat. *Mesocanthus porosus*, Sseliw., *Turkenst. Stan. Obsch. Antrop. i Etn.* XXXVII, p. 217 (1881), Turkestan, generi *Polyporogaster* etiam pertinet.

6. Segmenti ultimi pediferi sternum sat magnum, transverse subrectangulare, postice aliquantum sinuatum; pedum paria 81-97 ... *P. sinuatus*, sp. n.
 2. Sternorum area porosa (ad medium corpus) c. 3/5 sterni latitudinem aequans ... *P. indicus* (Mein.)

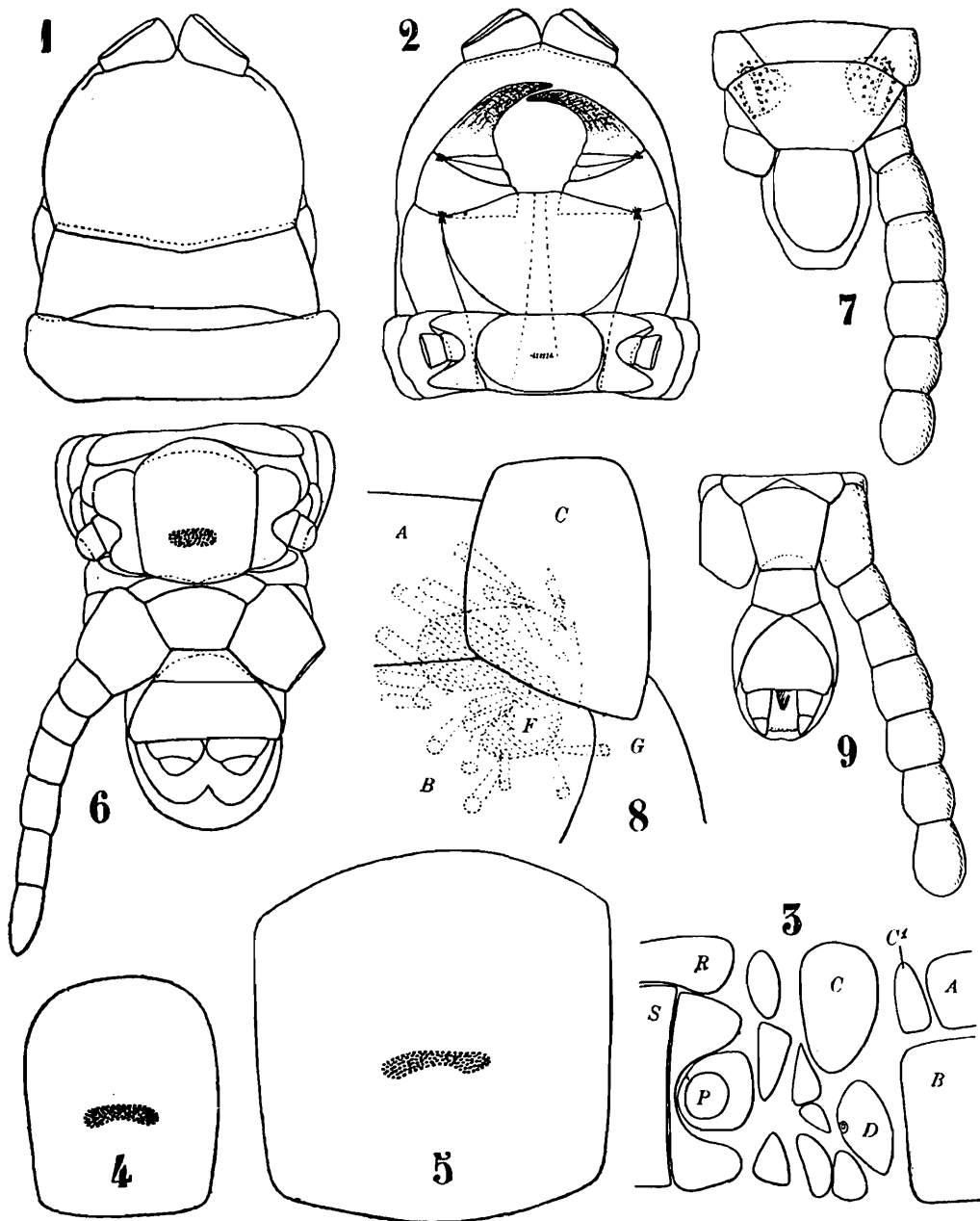


FIG. XXVIII.—*Polyporogaster insignis*: 1. caput et segmentum primum et secundum prona; 2. eadem supina; 3. segmenti 20ⁱ pars lateralis extensa (litterae ut in fig. praecedente); 4. sternum 40^{um}; 5. sternum 40^{um} exempli alii; 6. feminae corporis pars postica supina; 7. maris corporis pars postica prona; 8. fovea pororum segmenti ultimi pediferi multo ampliata: A = praetergitum, B = posttergitum, C = paratergitum, G = subcoxa; 9. maris pars postica supina.

***Polyporogaster insignis*, Mein.**

(Fig. XXVIII).

Himantarium insigne, Meinert, *Pr. Am. phil. Soc.* XXXIII, p. 227 (1885).

♀ Corpus antice parum postice parum magis attenuatum, testaceo-latericium.

Lamina cephalica aliquantum latior quam longior lateribus anticis convexis. Antennae quam laminae cephalicae latitudo minus quam duplo longiores, basi contiguae, cetero gradatim attenuato, articulo sexto c. $\frac{1}{3}$ latiore quam longiore, articulo ultimo c. $\frac{1}{3}$ longiore quam ad basim latiore.

Pedes maxillares flexi marginem frontalem spatio magno haud attingentes, subcoxae parte detecta c. duplo latiore quam longiore, antice vix sinuatis inermibus, articulis sequentibus omnibus inermibus; primo fere duplo ad basim latiore quam externe longiore, margine interno quam externus fere dimidio brevior, articulis 2^o et 3^o brevioribus, articulo 4^o attenuato, sat arcuato, integro, acuto.

Sternitum primum area porosa parva, sternita cetera area porosa transversali gradatim majore, in medio corporis fere sterniti latitudinis tertiam partem aequante, antice paullum convexa, postice parum concava.

Pedes breves articulo penultimo quam praecedens paullum longiore, ungue robusto spina basali brevior.

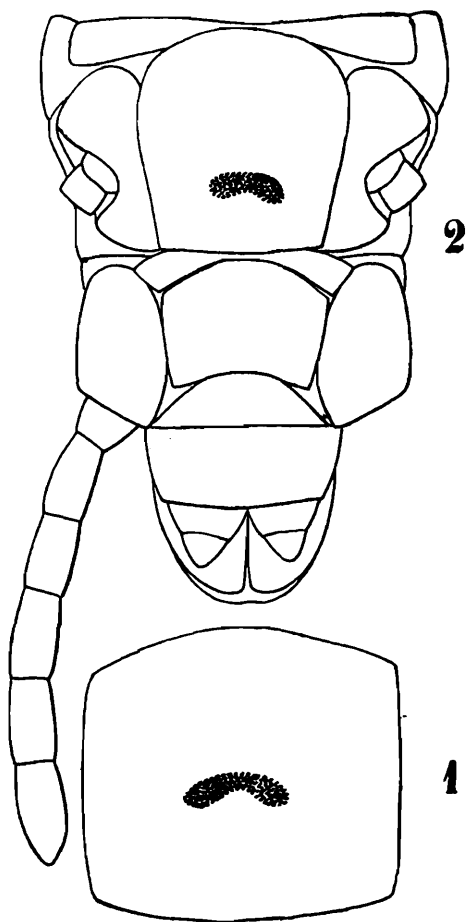


FIG. XXIX.—*Polyporogaster sinuatus*: 1. sternum 40 μ m; 2. feminae corporis pars postica supina.

Segmentum praegenitale sternito angusto, trapezoideo, ♂ pedibus quam paris praecedentis aliquantum longioribus et multo crassioribus, subcoxis supra (subtergito) fovea magna poris glandularibus numerosis instructa auctis, articulis ceteris brevibus et latis, articulo ultimo apice convexo.

Pedum paria ♀ 69, ♂ 75; long. corp. mm. 72, lat. 2.5.

Habitat.—N.W. Kashmir; Bijnor, United Provinces. Exempla typica a Cl. Meinert descripta ad Kulu collecta erant.

Polyporogaster sinuatus, sp. n.

(Fig. XXIX).

♀ Corpus pallide ochraceum.

Sternitum primum area porosa parva (poris c. 25), sternita cetera area porosa transversali submediana, antice convexa postice concava, tertiam partem sterniti latitudinis occupante instructa.

Segmentum praegenitale, sternito brevi, lato, subrectangularem postice parum sinuatum, pedibus

quam paris praecedentis paullo crassioribus, subcoxarum poris superis numerosis.

Pedum paria 81-97; long. corp. mm. 95, lat. 2.

Habitat.—N. Baluchistan (*Maynard and MacMahon*).

Observatio.—Species haec a *Polyp. insignis* (Mein) segmentorum numero, sterni segmenti ultimi pediferi forma et sternorum area porosa magis concava distinguenda est.

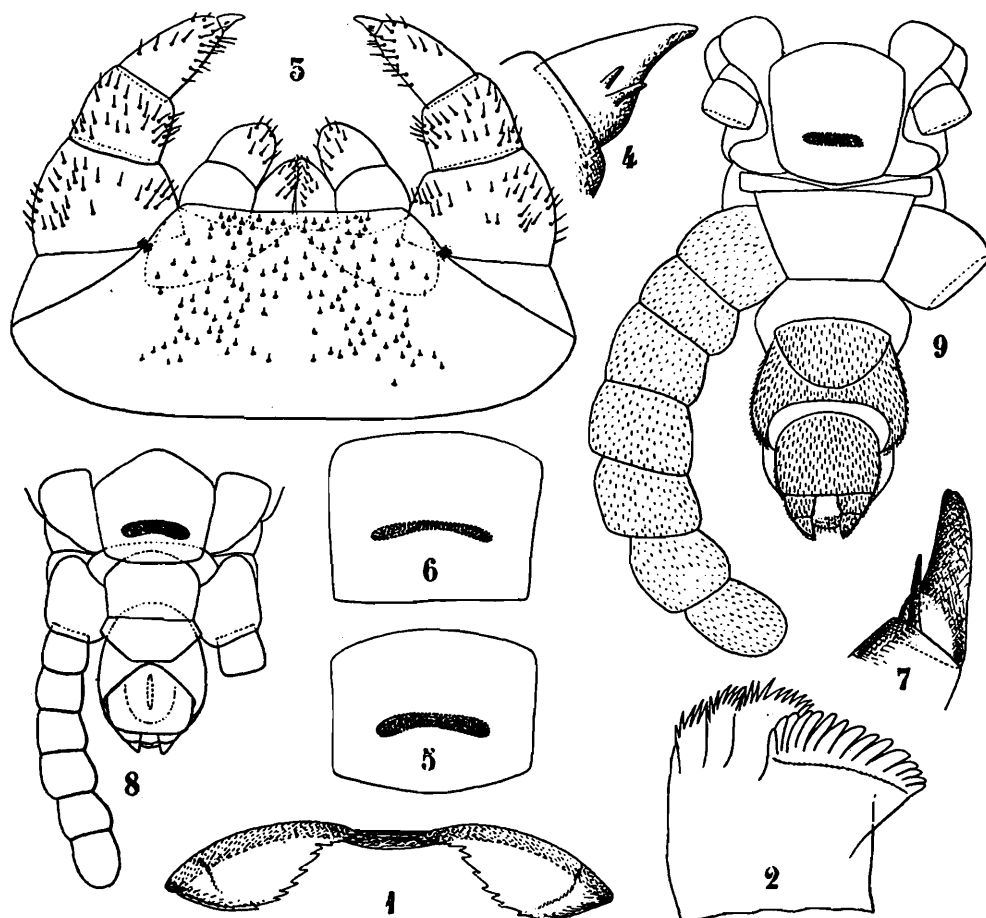


FIG. XXX.—*Polyporogaster indicus*: 1. labrum; 2. mandibulae pars distalis; 3. maxillae primi et secundi paris; 4. palpi maxillaris apex subtus inspectus; 5. sternum 40 μ m; 6. sternum 40 μ m exempli alii; 7. pedis apex; 8. maris corporis pars postica supina; 9. maris alii corporis pars postica supina.

Polyporogaster indicus (Mein.)

(Fig. XXX).

Himantarium indicum, Meinert, *Pr. Am. phil. Soc.* XXXIII, p. 228 (1885.)

♀ Corpus testaceo-latericium

Sternitum primum area porosa parva, sternita cetera area porosa transversali submediana gradatim majore, in medio corpore c. 3/5 sterniti latitudinem occupante antice paullum convexa, postice parum concava.

Segmentum praegenitale sterno transverse subrectangulari vel lateribus parum convergentibus, pedibus quam paris praecedentis parum crassioribus et parum longioribus.

Segmenti praegenitalis sternitum lateribus parum convergentibus, pedibus quam paris praecedentis multo crassioribus et fere duplo longioribus.

Pedum paria 69-83; long. corp. ad mm. 85, lat. 2.2.

Habitat.—India: Hurdwar, United Provinces; Theog, Simla Hills, 8,000 ft. (*Annandale*); Leh, Ladakh; Murree, W Himalayas (*Stoliczka*); Kiari, Naini Tal distr; Karwarpani, sal forests; W. Dun; Kalka, base of Simla Hills, 2,400 ft (σ p.p. 77); near Badrinath, British Garhwal, 10,600 ft. (*A. D. Imms*, 1 ♀ 75, 1 ♂ 71, 1 juvenis 77); Bagarkote, 8,000 ft., Kumaon, W Himalayas.

Exempla a Cl. Meinert descripta ad Kulu a Rev. Mr. Carleton collecta erant.

Gen. *Mesocanthus*, Mein.

(Figs. XXXI—XXXIV).

Mesocanthus, Meinert, *Naturh. Tids.* VII, p. 34 (1870); Attems, *Zool. Fahrh. Syst.* XVIII, p. 206; Verhoeff, *Bronn's Klass. u. Ord. Chilopoda*, p. 294 (1908).

Corpus angustum antice parum, postice parum magis attenuatum.

Lamina cephalica latior quam longior, pedes maxillares obtegens, sutura frontali indistincta. Antennae attenuatae.

Labrum sinuatum, medium laeve, lateraliter parum profunde dentatum; mandibulae lamina dentata et laminis pectinatis quatuor instructae; maxillae primi paris mala interna triangulari, mala externa integra processis palpiformibus nullis; maxillae secundi paris palpo (praeter subcoxas) 4-articulato, articulo ultimo unguiformi perparvo, nudo.

Lamina basalis perlata, brevis, transverse subrectangularis, lamina praebasalis obtecta. Pedes maxillares subcoxis lineis chitineis manifestis, margine antico et margine interno articularum sequentium inermibus, ungue terminali sat magno et sat arcuato.

Tergita sulcis indistinctis, praetergito sat magno, paratergito secundario parvo, paratergito primario magno quam scutellum spiraculiferum multo majus, scutellis ceteris vide fig. XXXI, 7. Sterna a primo ad penultimum area porosa instructa, praesterno medio plus minusve manifeste diviso.

Pedes ungue terminali parum arcuato et utrimque seta brevi basali instructo.

Segmentum praegenitale sterno parvo medio profunde sulcato vel non, tergito lato, subcoxis poris destitutis, pedibus, praeter subcoxas, 6-articulatis ungue destitutis crassiusculis, in mare crassioribus.

Observatio.—Genus hoc a gen. *Polyporogaster*, Verh. segmenti ultimi pediferi subcoxis supra poris haud instructis distinctum est.

Appendices genitales biarticulatae.

Pori anales nulli.

Pedum paria ad 91.

Typus: *Mesocanthus albus*, Mein.

CONSPECTUS SPECIERUM.

- | | | |
|--|--------|--|
| 1. Sternum primum poris destitutum, sterno segmenti ultimi pediferi medio sulcato | | <i>M. albus</i> v. <i>minuta</i> , Brölem. |
| 2. Sternum primum poris instructum, sterno segmenti ultimi medio haud sulcato. | | |
| 3. Area porosa in medii corporis sternito quam eorumdem sternitorum latitudo parum minus lata; corporis pedum paria 81 | | <i>M. perporosus</i> , sp. n. |
| 4. Area porosa in medii corporis sternitis quam eorumdem sternitorum latitudo c. $\frac{2}{5}$ minus lata. | | |
| 5. Corporis pedum paria 69-73; corpus parum angustum | | <i>M. discretus</i> , sp. n. |
| 6. Corporis pedum paria 57-59; corpus angustius | | <i>M. brevis</i> , sp. n. |

Mesocanthus albus, Mein. var. *minuta*, Brol.

(Fig. XXXI).

Brölemann, *Boll. Soc. ent. ital.* XXXV, p. 116 (1903).

The characters of the species are comprised in that of the genus and demonstrated by the figures.

The variety is certainly distinct from the typical form, as represented by *M. albus*, Mein. from Tunis (North Africa), especially on account of the number of legs, which reach 85-73 in specimens from Erythrea and 71-79 in specimens from India, instead of 87-91 as in specimens from Tunis.

The specimens preserved in the Indian Museum and referred by me to the named form are the following: 2 ♀ near Bombay, p.p. 75; 1 ♀ Nowgong, Central Provinces, p.p. 77, long. corp. 57, lat. 1.4; 1 ♀ Kach, W India, p.p. 79; 1 ♂, Beyt, Dwarka, Kathiawar, p.p. 73; 1 ♀ near stream, Dakar Hill near Junagadh, Kathiawar, p.p. 81; 1 ♀ Khas, Satara distr., c. 3,700 ft, p.p. 75; 2 ♂ Sasan, Kathiawar, p.p. 71 and 73.

Mesocanthus brevis, sp. n.

(Fig. XXXII).

Corpus luride testaceum capite parum obscuriore.

Lamina cephalica aliquantum ad basim latior quam longior. Antennae basi contiguae gradatim attenuatae quam lamina cephalica longitudo fere duplo longiores. Pedes maxillares flexi marginem frontalem spatio sat longo haud attingentes, articulis inermibus, articulo ultimo unguiformi arcuato, acuto.

Sternitum primum area submediana transversali porosa parva instructum, sternita cetera area porosa transversali submediana antice late convexa postice media plus minusve concava c. $\frac{3}{5}$ sterniti latitudinem occupante instructa.

Pedes breves, articulo sexto quam quintus $\frac{1}{3}$ longiore (ungue terminali robusto).

Segmentum ultimum pediferum lamina sternali brevi, trans-

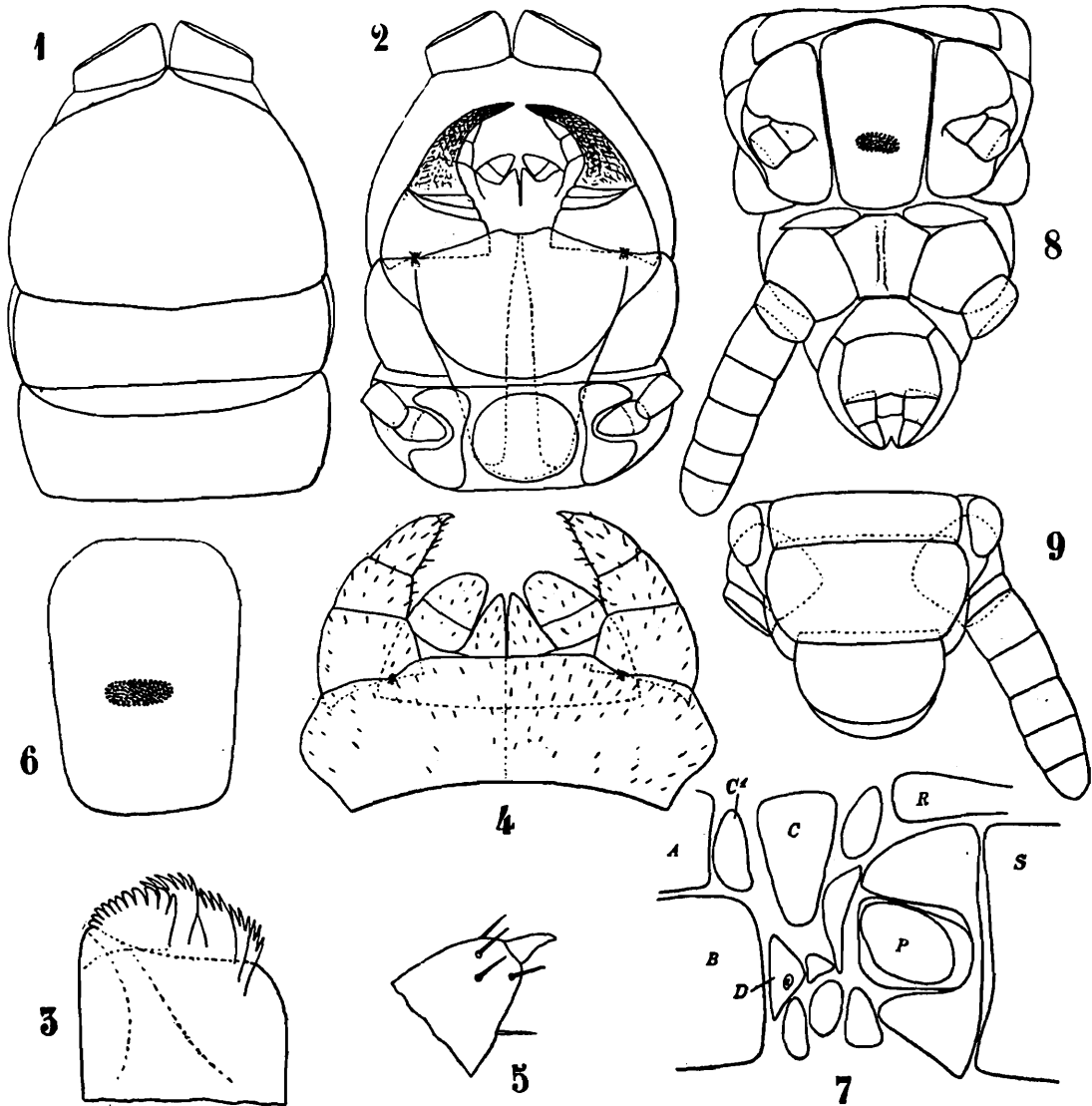


FIG. XXXI.—*Mesocanthus albus* v. *minuta*: 1. caput et segmenta primum et secundum prona; 2. eadem supina; 3. mandibulae pars distalis; 4. maxillae primi et secundi paris; 5. palpi maxillaris pars distalis; 6. sternum $40\mu\text{m}$; 7. segmenti 4^{i} pars lateralis (litterae ut in fig. XXVII); 8. maris corporis pars postica supina; 9. eadem prona.

verse subrectangulari, ad basim fere duplo latiore quam longiore, pedibus quam paris praecedentis vix longioribus et vix crassioribus.

♂ Segmentum ultimum pediferum lamina ventrali subtrapezoidea parum ad basim latiore quam longiore, pedibus quam paris praecedentis multo crassioribus et aliquantum longioribus.

Pedes paria ♀ 57-59, ♂ 57; long. corp. mm. 35, lat. 1.

Habitat.—Tambi, Koyna Valley, Satara dist., c. 2,100 ft. (F. H. Gravely).

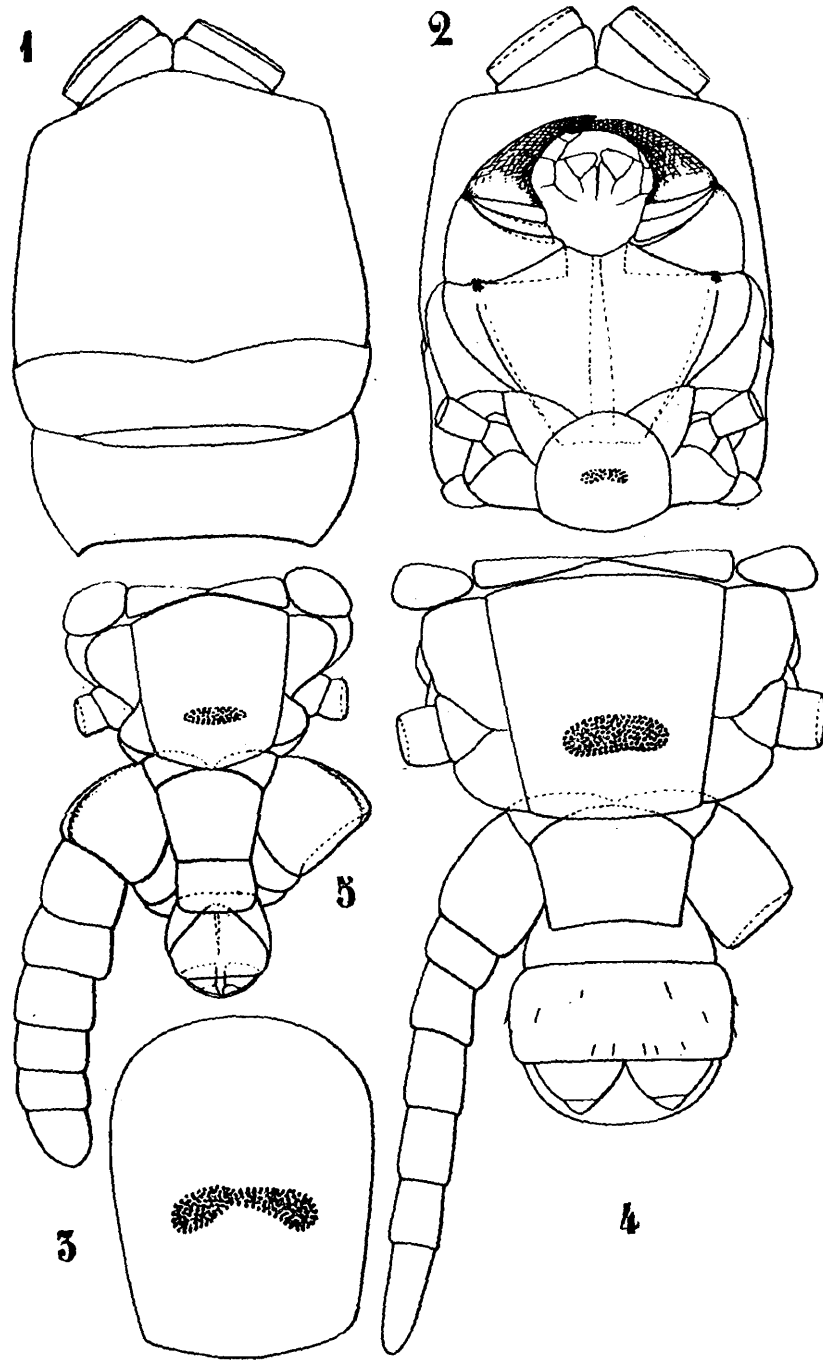


FIG. XXXII.—*Mesocanthus brevis*: 1. caput et segmenta primum et secundum prona; 2. eadem supina; 3. urosternum 40^{um}; 4. feminae corporis pars postica supina; 5. maris corporis pars postica supina.

***Mesocanthus perporosus*, sp. n.**

(Fig. XXXIII).

Corpus latericium, antice parum, postice parum magis attenuatum.

Sternitum primum area porosa trasversali parva, sternita cetera area porosa gradatim latiore, in medio corpore quam sterniti latitudo parum minus lata (= c. 11/14).

Segmentum ultimum pediferum sternito brevi, lato, transverse subrectangulari, pedibus quam paris praecedentis haud crassioribus paullum longioribus.

Pedum paria 81; long. corp. mm. 70, lat. 3.5.

Habitat.—Simla, W Himalayas (N Annandale).

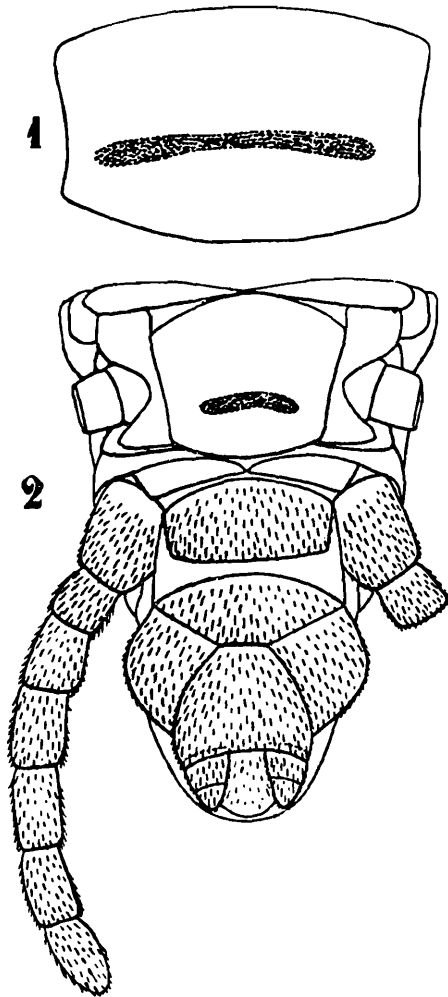


FIG. XXXIII.—*Mesocanthus perporosus*: 1. sternum 40 μ m; 2. maris pars postica supina.

Mesocanthus discretus, sp. n.

(Fig. XXXIV).

Corpus colore et forma eidem speciei praecedenti simile.

Sternita area porosa submediana transversali c. 3/5 sterniti latitudinis occupante et postice sinuata instructa.

Segmentum ultimum pediferum sternito brevi, transverse subrectangulari, pedibus quam paris praecedentis aliquantum longioribus et parum crassioribus.

Segmenti ultimi pediferis pedes crassiores.

Pedum paria ♀ et ♂ 69-73; long. corp. ad mm. 42, lat. 1.6.

Habitat.—Almora, 5,500 ft., Kumaon (*Paiva*); Siripur.

Observatio.—Species (vel subspecies) haec a praecedente corpore minus angusto pedum paribus magis numerosis distincta est.

Subfam. GONIBREGMATINAE.

Gen. *Himantosoma*, Poc.

(Figs. XXXV—XXXVII).

Himantosoma, Pocock, *Ann. Mus. Genova* XXX, p. 428 (1891); Attems, *Zool. Jahrb.* XVIII, p. 286 (1903); Verhoeff, *Bronn's Klass.u. Ordn. Chilopoda*, p. 274 (1908).

Corpus paullum antice, parum postice attenuatum.

Lamina cephalica parum latior quam longior, partem lateralem posticum pedum maximallarum spatio perparvo haud obtegens, sutura frontali male distincta. Antennae haud attenuatae vix crassatae.

Labrum integrum appendice setoliformibus longis instructum; mandibulae margine distali tantum pectinato; maxillae primi paris subcoxis haud coalitis, mala interna parva, mala externa biarticulata articulo primo perbrevis et supra enterne processu palpi-formi ut subcoxa instructo instructa; maxillae secundi paris subcoxis coalitis palpo, praeter subcoxam, 4-articulato, longo antorsum ad frontis marginem directo articulo ultimo subunguiformi interne pectinato.

Lamina basalis perbrevis, lata, capitis latitudinem paullum

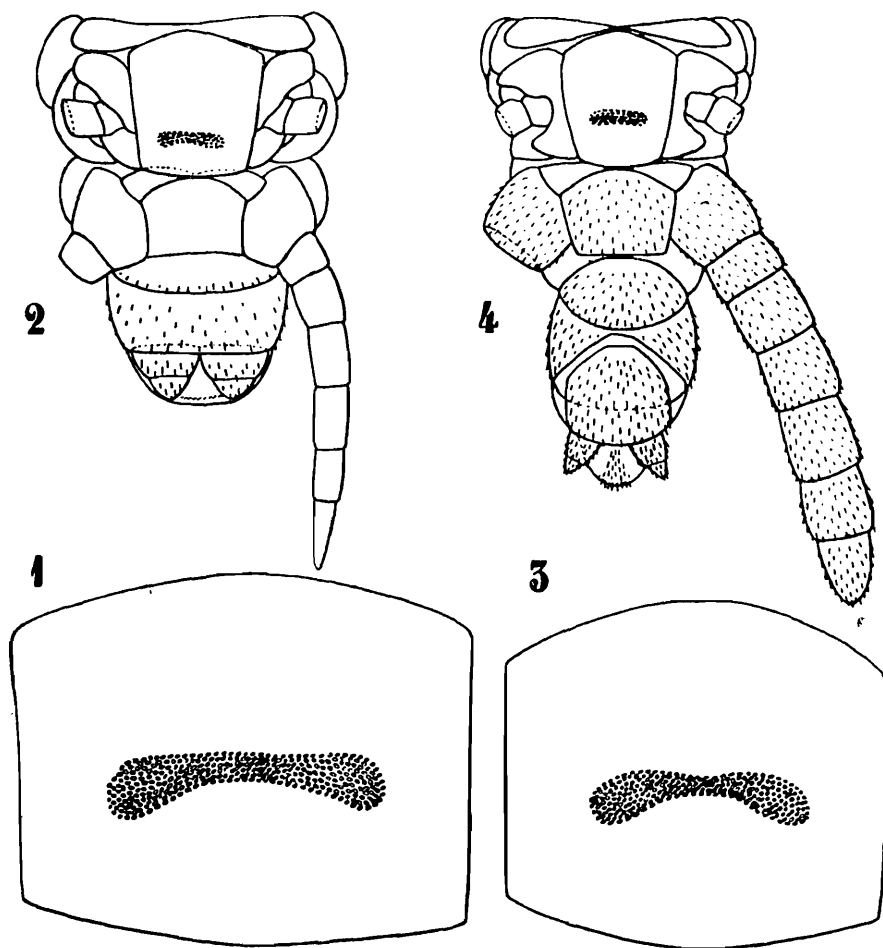


FIG. XXXIV.—*Mesocanthus discretus*: 1. feminae urosternum $40\mu\text{m}$; 2. feminae corporis pars postica supina; 3. maris sternum $40\mu\text{m}$; 4. maris pars postica supina.

superans, lamina praebasalis obtecta. Pedes maxillares flexi marginem frontalem haud superantes, lineis chitineis subevanidis margine antico et articulis ceteris inermibus, ungue terminali magni, attenuato.

Tergita haud distincte sulcata (an semper?), praetergito sat magno, praescutello magno, scutello spiraculifero sat parvo, scutellis ceteris vide fig. XXXV; 7. Sterna praesterno medio diviso; sternum primum area porosa parva postica, sternita cetera area porosa submediana parum lata et area porosa postica latiore interrupta vel non instructa.

Pedes ungue simplici, attenuato, parum arcuato et seta basali brevioris instructo.

Segmentum praegenitale sterno sat parvo, subcoxis aliquantum inflatis poris praesertim per superficiem inferam et superam internam numerosis parvis et perparvis, pedibus, prater subcoxas, 7-articulatis ungue incluso.

Appendices genitales biarticulatae.

Pori anales asunt.

Typus: *Himantosoma typicum*, Poc.

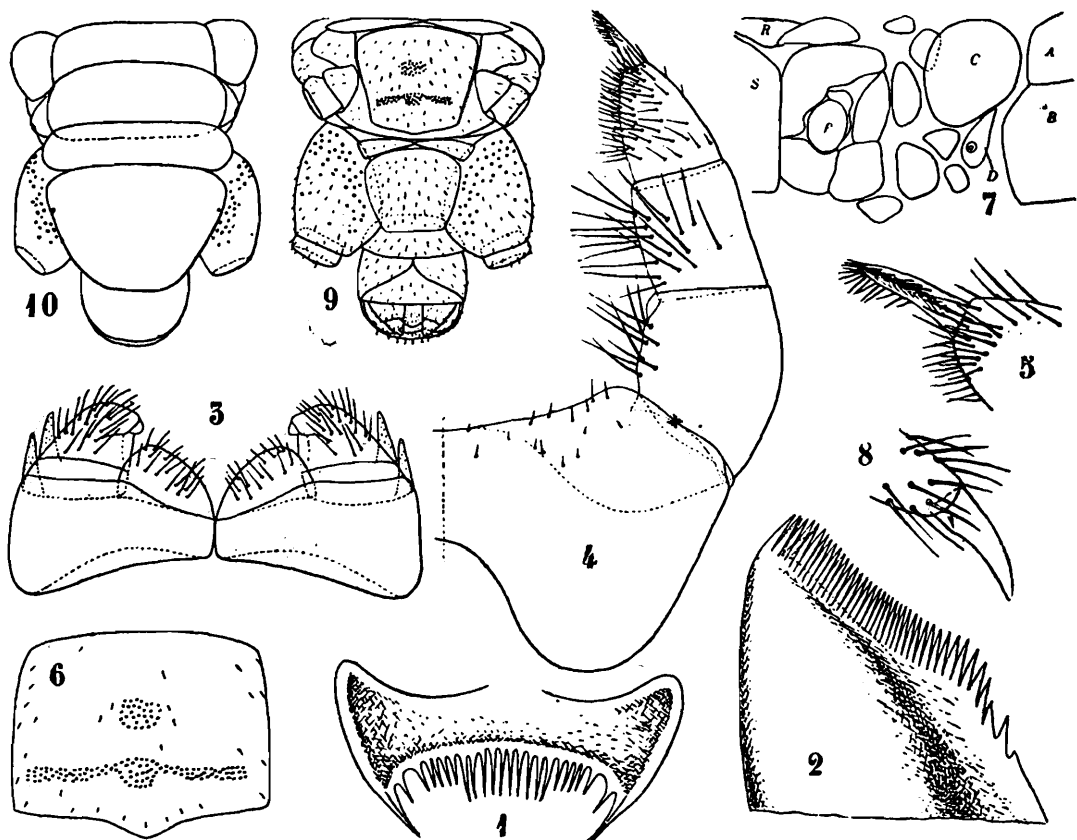


FIG. XXXV.—*Himantosoma typicum*: 1. labrum; 2. mandibulae pars distalis; 3. maxillae primi paris; 4. maxillarum secundi paris dimidia pars; 5. palpi maxillaris pars distalis; 6. sternum decimum; 7. segmenti decimi pars lateralis (litterae ut in fig. XXVII); 8. pedis decimi pars distalis; 9. maris corporis pars postica supina; 10. eadem prona.

Himantosoma typicum, Poc.

(Fig. XXXV).

Himantarium indicum, Pocock, *J. Linn. Soc.* XXI, p. 289, pl. xxiv, fig. 3 (1887) nec *Himantarium indicum*, Meinert.

Himantosoma typicum, Pocock, *Ann. Mus. Genova* XXX, p. 429 (1891).

♂ Corpus luride ochraceum. Lamina cephalica fere 1/4 postice latior quam longior; antennae parum attenuatae.

Pedes maxillares flexi marginem frontalem parum superantes ungue terminali perlongo, attenuato, parum arcuato.

Sternum primum area porosa parva postica, sterna cetera area porosa antica mediana subrotunda et area postica perlata in parte submediana attenuata instructa.

Segmentum ultimum pediferum sterno subtrapezoideo, subcoxis poris parvis numerosis subtus interne et antice, supra interne instructis, pedibus quam parvis praecedentis aliquantum crassioribus et paulum longioribus.

Pedes paria 63; long. corp. mm. 45, lat. segmenti primi 1.30.
Habitat.—Mergui Archipelago.

The description is based on a specimen in very poor condition preserved in the Indian Museum, originally referred by Pocock, on the suggestion of Meinert, to *Himantarium indicum* and subsequently taken by the same author as type of *Himantosoma typicum*. I have seen another specimen from Orissa and one from Sumatra: Si Rambè, which present little difference from *H. typicum*, and are considered for the present as varieties.

Himantosoma typicum, Pocock. var. tridivisa, nov.

(Fig. XXXVI).

Himantosoma porosum, Silvestri, *Ann. Mus. Genova*, XXXIV, p. 719 (1895) nec *Himantosoma porosum*, Pocock, *ibidem*, XXX, p. 31 (1891).

♀ Sterna a secundo ad penultimum area porosa transverse subovali et area porosa postica in parte submediana interrupta instructa. Superficies subcoxarum segmenti ultimi pediferi poris paucis inferis c. 18 sparsis et poris c. 8 superis instructa.

Pedum paria 59; long. corp. ad. mm. 22, lat. segmenti primi 0.75.

Habitat.—Sumatra: Si-Rambè.

Observatio.—Varietas haec a forma typica area porosa postica tridivisa et poris subcoxarum segmenti ultimi minus numerosis et etiam subtus postice sparsis distincta est.

Ab *Him. porosum*, Poc. poris subcoxarum segmenti ultimi minus numerosis saltem diversa est.

Himantosoma typicum, Poc. var. bidivisa nov.

(Fig. XXXVII).

♂ Corpus testaceo-latericium capite et segmentis duobus anticis testaceis, medio dorso fascia longitudinali angusta subtetacea, ventre umbrino, corporis parte postica subochracea.

Sterna a secundo ad penultimum area porosa antica mediana subrotunda vel subelliptica et area postica media divisa instructa.

Segmentum ultimum pediferum subcoxis poris praesertim subtus interne c. 18 et poro nonnullo sparso, nec non poris c. 25 supra interne instructis.

Pedum paria 79; long. corp. mm. 45, lat. segmenti primi 1.10.

Habitat.—Barkul, below 1,000 ft., Orissa (*Gravelly*).

Observatio.—Varietas haec a forma typica sternorum area postica porosa bidivisa et segmenti ultimi pediferi subcoxis poris minus numerosis bene distincta est.

Subfam. *EUCRATONYCHINAE*.Gen. *Eucratonyx*, Poc.

(Fig. XXXVIII).

Eucratonyx, Pocock in A. Willey, *Zoolog. Results, Loyalty Isl. etc.* p. 66, pl. vi, fig. 2-2c (1898); Attems, *Zool. Jahrb. XVIII*, p. 1917 (1903); Verhoeff, *Bronn's Klass. u. Ord. Chilopoda*, p. 288 (1908).

Corpus paullum antice et parum postice attenuatum.

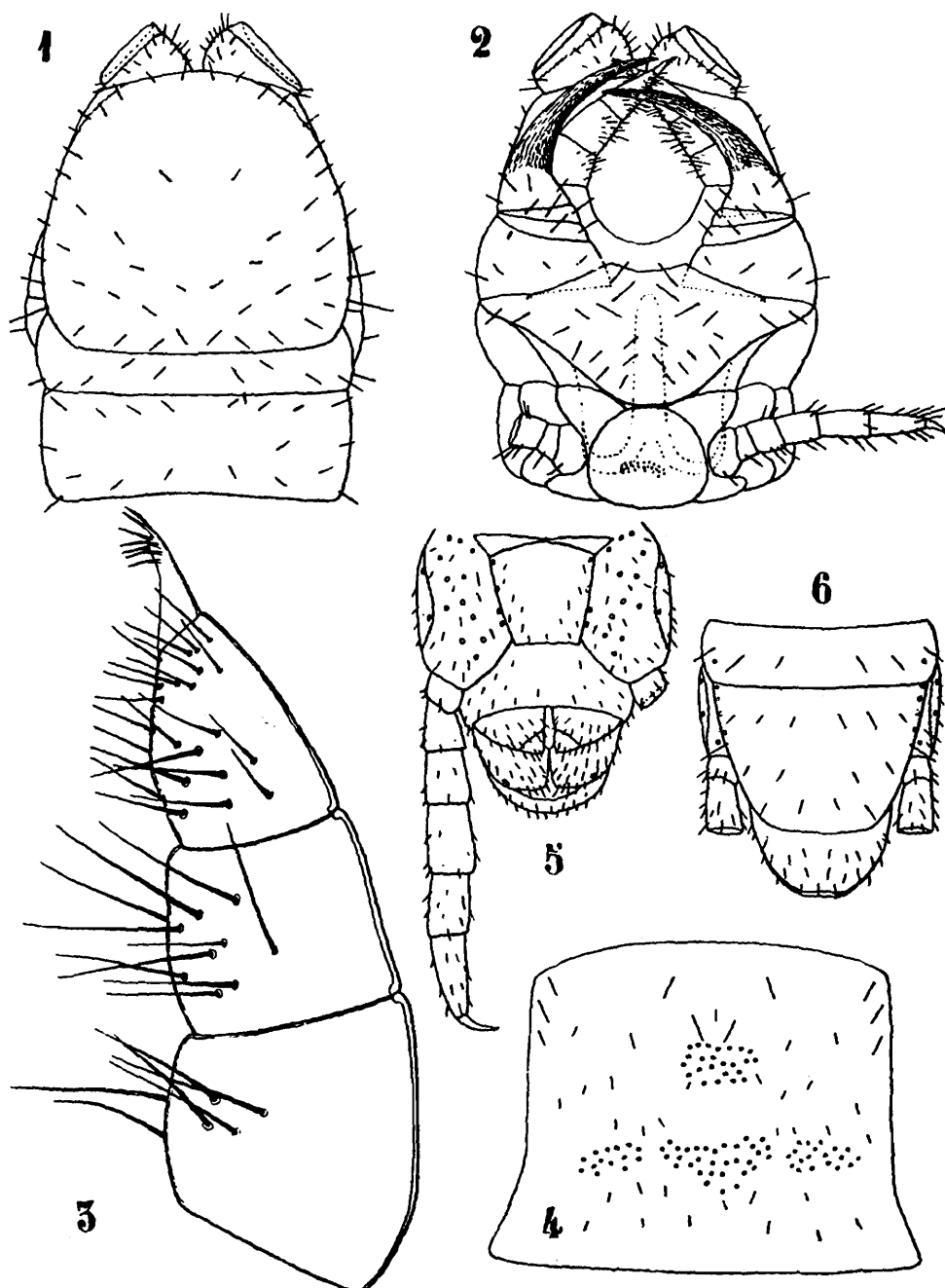


FIG. XXXVI.—*Himantosoma typicum* v. *tridivisa*: 1. caput et segmenta primum et secundum prona, 2. eadem supina; 3. palpus maxillaris; 4. sternum decimum; 5. feminae corporis pars postica supina; 6. eadem prona.

Lamina cephalica latior quam longior pedes maxillares obtegens, sutura frontali (saltem in *E. meynerti*) indistincta. Antennae

attenuatae. Labrum integrum processibus dentiformibus, sat longis, per marginem lateralem magis attenuatis instructum; mandibulae margine ipso per partem brevem internam dentato, per partem ceteram majorem pectinato sed haud lamella dentata et lamella pectinata distinctis instructo; maxillae primi paris mala externa biarticulata articulo primo supra externe processu palpi-formi instructo, subcoxis etiam externe processu palpi-formi instructis; maxillae secundi paris subcoxis coalitis, palpo (subcoxis exclusis) 4-articulato, articulo ultimo longo unguiformi setis marginalibus et setis inferis pectinis instar seriatis instructo.

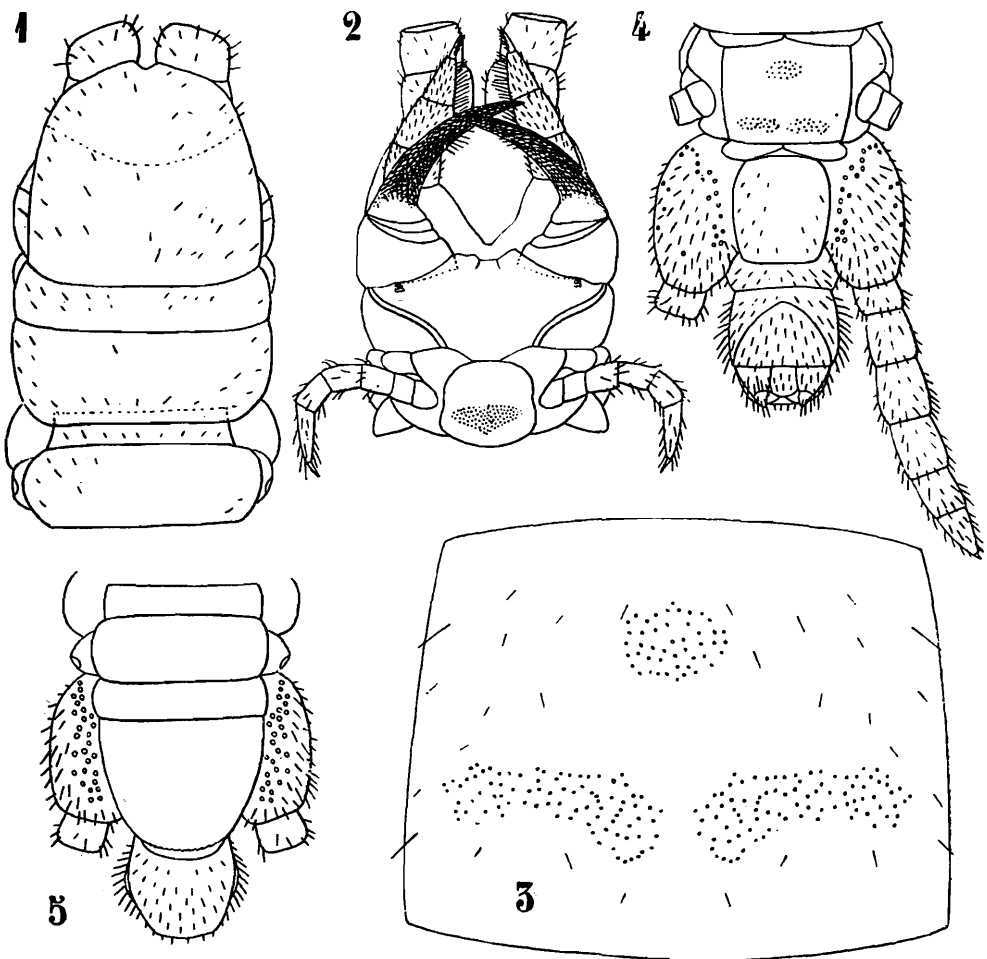


FIG. XXXVII.—*Himantosona typicum* v. *bidivisa*: 1. caput et segmenta 1-3 prona; 2. caput et segmenta primum et secundum supina; 3. sternum decimum; 4. maris corporis pars postica supina; 5. eadem prona.

Lamina basalis postice laminae cephalicae latitudinem subaequans, brevissima lateribus parum convergentibus, lamina prae-basalis plus minusve manifesta. Pedes maxillares flexi marginem frontalem spatio sat parvo haud attingentes, subcoxis aliquantum antice latioribus quam longioribus antice inermibus, lineis chitineis distinctis, articulis 2-4 brevibus, ungue terminali longo.

Tergita praetergito sat magno, paratergito (praescutello) quam scutellum spiraculiferum majus scutellis ceteris vide fig. XXXVIII, 8.

Sterna a primo ad penultimum area porosa lata postica et a secundo (saltem in *E. meinerti*) in corporis parte anteriore areis parvis subanticis lateralibus et areis parvis (antica et postica) per parasterna instructa, in corporis parte posteriore etiam poris medianis sparsis. Praesterna parva parte mediana subnulla lineari.

Pedes corporis partis anticae unguis seta basali longa, plus minusve latiuscula et ungue ipso parum vel multo curvato.

Segmentum praegenitale subcoxis plus minusve inflatis poris numerosis parvis praesertim subtus et supra interne distributis instructis, pedibus praeter subcoxis 6-articulatis, ungue nullo.

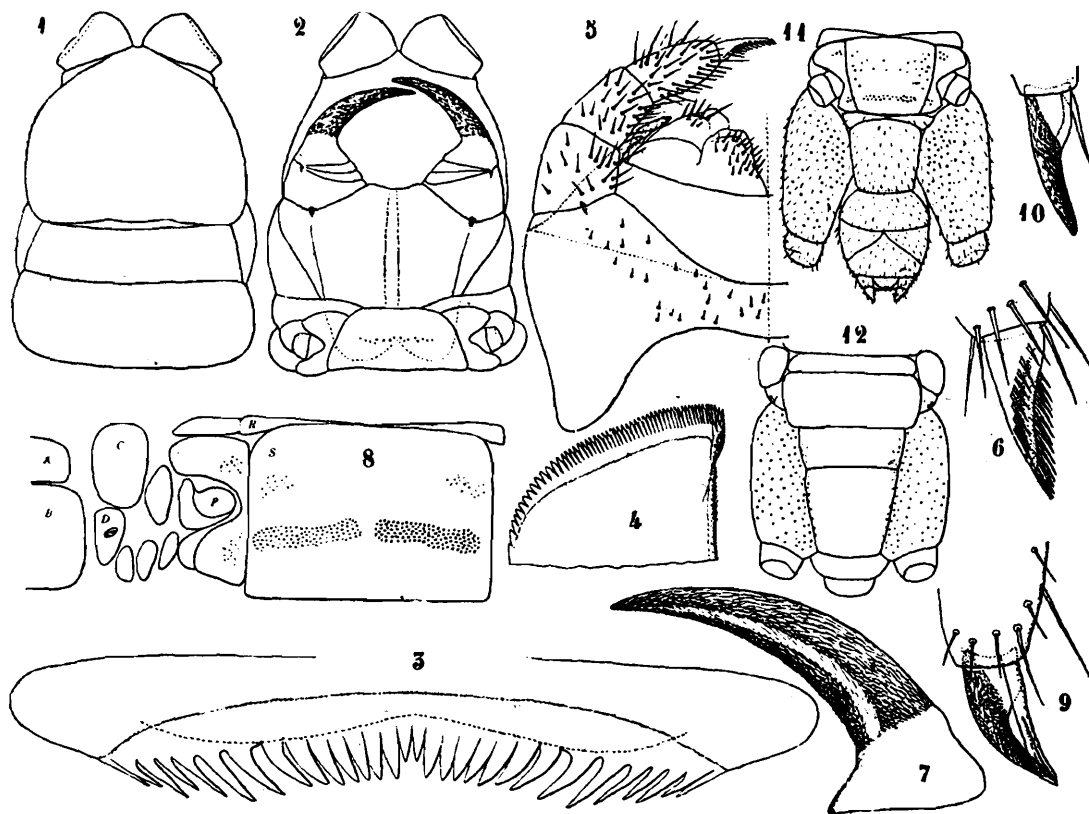


FIG. XXXVIII.—*Eucratoryx meinerti*: 1. caput et segmenta primum et secundum prona; 2. eadem supina; 3. labrum; 4. mandibulae pars distalis; 5. maxillarum primi et secundi paris dimidia pars; 6. palpi maxillaris pars apicalis; 7. pedum maxillarium unguis; 8. segmenti decimi latera et sternum totum (litterae ut in fig. XXVII); 9. pes paris decimi; 10. pes paris 5^o; 11. maris corporis pars postica supina; 12. eadem prona.

Appendices genitales biarticulatae.

Pori anales nulli.

Pedum paria ad 123.

Typus: *Eucratoryx meinerti* (Poc.).

Eucratoryx meinerti (Poc.).

(Fig. XXXVIII.)

Himantarium meinerti, Pocock, *J. Linn. Soc.* XXI, p. 289, pl. xxiv, fig. 1; *Id.*, *Ann. Mus. Genova* XXX, p. 426 (1891).

Eucratoryx meinerti, Pocock, in A. Willey, *Zool. Results, Loyalty Isl. etc.*, p. 66 (1898).

Corpus ochroleucum capite parum obscuriore.

Lamina cephalica fere $1/4$ latior quam longior. Pedes maxillares ungue longo bene arcuato et macroscopice crenulato. Labrum, mandibulae et maxillae vide fig. XXXVIII.

Sternum primum area porosa parva transversali submediana, sterna sequentia corporis partis anterioris area porosa lata subpostica et poris nonnullis subanticis sublateralibus, sterna corporis partis posterioris etiam poris nonnullis medianis sublateralibus sparsis instructa; parasterna antice et postice area porosa parva etiam instructa.

Pedes corporis partis anterioris ungue terminali parum ante mediam longitudinem infra exciso et ab excisione ad apicem gradatim attenuato parum arcuato, seta unguis basali quam unguis parum longiore lata, apice latiore, spatuliformi unguis apicem complectente; pedes ceteri ungue ad basim parum lato et gradatim attenuato paullum arcuato, seta basali attenuata quam unguis brevior.

Segmentum praegenitale sterno vix trapezoideo subaeque longo atque ad basim lato, subcoxis sat inflatis parum ante praetergitum pertinentibus, poris parvis numerosis praesertim supra et subtus per partem anticam internam, cetera superfie poris parvis sparsis, pedibus quam praecedentes circa duplo longioribus haud attenuatis setis brevioribus vestitis.

Pedum paria ♂ 103-109, ♀ 111-128; long. ad mm. 130, lat. segmenti primi 1.90.

Habitat.—Exempla vidi (♀ p.p. 111, ♂ 109) ex Little Coco Island, Andamans. Species iam nota erat ex Mergui Archipelago (Sullivan Island), Great Coco Island, Reef Island (Tavoy), Moulmein et Palon, Burma.

Subfam. *GEOPHILINAE*.

Gen. *Geoporophilus*, nov.

(Fig. XXXIX.)

Corpus angustum antice haud, postice parum angustius.

Lamina cephalica subquadrata, pedes maxillares obtegens, sutura frontali indiscreta. Antennae attenuatae; labrum tripartitum, parte mediana quam laterales minore profunde, pectinis instar, dentata, partibus lateralibus dentibus paucis longis, angustis, acutis gradatim minoribus armatis; mandibulae margine pectinato simplici; maxillae primi paris mala externa biarticulata articulo primo supra externe processu palpiformi sat longo, ut subcoxae angulus externus, instructo, mala interna sat magna, simplici maxillae secundi paris palpo, praeter subcoxam et ungue incluso, 4-articulato, ungue terminali subtus interne aliquantum excavato et per margines internos (superum et inferum) pectinato.

Lamina basalis fere duplo postice latior quam longior trapezoidea, pedum maxillarium latera haud obtegens, lamina praebasalis obtecta. Pedes maxillares flexi marginem frontalem haud

attingentes, subcoxis antice dentibus duobus armatis, articulis ceteris inermibus, ungue terminali attenuato margine interno maxima pro parte minute crenulato.

Tergita bisulcata praetergito magno, paratergito (praescutello) magno; quam scutellum spiraculiferum majore scutellis ceteris vide fig. XXXIX, 8, praesterna antica media subdivisa, cetera integra, sterna a secundo ad 45^{um} areis parvis duabus lateralibus inter sese poris nonnullis conjunctis vel non et areis duabus parvis (altera antica, altera postica) super parasternum instructa, a segmento 45° ad 88^{um} poris lateralibus anticis gradatim minus numerosis vel nullis et poris anticis parasterni aliquantum magis

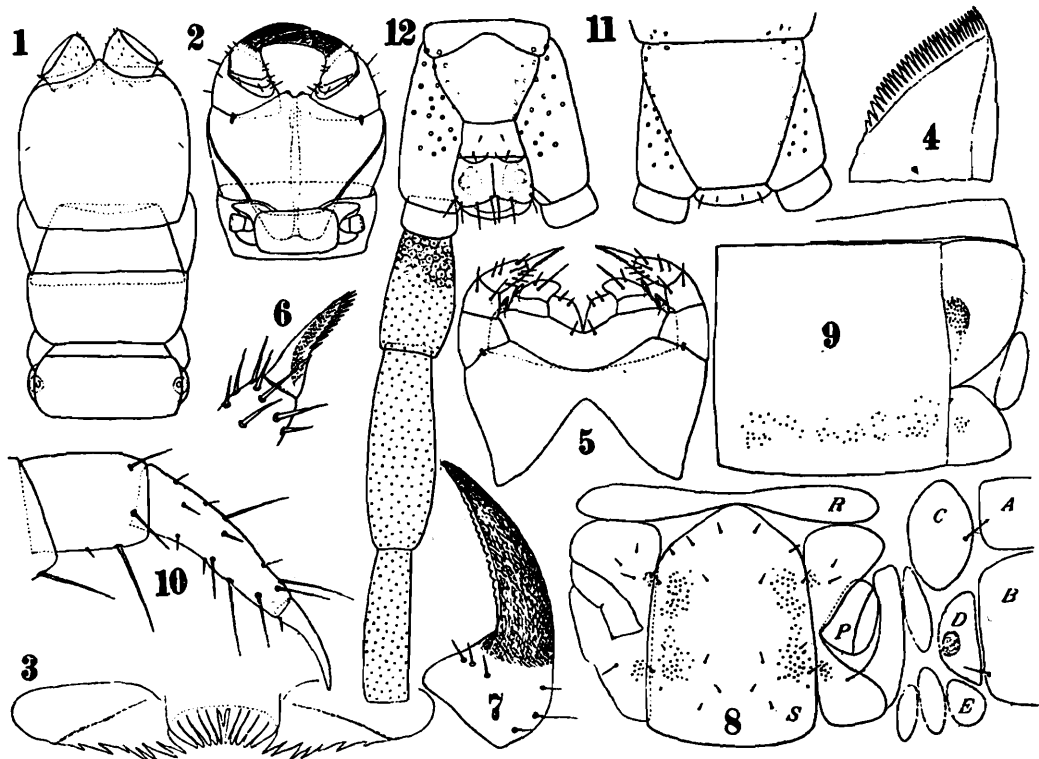


FIG. XXXIX.—*Geoporophilus angustus*: 1. caput et segmenta tria prona; 2. pedes maxillares et segmentum primum supina; 3. labrum; 4. mandibulae pars distalis; 5. maxillae primi et secundi paris; 6. palpi maxillaris pars distalis; 7. pedum maxillarum unguis; 8. segmenti 40^{i} sternum latera et tergiti pars (litterae ut in fig. XXVII); 9. sternum 90^{um} ; 10. pedis 50^{i} pars distalis; 11. corporis pars postica prona, 12. corporis pars postica supina.

numerosis, sterna postica area porosa lata postica et parasterna area porosa sat magna parum convexa antica et area porosa parva postica instructa.

Pedes ungue terminali longo seta basali antica minima et seta basali infera brevior instructo

Segmentum ultimum pediferum subcoxis subtus et supra antice et interne poris glandularibus sat numerosis instructis, lateraliter et postice poris destitutis (saltem in specie typica), pedibus in exemplo typico haud integris, forsan 6-articulatis et forsan ungue destitutis, articulis sistentibus (praeter subcoxam) quatuor quorum secundus, tertius et quartus elongati poris minimis glandularibus per superficiem inferam totam distributis instructo.

Pori anales adsunt.

Pedum paria ad 107.

Species typica: *Geoporophilus angustus*, sp. n

Observatio.—Genus hoc ad gen. *Pleurogeophilus*, Verh. aliquantum proximum est, sed palpi maxillaris ungue pectinato pedum maxillarium lineis chitineis nullis et pororum ventralium distributione saltem distinctum.

Geoporophilus angustus, sp. n.

Corpus ochroleucum totum. Pedum paria 107; long. corp. mm. 55, lat. segmenti primi 0.80.

Characteres ceteri vide generis descriptionem et figuras.

Habitat.—Sumatra: Indragiri (*Burchard*).

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VI THE FAUNA OF CERTAIN SMALL STREAMS IN THE BOMBAY PRESIDENCY

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of India.

(With Plates I—VII.)

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INTRODUCTION.

The notes embodied in this paper are based primarily on collections made in the course of a tour in the Satara and Poona districts in February and March, 1918. The chief localities at which these collections were made were Medha in the Satara district (alt. *ca.* 2,000 feet) and Khandalla in the Poona district (alt. *ca.* 2,500 feet). The former place is situated on the river Yenna or Vena, a tributary of the Kistna or Krishna, in a valley among the easternmost spurs of the Western Ghats; the latter on the hillside about a mile and a half east of the well-known pass Bor Ghat. From Medha the Zoological Survey of India already possessed large collections of aquatic invertebrates made by Dr. F. H. Gravely and Mr. S. P. Agharkar.

My main object in visiting Medha was to obtain further information about the freshwater medusa *Limnocythid indica*, which was originally discovered there by Mr. Agharkar; while Khandalla was selected as a suitable spot at which to study the fauna of the small mountain torrents of the Bombay Ghats. It is a locality well known to conchologists as the home of the interesting genera *Lithotis* (Succineidae) and *Cremnoconchus* (Littorinidae).

So far as *Limnocythid* was concerned the results of my tour were purely negative, but even so they are not devoid of interest, for they prove beyond doubt that the medusa must have a fixed

or resting stage in its life-history, perhaps with the structure of a minute hydroid, or more probably encysted in a form that would not be recognizable with our present knowledge.

The most interesting results obtained in the streamlets at Khandalla were those bearing on adaptation to environment in fish and molluscs.

Notes resulting from a tour of the kind cannot be exhaustive, but our knowledge of the bionomics and environment of the aquatic fauna of India is still in its preliminary stage, in which it is, in my opinion at any rate, worth while to publish notes of the kind, even at the risk of being superficial.

I must be held wholly responsible for all statements made in those sections of the paper in the superscription of which no author's name is given.

I. THE LIMNOCNIDA POOL IN THE YENNA RIVER AT MEDHA.

The Yenna or Vena is a stream of a type very common in hilly districts in Peninsular India. In the wet season it may be described as a small river in which deep pools alternate with rapids obstructed by rocks of irregular shape. In dry weather, however, the pools shrink considerably, while the rapids are reduced to a mere trickle of water or even disappear altogether leaving the pools completely isolated. The bed of the stream is for the most part rocky, with gravelly reaches; but in the pools it is covered with a layer of mud and vegetable debris. As in all the smaller tributaries near the source of the Kistna, the water contains an abundance of very finely divided silt never completely deposited, and is, therefore, opaque and brownish. After heavy rain it is further contaminated with red mud, from the Mahableshwar plateau, that seems to be particularly inimical to animal life. The pools are practically devoid of aquatic vegetation. The temperature of the water of the pools must rise to a considerable height in the hot season; at other times of year it is strictly temperate.

The pool in which *Limnocyclus indica* was originally found is, including the gorge at its upper end, about 50 yards long and a stone's throw across; its width must vary slightly with the seasons. A photograph of it is published by Gravelly and Agharkar in *Rec. Ind. Mus.* VII. In March the water is 7 to 12 metres deep, but must be considerably deeper in the "rains." In March there is very little current, as the rapid above the pool is then small and feeble. A tall man could stride across the outlet. The rocky bottom is very irregular; in the lower part of the pool it is covered with a fairly deep layer of gravel mixed with mud, but in the upper part, which is the deepest, there is only a sparse coating of small pebbles and vegetable debris. A large irregular rock rises far above the surface in the lower part and a foot-bridge spans the upper part at a considerable height above the water. It is impossible, owing to the opacity of the water, to see the

bottom of the pool. Except algae, which are scantily represented, there is no living vegetation.

The fauna of this pool is chiefly a bottom fauna. The bare rock of the sides is covered for considerable areas by the hard black encrusting sponge *Corvospongilla ultima* var. *spinosa* and by the much softer and rather thinner green species *Spongilla perviridis* and *S. sumatrensis* var. *rivularis*. The Polyzoa *Plumatella javanica* and *P. emarginata* occur sparingly on the cleaner parts of the rocky basin and also on the lower surface of loose stones. In the mud and dead vegetable matter a small white dipterous larva of the family Chironomidae is abundant, while in the more gravelly spots thick-shelled Unionids (*Parreyssia corrugata* and *P. cylindrica*, sp. nov.) are not uncommon. For some inches above the bottom Entomostraca, chiefly Copepods and Daphnids, are abundant and with them occur the larvae and pupae of the Corethrine Culicid *Chaoborus manillensis*.¹ None of these arthropods commonly rise to the surface, on which the only zooplankton taken in my nets consisted of the statoblasts of *Plumatella*. Surface-haunting fish such as *Barilius bendelesis* are scarce in the pool, but bottom-haunting forms, notably *Discognathus lamta* and *Gobius bombayensis*, are numerous; a large proportion of the fish bore the glochidia of Unionidae on their fins at the time of my visit. Small prawns of the genera *Caridina* and *Palaeomon* are not uncommon, and the crab *Paratelphusa* (*Barytelphusa*) *jacquemonti* burrows in the mud at shallow points near the shore.²

The facts known about the life-history of *Limnocoñida* are as follows:—they are taken mainly from the papers referred to in a footnote below.³

L. indica has been found only in the smaller streams of the upper Kistna river-system, and only in pools situated as described above. It has been observed only in the months of April and May; in places where it is abundant in these months it has been proved to be completely absent in February March and October,

¹ Both larva and pupa of this fly are modified in correlation with life near the bottom instead of at the surface, the larva in its very small air-sacs, the pupa in several structures, particularly in its balloon-like breathing trumpets, which are sufficiently bouyant to keep it in an upright position but not to raise it to the surface. See Baini Prashad, *Rec. Ind. Mus.*, XV, pp. 154-156 (1918).

² I may refer briefly to two small but remarkable Orthopterous insects common at the edge of the pool, viz. *Scelimena harpago* (Serv.) and *Paranemobius pictus*, Sauss. The former is an Acridiid grasshopper of the subfamily Acrydiinae (or Tettiginae) and is amphibious in habits, flying, diving and swimming with equal ease. I hope on some future occasion to discuss the peculiar modification of its hind legs by means of which it can cling to rocks under water. The *Paranemobius* is a brachypterous, long-legged cricket which runs, as often sideways as forwards, with great agility on the shady sides of dry rocks at the edge of water. It is widely distributed in India (Kashmir to South India) and is always found in this position. I have to thank M. L. Chopard for this identification.

³ See Annandale, "A Preliminary Description of a Freshwater Medusa from the Bombay Presidency," *Rec. Ind. Mus.*, VII, p. 253 (1912); Gravely & Agharkar, "Notes on the Habits and Distribution of *Limnocoñida indica*," *Rec. Ind. Mus.*, VII, p. 399 (1912); Agharkar, "Further Notes on the Habits and Distribution of *Limnocoñida indica*," *Rec. Ind. Mus.*, IX, p. 247.

and is stated by natives of these places (who are well acquainted with it under the names "water-wheels" or "water-flowers") to be absent at all other times of the year. In the pools it feeds on minute crustacea, which are probably always to be found in abundance at the bottom, near which the medusa spends most of its time. All attempts either to breed the animal in captivity or to discover what becomes of the species when the medusa is not present have hitherto failed. Investigation of the latter point is rendered difficult at Medha by the inequalities of the rocky basin of the pool. I found that a heavy dredge invariably caught in projections of the rock, but succeeded by careful manipulation in dragging a D-net over the bottom and in bringing up pebbles and vegetable debris from it. I could detect no organism of a coelenterate nature in this matter; nor could I find any trace of a parasitic or quasiparasitic stage on or in any of the fish, molluscs or crustaceans of the pool. The structure of the stream and of the surrounding country renders it almost impossible that the medusa could be introduced periodically; at other localities it appears in bodies of water completely isolated at the time of its appearance. We know that it is killed off annually by the red mud brought down from higher up stream in the first summer freshets. We know also that sexual reproduction is active immediately before this occurs, and evidence that asexual budding ever occurs is altogether lacking. I am sure no ordinary hydroid, if at all abundant, could have escaped my notice in the investigations I undertook at Medha, while Mr. Agharkar's experiments at the same place had equally negative results. The most probable explanation seems to me to be that the hydrozoon remains for the greater part of the year in an encysted condition and that the medusa becomes fully developed in favourable conditions of temperature, as soon as the hot season is fully established. The union of ova and spermatozoa probably gives rise to planulae of the type usual in hydroids. Probably those planulae which are produced in the earlier part of the brief season of activity develop directly into medusae, but there may be a short-lived hydroid generation. Those planulae, however, which have not undergone further development at the time when the water is rendered unfit for the activities of the medusa by the freshets, perhaps become encysted and lie on the bottom until conditions favourable for active life return. Their cysts may be very minute and have no definite characters by which they could be recognized. I know of no case¹ in the Hydrozoa precisely parallel, but that of the encysted embryo of *Hydra* is similar and encystment is a phenomenon of such common occurrence in many diverse groups of freshwater invertebrates that it would not be at all surprising to find it in *Limnocooida*.

¹ In *Annulella*, an anomalous hydroid from the brackish water of the Gangetic delta, an encysted resting stage has been described. See Ritchie, *Rec. Ind. Mus.*, XI, p. 552, pl. xxxa, fig. 9 (1915).

II. THE FAUNA OF MOUNTAIN STREAMLETS AT KHANDALLA.

The hills at Khandalla are fairly steep and almost bare or at any rate devoid of heavy jungle. Numerous small streams rush down them, falling over many cliffs and rocks and thus forming cascades and waterfalls, some of which are of a considerable, even a great height. The streams are for the most part very small indeed, nowhere more than a yard or two across and in the deepest pools not more than a foot or two deep. This description applies to their conditions in the dry season; in the rainy season they must be small but raging torrents, the biological investigation of which would be difficult. In the following notes I discuss the true aquatic fauna of these streamlets; the fauna of damp rocks at the edge of the waterfalls will be considered separately.

It is impossible at present to give anything like a full account of the fauna of any body of water in India, because it inevitably includes among its members a large proportion of insect larvae even the adults of which are imperfectly known, if known at all. This is particularly unfortunate in the case of small torrents, the insect larvae of which are almost without exception highly modified and adapted forms. In present circumstances, however, it is perhaps best to ignore the curious flattened Ephemeropterid and other larvae that play an important part in the natural history of the streamlets at Khandalla, and also the aquatic and semi-aquatic beetles which, though never of large size, are by no means uncommon in the water or at the edge. Mr. Paiva's co-operation has made more satisfactory reference to the Rhynchota possible. I shall do no more than mention here that Anopheline larvae are abundant in small pools and that the adults rest in large numbers on damp rocks shaded from the sun and standing in the water. It will be remembered that my observations were made in March, when there was very little water in the streamlets.

Batrachia.—The only frogs observed at the edge of the streamlets were *Rana limnocharis syhadrensis* and *Ixalus bombayensis*, both of which were fairly common under stones. The *Ixalus* was also found in the cracks between the narrow strata of the rocks over which little cascades fall in the streamlets. These cracks often make it possible to strip off slabs of stone by the exercise of a little force, and when this is done the frogs appear flattened against the parent rock, with their pupils strongly contracted. With them there is abundant food, particularly in the form of earwigs (*Forcipula*), which greatly favour such situations. When the streamlets become broader owing to natural or artificial obstructions in comparatively level areas *Rana cyanophlyctis* is abundant round the margin. I found no tadpoles of any species.

Fish.—Three species of fish, all very small, make their way into the smallest pools in the streamlets. They are *Nemachilus evezardi*, *Discognathus nasutus* and *Psilorhynchus tentaculatus*. All of these, and especially the two last, are modified forms.

The loach resembles other small species of its genus in general structure but has the processes between the two nostrils on each side of the head prolonged into regular barbels. This feature does not occur in any other Indian species of *Nemachilus* but is present in the closely allied genus *Aborichthys*, which is found in hill streams in Assam and north-eastern Burma.

The modifications exhibited by the *Discognathus* and the *Psilorhynchus* are of a more extreme and more clearly adaptive nature. Many species of *Nemachilus*, with their ventral mouth, swollen suctorial lips, glandular skin, flat ventral surface and small size are well fitted to live in rapid-running water among rocks, to which they are able to adhere and over which they can crawl even when the surface is not entirely submerged; but other species of similar structure live in ordinary rivers. The two species of *Psilorhynchus* are inhabitants only of streams in or near Indian mountains, and are modified accordingly. The Bombay species does not differ from its Himalayan congeners to any important degree in this respect. It has been generally assumed that the genus

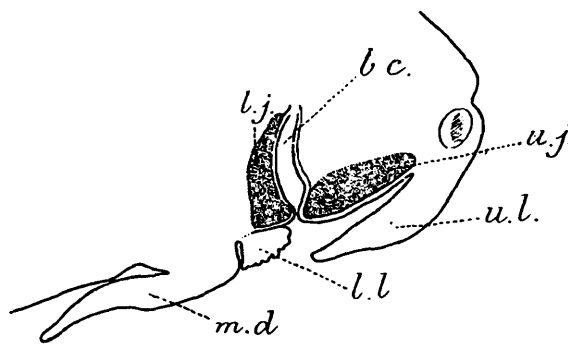


FIG. 1.—Vertical section through the mouth of *Discognathus lamta*.

b.c. = buccal cavity. *l.j.* = lower jaw. *l.l.* = anterior free portion of lower lip.
m.d. = mental disk. *u.j.* = upper jaw. *u.l.* = upper lip.

Discognathus has had a similar history, but though *Psilorhynchus* may be a more primitive form of *Discognathus*, there is something to be said for another view.

The main if not the only generic peculiarities of *Discognathus* lie in the structure of its mouth and lips (fig. 1). The jaws are of semicircular shape, firm and bony, with blunt edges and covered with soft integument; they are directed downwards and can be tightly closed together with their margins in contact. The upper lip is a deep but delicate fold covered with minute papillae, mobile and probably sensitive. It entirely conceals the upper jaw, to which it is not attached. The lower lip bears much the same relation to the lower jaw so far as its anterior part is concerned, but the free portion is shorter; posteriorly it is much enlarged and flattened and bears in its centre a relatively large transversely oval or nearly circular pad, which can be elevated by muscular action and so produce a partial vacuum, thus forming an organ of adhesion. The mouth of *Psilorhynchus* is essentially similar, except that the pad is entirely absent or represented, as in *P. ten-*

taculatus, by a slight swelling. From the more normal species of *Discognathus* the genus is further separated by the structure of the pectoral fins, which are greatly expanded, entirely horizontal in position and with their rays broad, flat and sparingly branched. The chest is also flat, devoid of scales, highly muscular and, with the pectoral fins, capable of adhering tightly to flat or uneven surfaces. The other generic differences are trivial or inconstant: *Discognathus* may have two or four barbels or none, *Psilorhynchus* two or none; the two lips are joined together by a fold in *Discognathus*, separated by a groove in *Psilorhynchus*. In the Indian species there is no difficulty in separating the genera, but both in India and Africa forms occur that are intermediate in one way or another. Boulenger¹ in describing the Nilotic species of *Discognathus* says:

“ Aberrant Cyprininae adapted for living in torrents and mountain rivers. The mental disk by which they are enabled to fasten themselves to stones varies greatly in its degree of development, and is so reduced in some specimens of the species described below as *D. quadrimaculatus* as to be almost indistinguishable. Such specimens might be referred to the genus *Crossochilus*, Van Hasselt, were it not for the more reduced gill-openings, which do not extend to the lower surface of the head, the isthmus being much broader than in the related genera.”

The resemblance between *D. quadrimaculatus* and *Psilorhynchus* seems to me to be very close indeed, both in the structure of the mouth and as regards general facies. There is no resemblance, however, in the structure of the pectoral fins, and the lips are continuous in the African fish.

If we have in this African species a close approximation to *Psilorhynchus*, we have among Indian forms a still closer resemblance in the modification of the pectoral fins and chest in one or possibly two species of *Discognathus*. This is the case in *D. nasutus*. Here again, however, we have a difference as well as a resemblance, for the pectoral fins in *D. nasutus* differ from those of all species of *Psilorhynchus* in that all the rays except the outermost ones are branched, though sparingly so, whereas in *Psilorhynchus* several of the outer rays are simple or nearly so.

Resemblances between the mouth-parts in these fish are perhaps more important genetically than those between the fins, both because they are more exact and because we find similar modifications in the fins of other unrelated genera (such as *Homaloptera* and even some Siluridae) that also live in mountain streams. The latter resemblances are, therefore, without doubt convergent. It will be as well, however, to inquire a little further, before coming to any conclusion, what are the normal modifications in the

¹ *The Fishes of the Nile*, p. 180 (1907). See also the same author's *Fresh-Water Fishes of Africa*, I, p. 343 (1909).

clearly specialized genus *Discognathus* and in what way these modifications are actually utilized.

With the structure of the mouth in *Discognathus* I have dealt to some extent. The Western Asiatic forms (*D. variabilis* and *D. lamta* var. *rufus*) closely resemble the Indian forms in this respect, and so does the one species (*D. borneensis*) known from the Malay Archipelago. I have been able myself to observe both the typical *D. lamta* and its Syrian race under natural conditions in exceptionally favourable circumstances. Neither of these forms lives habitually in mountain streams; both affect the pools of streams and rivers and even isolated masses of still water; they are what we may call normal forms of the genus with well-developed mental suckers and with the pectoral fins and chest comparatively little modified. My observations on the Syrian fish were made in a walled fountain at the Lake of Tiberias, those on the Indian form in the Inlé Lake in the Southern Shan States. Moreover, in the literature on other species of the genus I can find no statement that would justify, so far as most species are concerned, the belief that the genus is like *Psilorhynchus*, essentially a mountain one. Blanford¹ took the types of *D. blanfordii* in a stream which he describes as a torrent, and Max Weber² states that *D. borneensis* lives in mountain streams. All the other species are recorded from rivers or lakes. *Discognathus lamta*, in both its races, feeds on small organisms that are tightly fixed to rocks or other hard objects. Its manner of feeding is this. Having fastened itself, usually in a more or less vertical position with the head uppermost, to a rock or post by means of its mental disk, it selects suitable food with its lips, bites it off with its jaws and sucks it into its almost horizontal buccal cavity. When the food in its reach is exhausted, it relaxes its adhesive organ and by means of an almost imperceptible movement of its tail, thrusts itself slightly upwards. The disk then takes hold again. In Palestine I experienced this process by bodily sensation on placing my bare feet in the water of the fountain. The fish invariably attached themselves and it was possible to feel the action of the disk fixing itself, the movements of the lips and the nibblings of the jaws, which were not sharp enough to pierce the human skin. *Psilorhynchus* apparently feeds in the same way but clings rather by means of its pectoral fins and flattened, highly muscular chest, which can probably be rendered concave by muscular action. *Discognathus nasutus* has both means of attachment strongly developed.

It is noteworthy that in *D. blanfordii*, so far as can be seen from Boulenger's figures, the fins and chest have a considerable resemblance to those of *D. nasutus*, while those of the other African species, which apparently live in comparatively still water, resemble those of *D. lamta*. The Bornean species also

¹ *Discognathus lamta*, Blanford, *Geol. Zool. Abyssinia*, pp. 460-461 (1870).

² *Indo-Australian Fish*, III, p. 228 (1916); see also Vaillant, *Notes Leyden Mus.*, XXIV p. 9, figs. 25, 26 (1902).

resembles *D. nasutus* in this respect, so far as can be judged from published figures.

Taking all these facts into consideration and further remembering that the peculiar structure of the pectoral fins found in *Psilorhynchus* is also found in *Homaloptera* and to a still greater degree of specialization in the Bornean genus *Gastromyzon*,¹ I am of the opinion that the resemblance between *Psilorhynchus* and *Discognathus* is to a large extent due to parallel evolution. In the species of the latter genus that live in comparatively still water (*i.e.* in the majority of species) it is superficial, while in those species that live in hill torrents convergence has certainly taken place. I am inclined to think, therefore, that both *Psilorhynchus* and *Discognathus* have been derived from a genus like *Crossochilus* or probably *Labeo*, but that their evolution took place independently, and that whereas the chief factor in the case of *Psilorhynchus* was rapid-running water in a rocky stream-bed, in *Discognathus* the primary factor was a peculiar mode of feeding. The close resemblance between such forms as *P. tentaculatus* and *D. nasutus* is due, if this be so, to secondary convergence. The resemblance between *D. quadrimaculatus* and *Crossochilus* may or may not be due to a real genetic relationship, while that between the former and *Psilorhynchus*, close though it seems at first sight, cannot be closer at most than that between distant cousins, so far as descent is concerned.

Molluscs.—The only mollusc found in the upper parts of the streams at Khandalla was *Ampullaria nux*. As we have pointed out in our systematic notes on the Mollusca collected on my tour, this species is modified for its peculiar habitat in respect to two characters: (1) its small size and (2) the curious development of the inner lip of the aperture of the shell. It is the only species of *Ampullaria* that I have seen in anything but still or at most very sluggish water. The columellar callus of the shell is a flattened ridge nearly two millimetres broad, and this ridge forms with the outer lip a continuous margin of attachment, enabling the shell to come into much closer contact with the rocks to which the animal attaches itself than is the case with the shells of more normal species that crawl on water-weeds. Only one living individual was seen, though broken shells were not uncommon in the streamlets and it is probable that *A. nux*, like many other species of its genus, conceals itself in the dry season. The one individual was attached to the rocky margin of a small pool densely shaded at all times of day and supplied by a small but perennial waterfall.

Paludomus obesa was found in some abundance in the same streams, but in a small plain where it was not shaded and had lost for a short distance its peculiar character as a mountain streamlet. It was feeding on algae covering stones.

Insects.—As I have already stated I can deal only with the Rhynchota of the streamlets. These fall from a bionomical point

¹ See Weber, *Indo-Australian Fishes*, III, p. 3, fig 1 (1916).

of view into three categories: (1) surface forms, (2) mid-water forms confined to still pools, and (3) bottom forms that can live in rapid running water. The list of species collected in the streamlets at Khandalla is as follows; I have distinguished the names of those that belong to the first category with an *, those of the species of the second category with a † and those of the species of the third category with a §.

<i>Rhagovelia nigricans</i> .*	<i>Heleocoris elongatus</i> .§
<i>Ptilomera laticaudata</i> .*	<i>Naucoris sordidus</i> .§
<i>Metrocoris stali</i> .*	<i>Erithares templetoni</i> .†

Even in dealing with the Rhynchota I think it will be better to defer a detailed discussion until it has been possible to investigate the structure of Indian aquatic insects more completely. I shall merely point out that the Hydrometridae of running water, in India at any rate, usually differ from those that live on the surface of pools and have either extremely long legs and bodies, as in *Cylindrostethus*, or else have the body short and rounded like that of the marine species, as in *Metrocoris*; while the species of *Heleocoris* are flattened and smooth and are thus well adapted to cling tightly to stones or to make their way beneath and between them. Such small, short-legged surface forms as *Rhagovelia* live at the edge of the stiller parts of the streamlets and are not perceptibly modified.

III. THE FAUNA OF DAMP ROCKS AT THE EDGE OF WATERFALLS AT KHANDALLA.

Where the small streamlets near Khandalla are precipitated over the sheer basaltic cliffs that abound in the neighbourhood waterfalls of different heights are formed. The larger of these, where the water drops for some hundreds of feet, are practically inaccessible, but many smaller ones can be readily investigated in which hundreds of feet are represented by tens and the amount of water is by no means great.

The fauna of these waterfalls is of considerable bionomic interest, but what I have said in reference to insects of small streams has even greater force here. The fauna of the actual falls is perhaps exclusively entomological, its most conspicuous members being certain moth-larvae that spin their flattened cocoons on the rocks and certain caddis-worms that make bag-shaped reticulate snares of such strength that the water pours right through without breaking them. At the edge of the falls, however, at any rate in the dry season, a much larger and more varied fauna has established itself where the rock is kept wet with spray and the growth of algae is thus encouraged.

Here again insects predominate, but other animals also occur.

Batrachia.—*Ixalus bombayensis* is not uncommon in cracks in the damp rock, and *Rana limnocharis syhadrensis* may be found under stones at the bottom of the falls.

Molluscs.—Two species of molluscs, both belonging to highly peculiar genera probably of very limited range, have been described from the edge of the waterfalls at Khandalla. These are *Cremnoconchus* of the almost exclusively marine family Littorinidae and *Lithotis* of the semi-terrestrial pulmonate family Succineidae. Our knowledge of both these interesting genera is due primarily to the work of the late Dr W. T. Blanford.¹ In March *Lithotis* was entirely absent from the cliffs from which it was described. Its absence in the dry season is additional evidence for the belief that, like other members of its family, it is an air-breathing mollusc that can only exist in damp surroundings. In dry weather it probably conceals itself and aestivates. *Cremnoconchus syhadrensis*, on the other hand, was found in great abundance, but only at places where the cliff was shaded from the midday sun and supported a growth of the peculiar dull green filamentous alga on which it feeds. Some individuals were in an active condition, crawling and feeding in the spray of the falls; others, in drier places, were apparently quite torpid and had their opercula tightly closed. A number of individuals in both states were placed in jars of water. Some were prevented from reaching the surface. These were drowned in 24 hours, dying partially expanded. Others, placed in a jar with flat sides and only half full of water, crawled out after a short time. Their movements could be observed with great nicety through the glass. They moved upwards slowly. When out of the water the shell was closely applied to the glass except where the tentacles protruded in front, the ventral surface of the body-whorl being in contact with it as well as the rim of the aperture. The opening of the branchial cavity was patent, but was relatively small and had a somewhat lunate form. It could be easily seen that this cavity was full of water, and the animal took with it a film of water that surrounded the shell on the glass. After it had been moving about for some hours this film grew smaller and finally disappeared. The orifice of the branchial cavity was then shut, the foot retracted and the operculum closed. The mollusc remained for days in this condition, absolutely immobile, and probably would have so remained until it had been soaked with water. Although the glass on which it crawled was quite clean, it opened its mouth and thrust out its radula from time to time, as though trying to scrape off its food, so long as it remained active. Fig. 3, pl. IV, which shows the film of water, the open branchial orifice, etc., was drawn from a specimen brought alive but torpid to Calcutta and revived by being placed in water.

Cremnoconchus seems, therefore, to be in a sense a water-breather, incapable of obtaining its oxygen direct from the air, but also incapable of obtaining it from water in the manner usual

¹ Blanford, *Ann. Mag. Nat. Hist.*, (3) XII, p. 184 (1863), and (4) III, p. 343 (1869). For *Lithotis* see also Gude, *Faun. Brit. Ind. Moll.*, II, p. 457 (1914); for *Cremnoconchus*, Stoliczka, *Proc. As. Soc. Bengal*, 1871, p. 108.

in aquatic Prosobranchiate molluscs. It possesses both a gill and a branchial chamber with a small orifice that can be completely closed. The branchial chamber, however, is not transformed into a lung and is apparently never filled with air; breathing is effected by the absorption of atmospheric oxygen through a thin film of water. *Cremnoconchus* belongs to a family (the Littorinidae) of which other forms are maritime, rupicolous or even arboricolous and more or less amphibious. According to Pilsener,¹ the branchial cavity of some species of *Littorina*, though not transformed into a lung like that of Pulmonates and though containing a gill, is filled with air when the animals are out of the water, and with water when they are submerged; while other species of the same genus "mènent ordinairement une véritable existence de Pulmoné." The physical modifications of the breathing apparatus found in *Cremnoconchus* are not very greatly different from those found in *Littorina*, but they are different and have a different function. In the former genus the branchial cavity is more of a closed chamber; the structure of the gill,² though essentially similar, is somewhat more simplified, its vascular outgrowths are less developed and the osphradium is still more reduced, having become papilliform instead of ridge-like. The small size of the branchial orifice and the completeness with which it can be closed are adaptations correlated with life in circumstances in which prolonged periods of desiccation occur. In these periods the animal is in a state of coma and probably requires little fresh oxygen, but the gill must be kept wet.

Insects.—The insect fauna of damp rocks at Khandalla is a rich one. In little ledges in which masses of damp algae grow or dead leaves accumulate numerous dipterous larvae of the families Tipulidae,³ Chironomidae and Stratiomyidae occur, with small beetles belonging to the Staphylinidae, the Clavicornia and other groups. In cracks in the rocks the earwig *Forcipula quadrispinosa* and the Reduviid bug *Pirates arcuatus* are not uncommon, while Tettigine grasshoppers frequently alight on the algae coating smooth surfaces. I shall, however, say nothing of these, but merely draw attention to the great abundance of two species of water-bugs, *Hebrus bombayensis* and *Onychotrechus rhexenor*. The former runs about on the damp alga and takes readily to flight. It was also found on the surface of water at Medha, and exhibits no particular modification for life on rocks. *Onychotrechus* is a genus which, so far as my experience goes, is always found either on damp rocks or on the surface of small rocky streams.⁴ It differs from its nearest ally *Gerris*, which always

¹ Pilsener, *Arch. de Biol.*, XIV, p. 356 (1895).

² Stoliczka, *Proc. As. Soc. Bengal*, 1871, p. 108, fig. 1.

³ An adult fly of this family found beneath a stone on a ledge in one of the waterfalls has been identified by Mr. Brunetti as a new species of *Antocha*.

⁴ Mr. Green's remarks on *O. vadda*, Dist. (quoted by Distant on p. 147 of Vol. V of the "Fauna" volumes on the Rhynchota) would apply equally well to *O. rhexenor* at Khandalla.

lives on the surface of water, and as a rule, though not invariably, of still water, in the structure of its feet, more particularly of those of the two hinder pairs of legs. On these feet there is in *Gerris* a pair of slender, almost bristle-like claws, which are situated at the tip of the limb; some distance in front of them, on the lower surface, there is a large bristle, but there is no definite empodium and the whole structure is degenerate. In *Onychotrechus* the claws are real claws, of a horny consistency, curved towards the tips, sharply pointed and flattened from side to side; they are separated from the extremity of the limb by several strong bristles and small processes perhaps of a sensory nature; similar processes also occur just behind the claws, and between them protrudes a coiled hand-like empodium. These structures deserve a more detailed examination. I refer to them here merely to indicate that the foot is modified in this genus to enable it to cling to slippery surfaces, while in *Gerris*,¹ which apparently does not use the claws of its hinder legs at all, they are degenerate. There is less difference between the anterior feet of the two genera, both of which probably use them for grasping prey, but even in these feet the claws of *Onychotrechus* are much stronger and larger than those of *Gerris*. These facts are illustrated in figures 8 and 9 on plate III, drawn on the same scale from insects of approximately the same size.

Oligochaeta.—Small white worms of the family Naiadae are abundant in damp algae on the cliffs.

The fauna of these cliffs, where they are wet with the spray of waterfalls, includes, therefore, highly modified forms among both the Mollusca and the insects. The latter are still imperfectly known, but there is every reason to think that a proper entomological investigation of the waterfalls would have great biological interest.

IV. SOME FROGS FROM STREAMS IN THE BOMBAY PRESIDENCY.

Only three species of frogs were found at the edge of the streams investigated at Medha and Khandalla. They are *Rana cyanophlyctis*, an undescribed race of *R. limnocharis* for which I propose the subspecific name *syhadrensis*, and an undescribed species of *Ixalus*, which I have called *I. bombayensis*. Both new race and new species are abundant in the Bombay Ghats. The *Ixalus* has been found in the North Canara, Satara and Poona districts, the race of *R. limnocharis* in the two latter and also in the Nasik district; neither form is known to occur at altitudes below 2,000 or above 4,000 feet.

¹ I have seen a species of *Gerris* clinging to rocks at the edge of the Bhavani river by means of its anterior claws. It could not, however, run about on the slippery surface.

Rana cyanophlyctis, Schneider.

This frog, one of the commonest species in the plains of India, is found only in the immediate neighbourhood of water. It is equally at home in puddles of rain-water, ponds and streams, but does not frequent the smaller mountain streamlets. So far as my own observations go, it is the only species that skips over the surface of the water as *R. limnocharis* is sometimes stated, I believed incorrectly, to do. The habit was first noted in literature by the Emperor Bābur¹ in the year 1525-1526. *R. hexadactyla* may have the same habit when young, but when full grown is probably, as Dr. Henderson points out in a letter, too heavy an animal.² *R. cyanophlyctis* is frequently seen in wells and in pools with a steep margin. In such conditions it floats on the surface of the water, but when a resting place is available it usually sits at the edge. When disturbed it gives a short leap, horizontally

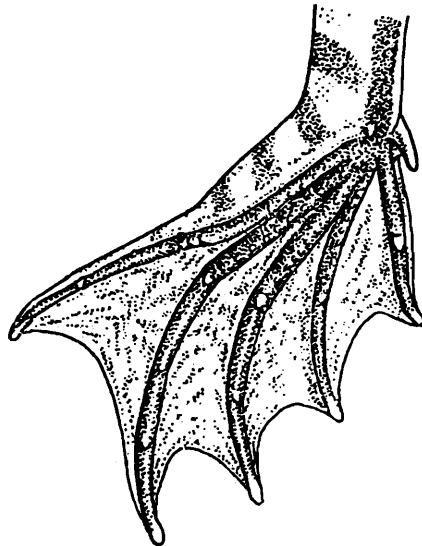


FIG. 2.—Hind foot of *R. cyanophlyctis* (enlarged).

rather than upwards, and strikes the surface of the water with its short, broad, slightly cup-shaped and stoutly webbed hind feet (fig. 2) at such an angle that it is again propelled forwards through the air for some inches; it then again strikes the water in the same way, and the manoeuvre may be repeated as many as seven times. When the impetus is exhausted, as it usually is after a couple of yards or at most 10 feet—the Emperor's observation was not strictly accurate—the frog dives obliquely forwards to the

¹ He says in his "Memoirs," "The frogs of Hindustan, though otherwise like those others (Tramontane) run 6 or 7 yards on the face of the water." See *The Memoirs of Emperor Bābur*, translated by Annette S. Beveridge, fasc. III, p. 503 (1918).

² Since this was written I have been able to observe *R. hexadactyla* in Madras. The adult usually sits among weeds in the water, where its bright green colour conceals it to some extent. When disturbed it dives through the weeds but if they are too thick it skips feebly two or three times.

bottom. If this be soft it burrows into it with its fore feet, impelling itself forwards at the same time by vigorous kicks of its hind legs. It makes its way more or less completely into the mud or sand but does not attempt to go downwards. After remaining buried or half buried for a few minutes, it backs from its temporary burrow and rises cautiously to the surface. If no danger threatens it then swims ashore. I have often seen a frog dive direct into the water from a stone or rock and then leap out and skip two or three times. When living at the edge of a stream it dives against the current, and often has difficulty in reaching the bottom. Its swimming stroke is, however, very powerful; it is the only frog with the habits of which I am acquainted that habitually swims upstream.

R. cyanophlyctis is abundant at the edge of the Yenna at Medha and also at that of ponds and of the larger streams, where they traverse fairly level ground, at Khandalla. It evidently prefers pools or streams of which the bottom is soft. It appears rapidly in isolated temporary pools and must make its way overland by night; I have never seen it except at the edge of water by day.

Rana limnocharis, subsp. *syhadrensis*, nov.

This is a dwarfed race akin to the subsp. *niligiraca* but of much smaller stature and with the hind limbs as a rule shorter. The first finger hardly extends beyond the second; the hind feet are as in the typical form except that the webbing is slightly less extensive and the tibio tarsal articulation reaches the anterior border of the eye or a point between it and the tip of the snout. The dorsal surface is grey with black spots sometimes with a reddish suffusion; a narrow pale mid-dorsal line is often present; the ventral surface is white; with the whole of the throat black in the adult male. The length does not exceed 3.5 cm.

Measurements in millimetres.

	(type)	
	♂	♀
Snout to vent	27	31.5
Length of head	11	12.5
Width of head	9.5	11
Snout	4.5	6
Eye	3.4	3.4
Interorbital breadth	2.8	3
Tympanum	1.7	2
Fore limb	13.2	16
1st finger	4	5
2nd finger	3.8	4.5
Hind limb	42.7	45.8
Inner metatarsal tubercle	2	2.3
Middle toe	11	12

Type-specimen.—Rept. No. 19764, Z.S.I. (*Ind. Mus.*).

Geographical Range.—This little frog is abundant in the hills and elevated valleys of the middle region of the Bombay Presidency. I have examined specimens from several places in the Satara district at altitudes between 2,000 and 4,000 feet; also from Khandalla (2-3,000 feet) in the Poona district and from Igatpuri (2,000 feet) in the Nasik district. Apparently the typical *R. limnocharis* is absent from these localities.

***Ixalus bombayensis*, sp. nov.**

(Plate I, fig. 1).

Tongue with a free pointed papilla, often inconspicuous, in the anterior part of the median line. Snout rounded, as long as or a little longer than the orbital diameter; canthus rostralis distinct; loreal region concave; nostril much nearer the tip of the snout than the eye; eye very large and prominent; *interorbital space broader than the upper eyelid*; tympanum small, hidden. Fingers free; *toes not more than one third webbed*; disks and sub-articular tubercles moderate; a fairly large but by no means prominent oval inner metatarsal tubercle; outer toes slightly fringed. The hind limb being carried forward along the body, the tibio-tarsal articulation reaches the eye. *Skin more or less distinctly rugose¹ above, bearing small, scattered pointed warts or tubercles; upper eyelid tubercular*; throat and chest smooth; belly coarsely granular; a fold from the eye to the shoulder; a low ridge, sometimes broken up into a series of tubercles, on the mid-dorsal line of the head. The adult male with a very large gular pouch.

Colouration variable; dorsal surface dark brown or grey speckled with black, sometimes almost entirely occupied by a large dicebox-shaped mark of pinkish buff edged and speckled with black; a dark pale-edged cross-bar often present between eyes; sides dark, spotted and blotched with dull yellow; a large black and lemon-yellow mark in front of the groin in adults; limbs pale grey more or less irregularly cross-banded with black; hind part of thighs mottled with black and dull yellow; ventral surface greenish-yellow suffused with black.

Length not exceeding 3 cm.

Type-specimen.—Rept. No. 18782, Zool. Survey of India (*Ind. Mus.*), from Castle Rock.

Geographical Range.—Hills of the Bombay Presidency from N. Canara (Castle Rock) to the Satara (Khas) and Poona (Khandalla) districts at altitudes between 2,500 and 4,000 feet.

The species is closely allied to *I flaviventris*, Boulenger,

¹ In the specimen figured on pl. I it is smoother than usual. This specimen is the only fully developed adult male in the series examined.

whose description of that species I have followed closely, italicizing the more important differences. I have examined a large series of specimens.

I. bombayensis is common at Khas (where it occurs with *I. glandulosus*) and Khandalla; Mr. Kemp found a single specimen at Castle Rock. It is evidently nocturnal in habits and in the daytime its pupil is often reduced to a very narrow transverse slit. It hides under stones in damp places at the edge of small streams and in cracks in rocks kept wet by the spray of waterfalls.

V NOTES ON FRESHWATER FISH MOSTLY FROM THE SATARA AND POONA DISTRICTS.

Fish of the following species were collected in the Yenna at Medha in February and March:—

<i>Euglyptosternum saisii</i> (Jenkins).	<i>Barbus malabaricus</i> , Jerdon.
<i>Lepidocephalus thermalis</i> (C. & V.)	<i>Barbus kolus</i> , Sykes.
<i>Nemachilus botia</i> (Ham. Buch.).	<i>Barbus ticto</i> , Day.
<i>Nemachilus savona</i> (Ham. Buch.).	<i>Rasbora daniconius</i> (Ham. Buch.).
<i>Nemachilus anguilla</i> , sp. nov.	<i>Barilius bendelisis</i> (Ham. Buch.).
<i>Psilorhynchus tentaculatus</i> , sp. nov.	<i>Danio aequipinnatus</i> (McCl.).
<i>Discognathus lamta</i> (Ham. Buch.), Day.	<i>Chela boopis</i> , Day.
<i>Cirrhina reba</i> (Ham. Buch.).	<i>Mastacembelus armatus</i> (Lacép.).
	<i>Ophiocephalus gachua</i> , Ham. Buch.
	<i>Gobius bombayensis</i> , sp. nov.

About several of these fish, having put on record their occurrence in the head waters of the Kistna, I have nothing further to say.

In small hill streamlets at Khandalla I obtained three species of fish:—*Nemachilus evezardi*, Day; *Psilorhynchus tentaculatus*, sp. nov. and *Discognathus nasutus* (McCl.). These I have already discussed at some length (pp. 113–117).

In addition to my own collection I have before me some interesting specimens of *Barbus* from the Satara district, sent me by Mr. C. D. McIver of the Public Works Department, a very keen student of the local fish-fauna. To these I shall refer, and with them to an interesting specimen of the same genus recently sent to the Indian Museum from Gauhati on the Brahmaputra by Mr. T. R. Phookun on behalf of the late Chief Commissioner of Assam.

I shall also discuss the Indian species of the genus *Discognathus*, so far as the material at my disposal permits me to do so.

Family SILURIDAE.

Euglyptosternum saisii (Jenkins).

1910. *Glyptosternum saisii*, Jenkins, *Rec. Ind. Mus.* V, p. 128, pl. vi, fig. 6.

A specimen from the Yenna (Vena) River at Medha in the Satara district agrees well with the type-specimens from Paresnath in Bihar except in being much larger; its total length is 121 mm.

In general facies the species resemble *Euglyptosternum* rather than *Glyptosternum* and I find that both in Dr. Jenkin's specimens and in my own microscopic horny teeth are scattered on the palate. They are, however, attached to skin and not to the bone and are not arranged in any definite manner. The tooth-band on the upper jaw is narrow as in *Glyptosternum*. I have examined the palate of *E. lineatum* and of several species of *Glyptosternum* and cannot discover any trace of scattered teeth.

Family CYPRINIDAE.

Lepidocephalus thermalis (C. and V.).

1889. *Lepidocephalichthys thermalis*, Day, *Faun. Brit. Ind., Fishes*, I, p. 221.

Weber¹ has shown that the clumsy generic name by which this fish and its congeners were known to Day may be abbreviated to *Lepidocephalus*.

L. thermalis is characteristic of Peninsular India and Ceylon as distinct from the Indo-Gangetic river-systems. It is not uncommon in the Yenna River

Nemachilus evezardi, Day.

(Plate I, figs. 2, 2a).

1878. *Nemachilus evezardi*, Day; *Fishes of India*, II, p. 613, pl. cliii, fig. 11.

1889. *Nemachilus evezardi*, Day, *op. cit.*, p. 226.

Hitherto known from a single specimen (now in the Indian Museum) from a stream near Poona, this little loach is actually one of the commonest species in small streamlets in the Bombay Ghats. I obtained numerous specimens at Khandalla in the Poona district and my assistant Mr. J W Caunter collected others at Khas in the Satara district, while Mr. E. A. D'Abreu of the Nagpur Museum has recently sent me one from Pachmhari in the Central Provinces. All these places lie between 2,000 and 4,500 feet above sea level.

The species is stated by Day to differ from all other Indian species of its genus in possessing a pair of nasal barbels. These

¹ *Indo-Australian Fishes*, III, p. 27 (1916).

are merely prolongations of the processes that always occur between the two nostrils on either side of the head. The colouration of the fish varies considerably in different parts of the same streamlet. When the bottom is sandy the dark bars or spots on the sides are much less strongly marked than where it is of a dark colour.

At Khandalla I found *N evezardi* with *Discognathus nasutus* and a new species of *Psilorhynchus* in hill streamlets nowhere more than a few feet in breadth. It frequented small pools, taking the place occupied by *N montanus* in similar streamlets in the Eastern Himalayas.

Nemachilus savona (Ham. Buch.).

This loach is common in many of the smaller rivers of Peninsular India and the Indo Gangetic plain. I obtained several specimens from the Yenna River at Medha.

In fresh specimens the head and forequarters are of a rather bright olivaceous green, obscurely mottled; the posterior part of the body is of the same colour but with a variable number of pale vertical bars, which vary greatly in breadth but are always narrower than the green interspaces. A purplish black band embraces the posterior extremity of the caudal peduncle and there is a black spot at the root of the dorsal fin in front. This fin is opaque white with seven longitudinal rows of small black spots, while the caudal has similar rows of black spots arranged vertically.

Nemachilus botia (Ham. Buch.).

1878. *Nemachilus botia*, Day, *op. cit.*, p. 614, pl. clvi, fig. 5.

1889. *Nemachilus botius*, Day, *op. cit.*, p. 227.

This fish is perhaps the most widely distributed of the Indian species of the genus. It occurs in small streams all over northern and central India and also on the Shan Plateau, and is not absent from the Kistna as Day thought.

Specimens from Medha agree with Day's var. *aureus* in that the lateral line disappears behind the dorsal fin, but the number of rays in that fin seems to be variable.

Nemachilus anguilla, sp. nov.

(Plate I, fig. 3; plate III, fig. 1).

D. 10 (2/8). P. 13. V 8. A 6 (2/4).

Habit elongate, shallow and somewhat compressed; total length $5\frac{1}{3}$ to $5\frac{1}{2}$ times that of head, $4\frac{3}{4}$ that of caudal fin, about 9 times the greatest depth of the body. Head narrow, conical; snout bluntly pointed, with 6 slender and rather short barbels, the rostral pair of which extend backwards almost as far as the anterior border of the eyes, while the outer maxillary pair almost

reach their posterior border. Lips greatly swollen, corrugated; the upper lip with two short, stout digitiform processes in front; the lower lip interrupted in the middle line, with two or three longitudinal ridges on either side; mouth entirely ventral. Eye large and prominent, situated dorsally near the middle of the length of the head.

Pectoral fins long and narrow, extending backwards about $\frac{2}{3}$ the distance between their own roots and those of the ventrals; ventrals narrow, extending backwards about the same distance towards the anal; anal very short, a little deeper than the body; dorsal short, a little higher than the body, with its upper margin nearly straight but sloping rapidly downwards and backwards; caudal very long, deeply emarginate, with the two halves pointed. Scales small, absent from the head, hardly distinguishable on the ventral surface of the body. Lateral line complete or nearly so.

Natural colouration.—Head and body dull golden yellow; tip of snout scarlet; numerous transverse bars of dark olive green, usually broader than the interspaces, across the back; a row of large blackish spots or blotches running along the mid-lateral line and sometimes coalescing, extended on to the caudal fin. Fins yellowish; dorsal with an anterior scarlet border and caudal broadly edged both above and below with the same colour. Red markings evanescent.

I have examined three specimens, the largest of which is 57 mm. long.

Type-specimen.—F $\frac{9692}{1}$, *Zool. Survey of India (Ind. Mus.)*.

Locality.—Yenna River at Medha, Satara district, Bombay Presidency.

Psilorhynchus tentaculatus, sp. nov.

(Plate I, figs. 4, 4a; plate III, fig. 2).

D. 9-10 (3/6-7). P. 15. V. 9. A. 6 (2/4). L. 1. 37. L. t. 6/3 $\frac{1}{2}$.

A very distinct species, distinguished from *Ps. balitora* by the possession of a pair of rostral barbels, by the fact that the dorsal fin commences immediately above the ventrals, etc.

Size small; back moderately elevated; ventral surface flat. Total length 5 to 5 $\frac{1}{2}$ times length of head, about 5 times length of caudal fin and 4 $\frac{1}{2}$ to 5 times greatest depth of body. Eye 2 $\frac{3}{4}$ to 3 $\frac{1}{2}$ times in length of head. A pair of short barbels on the snout. Upper lip long, fringed, plicate; lower lip bilobed, covered with minute tubercles. Five outer pectoral rays undivided, flattened; pectoral not nearly reaching root of ventral when adpressed; ventral a little longer than in *P. balitora*, with a small fleshy appendage at its root in the male; anterior border of dorsal immediately above that of ventral; the last undivided dorsal ray considerably shorter than the first branched ray; caudal bilobed, the lobes rounded. Lateral line complete, running along caudal peduncle. The pharyngeal bones very slender; their teeth long,

narrow and pointed, 11 in number, arranged in three rows, 2 in the outer row, 5 in the middle row and 4 in the inner row, grouped close together on a very distinct outward protuberance of the bone; the two outer teeth less sharply pointed than the others. The air-bladder well developed and distinctly divided into two parts.

Head and body dark purplish-grey or black, paler immediately above and below mid-lateral region; ventral surface white; operculum strongly iridescent, edged with white behind; a black horizontal bar or spot on the caudal peduncle edged with white posteriorly; fins whitish; dorsal more or less infuscated and with a black spot on each branched ray, caudal with its central part infuscated and with a vertically oval black spot at its base.

My largest specimen is less than 45 mm. long.

Type-specimen —F. 9695/1, *Zool. Survey of India (Ind. Mus.)*.

Distribution.—Abundant in small hill-streamlets at Khandalla in the Poona district (2-3,000 feet), less common in the Yenna River at Medha in the Satara district (2,000 feet).

Genus *Discognathus*, Heckel.

(Plate II, figs. 1-3).

1868. *Discognathus*, Günther, *Cat. Fishes Brit. Mus.* VII, p. 68.

Both the name and the species of this genus have been subjected to many vicissitudes and the Indian forms are still imperfectly known. The earlier writers on Indian ichthyology, notably Buchanan and McClelland, described a considerable number of so-called species that would now be placed in the genus, but they paid little attention to sexual differences or individual variation and their descriptions were too brief to be definitive. Day in his *Fishes of India* (1878) and his volume in the *Fauna of British India* (1889) recognized three species, *D. lamta* (Ham. Buch.), *D. jerdoni* and *D. modestus*. Günther, however, in his British Museum Catalogue (1868), though he also recognized three Indian species, gave them different names and different definitions: he called them *D. lamta*, *D. macrochir* and *D. nasutus*. Jenkins (*Rec. Ind. Mus.* III, p. 291: 1909), with Day's specimens before him, was of the opinion that they represented a single species, possibly with local varieties, while I pointed out in 1913 (*Journ. As. Soc. Bengal*, n. s. IX, p. 36) that a considerable number of forms occurred in different parts of the Indian Empire that were at least worthy of racial distinction. In the meanwhile Vinciguerra¹ had not only discussed the form he believed to be Buchanan's *Cyprinus lamta* but had also described a very distinct Burmese species under the name *D. imberbis*. Finally, in the early part of the present year, I was able to provide evidence that two distinct species occurred in the Southern Shan States and that one of them was the *D. lamta* of Day (*Rec. Ind. Mus.* XIV, p. 45).

¹ *Ann. Mus. Stor. Nat. Genova* (2) IX (XXIX), pp. 275-280, figs. (1889).

Since I discussed the collection from the Inlé Lake I have had an opportunity of examining a large series of fresh and well preserved specimens of the two commonest Indian forms from the Deccan and elsewhere. The names most convenient for these two forms are *D. lamta*, Day and *D. nasutus* (McClelland). I give Day and not Buchanan as the author of the former, because it is impossible to be sure as to the species to which Buchanan first applied the name *Cyprinus lamta*; his original figures in the library of the Asiatic Society of Bengal cast no light on the subject.

A great deal of the uncertainty about the Indian species of the genus has arisen from the fact that the marked and constant structural characters which separate these two forms are to some extent concealed by bad preservation of specimens. The essential differences between *D. lamta* and *D. nasutus* (= *D. modestus*, Day) are correlated with the fact that whereas the former lives in the pools of larger streams in or near the plains or even in upland lakes, the latter is an inhabitant of mountain torrents. In *D. lamta*, although the fish can cling to vertical surfaces by means of its mental disk, the abdomen is not flattened, the pectoral fins are set obliquely on the sides of the body and the rays are not greatly flattened or expanded. In *D. nasutus* on the other hand the fins and chest are modified to form an organ of adhesion, as is well shown in fig. 2a, pl. II. Unless great care is exercised in preserving specimens of *D. lamta*, however, the ventral surface collapses and though the structure of the pectoral fins remains of course unchanged, their relations to the chest and to one another are distorted. The form I describe here as *D. graveleyi* is allied to *D. lamta*, from which it differs in outline, in the shape of the head and in the form of the mental disk.

The form Day called *D. jerdoni* seems to me to be distinguished from *D. lamta* by characters which are quite apparent when adult specimens are compared.¹ They lie mainly in the shape and proportions of the body and the relative size of the head and eye.

D. macrochir (McCl.) from Assam is evidently allied to *D. nasutus*, but may be distinct.

Two forms of the genus occur in Syria and Mesopotamia. One of these (*D. rufus*, Heckel) I regard as a variety of *D. lamta*, while the other (*D. variabilis*,² Heckel) differs from all the Indian forms in having only one pair of barbels. A form has been described from Southern Arabia and the Punjab Salt Range the male of which bears a forwardly directed tubercular appendage on the

¹ Since this paper was written I have examined a good series of fresh specimens from the Bhavani River at the base of the Nilghiris. They fall definitely into three species, two of which are distinguished from all those included in my key by the possession by the adult male of a conical tuberculate process between the nostril. I hope to discuss this new material shortly.

² This species also occurs in the Helmand basin, possibly within the limits of the Indian Empire. See Tate Regan, *Fourn. As. Soc. Bengal*, (n.s.) II, p. 8 (1906).

head, but no specimens of this form are at present in Calcutta. The only species known from the Malay Archipelago is *D. borneensis*, Vaillant, which has larger scales than any Indian species.

Key to the Asiatic forms of Discognathus at present described.

- I. No barbels. L.L. 44 *D. imberbis.*
- II. Two barbels. L.L. 38-40 *D. variabilis.*
- III. Four barbels. L.L. 28 *D. borneensis.*
- IV. Four barbels. L.L. 32-36.
 - A. Pectoral fins entirely horizontal, with their rays broad and flat; chest flat, without scales.
 - 1. Pectoral fins longer than head, their tips extending nearly to base of ventrals ... *D. macrochir.*
 - 2. Pectorals hardly longer than head, their tips not approaching the base of the ventrals *D. nasutus.*
 - B. Pectoral fins set obliquely on the sides of the body; chest convex, with scales.
 - 1. Pectoral fins longer than head, their tips approaching the base of the ventrals; eye much nearer margin of opercle than tip of snout; 2nd dorsal fin-ray slender ... *D. graveleyi.*
 - 2. Pectoral no longer than head, not approaching base of ventrals; eye near middle of head; 2nd dorsal fin-ray stout.
 - a. Posterior barbels longer than anterior; pectorals directed backwards and upwards, arising some distance from ventral surface *D. lamta* var. *rufus.*
 - b. Barbels subequal, anterior pair usually a little longer; pectorals directed backwards and a little downwards, arising immediately above ventral surface.
 - i. Length of head 5 to 5½ times in total length; dorsal profile convex in adult male ... *D. lamta* (s.s.)
 - ii. Length of head 6 to 6½ times in total length; dorsal profile nearly straight in adult male *D. jerdoni.*

***Discognathus lamta* (Ham. Buch.), Day.**

(Plate II, figs. 1, 1a).

- 1841. *Chondrostoma mullya*, Sykes, *Trans. Zool. Soc. London*, II, p. 359.
- 1889. *Discognathus lamta*, Day, *Faun. Brit. Ind. Fish.*, I, p. 246, fig. 87.
- 1909. *Discognathus lamta*, Jenkins, *Rec. Ind. Mus.*, III, p. 291 (in part).
- 1913. *Discognathus lamta*, Annandale, *Journ. As. Soc. Bengal*, (n.s.) IX, p. 36, fig. 1.
- 1918. *Discognathus lamta*, *id.*, *Rec. Ind. Mus.*, XIV p. 45.

The form to which I give this name is certainly the *D. lamta* of Day, but there is some doubt as to whether Buchanan's *Cyprinus lamta* was not rather the form called *D. modestus* by Day and *Platycara nasuta* by McClelland. In any case, as the point cannot be settled satisfactorily, it is best to accept Day's nomenclature so far as *D. lamta* is concerned.

In this species the abdomen is naturally convex (it is apt to collapse in preserved specimens) and the pectoral fins are set on the sides of the body a short distance above the ventral surface and somewhat obliquely. These fins, though sometimes as long as the head, are usually a little shorter; the distance between their tips and the base of the ventrals is about $\frac{1}{2}$ their own length; they are not greatly expanded and only the outermost ray is simple and flattened. The eye is variable in size even in specimens from precisely the same locality, but its length is usually contained at least very nearly 5 times in the length of the head; its upper border is situated considerably below the upper profile of the head. The upper profile of the body is arched. A broad but shallow depression runs across the snout of the adult male a little in front of the eyes and the region immediately in front of and behind it is covered with prominent tubercles.

D. lamta is common in the river at Medha, where it is captured in considerable numbers for food by fishermen using cast-nets. Specimens are very similar to those recently obtained in the Shan States (*op. cit.*, 1918), but perhaps a little darker in colour. The largest collected is 152 mm. long. The sides and back of the head and body are dark olivaceous green. Traces of a darker mid-lateral stripe extending on to the caudal fin can be detected, and of a small dark spot just behind the upper angle of the opercle. The free border of the opercle is paler and the ventral surface yellowish. The fins are pale olivaceous.

Discognathus jerdoni, Day.

1889. *Discognathus jerdoni*, Day, *op. cit.*, p. 247.

This species is distinguished from the former by the following characters:—

- (a) The head is relatively smaller.
- (b) The eye is as a rule larger in proportion to the head.
- (c) The pectoral fin is much shorter than the head and its tip is further removed from the root of the ventral fin.
- (d) The body is less elevated, the dorsal and ventral profiles being nearly parallel in the adult male.

I can detect no real difference in the scales and fin-rays.

Discognathus nasutus (McClelland).

(Plate II, figs. 2. 2a).

1839. *Platycara nasuta*, McClelland, *As. Res.* IX(2) (*Ind. Cypr.*), p. 300, pl. lvii, fig. 2.

1871. *Mayoa modesta*, Day, *Journ. As. Soc. Bengal* (2)XL, p. 108, pl. ix, fig. 2.

1889. *Discognathus modestus*, Day, *op. cit.*, p. 247.

1890. *Discognathus lamta*, Vinciguerra, *Ann. Mus. St. Nat. Genova* (2)IX, p. 270, fig.

McClelland's figure is a somewhat exaggerated presentment of an adult male of this form, which must be accepted as specifically distinct in that it exhibits quite definite and constant structural modifications. It differs from *D. lamta* in the following characters :—

- (a) The head is flattened and depressed in such a way that the upper border of the eye is practically co-terminous with the upper profile. The whole of the upper profile is straight and horizontal.
- (b) The abdomen is flat, and the chest is both flattened and expanded.
- (c) The adhesive organ on the lower lip is much larger.
- (d) The pectoral fins are enlarged and expanded, being always longer than the head and separated when adpressed from the ventrals by a distance less than half their own length. They are set on the body horizontally at the junction of the ventral and lateral surfaces and form with the chest an organ of adhesion.
- (e) Several of the outer pectoral rays are simple and flattened.
- (f) The whole of the dorsal and lateral surfaces is nearly black, the ventral surface dead white.
- (g) The length rarely if ever exceeds 110 mm.

This species is found only in small hill streamlets. It occurs in the Himalayas, the hills of Assam, the Western Ghats, the hills of the Central Provinces and probably those of Burma. Vinciguerra's figure cited above seems to represent this species rather than *D. lamta*, but probably he had examined specimens of both.

Discognathus gravelyi, sp. nov.

(Plate II, figs. 3, 3a).

Having now been able to compare good series of well-preserved specimens of *D. lamta* from districts so far apart as the Shan States and the Deccan, and having found certain differential characters quite constant, I no longer hesitate to describe the new species referred to in my recent account of the fish of the Inlé Lake (*Rec. Ind. Mus.* XIV, p. 45 : 1918). It is distinguished from *D. lamta* by the different shape and the larger size of its mental disk, by the different shape of the head, by its larger scales and apparently also by difference in the formulae of the fin-rays.

D. 10(2/8). P. 14. V 8. A 7(2/5). L. tr. 3½/3.

The total length is 5⅔ times the greatest depth of the body and a little more than 5 times the length of the head. The length of the eye, which is large and prominent, is contained a little more than 4½ times in that of the head. The snout is somewhat produced and in the adult male there is a deep but narrow

transverse groove just behind the tip. The dorsal profile slopes abruptly from a point a little in front of the dorsal fin to the tip of the snout and, although the head is not flattened, the upper border of the orbit is practically co-terminous with its upper surface; behind the dorsal fin the profile is highly convex. The upper lip is very broad, the lower lip greatly enlarged, the mental disk large and subcircular; the fringe of the lower lip broad, with the margin semicircular. In the adult male there is a semicircle of glandular openings beneath and behind the eye. There are four short barbels, those at the angle of the mouth being particularly small. The ventral surface is convex and the scales extend all over the chest. The pectoral fins are longer than the head and broad in proportion, but they are lateral and oblique. They extend backwards almost as far as the base of the ventrals, but their rays are not flattened and expanded. The ventrals are also large and almost reach the anal when adpressed. The caudal is deeply forked and the upper lobe is a little smaller than the lower. The dorsal is short; its unbranched rays are slender and not at all ossified, but the second is longer than the head.

Colouration.—Head and body purplish-brown, with a darker mid-lateral streak and a dark horizontal lunate mark on the caudal peduncle; ventral surface slightly paler; pectoral fins infuscated, with pale edges; other fins pale yellowish clouded towards the base with a dusky brown.

The only specimen I have seen, an adult male, is 112 mm. long.

Type-specimen.—F 9694/1, *Zool. Survey of India (Ind. Mus.)*.

Locality.—Stream at He-Ho, Yawnghwe State, Southern Shan States, Burma: alt. 3,800 feet.

The type-specimen was taken with typical specimens of *D. lamta*.

Genus *Barbus*, Cuvier.

There are few genera among the freshwater fish that have received greater difference of treatment from different ichthyologists than this. Day in his works on Indian ichthyology recognizes three subgenera or groups of species, while Boulenger in his "Fishes of the Nile" and in his recent monograph of the freshwater fishes of Africa divides the genus into a number of sections for which he does not provide names. Weber, on the other hand, in the third volume of his "Indo-Australian Fishes" recognizes a number of distinct genera among the species placed in *Barbus* by other authors, but denies the occurrence of *Barbus* s.s. in the Malay Archipelago. So far as specific limits and definitions are concerned there is still much confusion among the Indian species, and this is the case not only with rare and inconspicuous forms but even with some of the largest and most conspicuous. Indeed, there is no group in which confusion is greater than that of the Mahseer so familiar to Indian sportsmen.

I have not the material to attempt a revision of the Mahseer group, specimens of which are difficult to preserve in large series on account of their size, but two species have recently come to my notice which it seems justifiable to rescue from the oblivion of synonymy as they possess differential characters of a marked nature and likely to be constant. These species are *Barbus putitora* (Ham. Buch.) and *Barbus mussullah*, Sykes. That Hamilton's *mossul* and Jerdon's *hamiltonii* differ in some respects from the *forma typica* of *Barbus tor* the collection in the Indian Museum provides abundant evidence, while specimens from the upper Kistna seem to differ from any of these; but the question whether the differences should be considered specific or merely racial must be left to be answered with more extensive experience.

Another group of species in which confusion exists so far as the Indian forms are concerned is that popularly called Carnatic Carp. It is, indeed, doubtful how far this designation has any scientific basis, for certain species so called have no more than a distant resemblance to *Barbus carnaticus* (Jerdon).

I have nothing particular to say about the species of *Barbus* (*B. malabaricus*, *B. kolus* and *B. ticto*) that I obtained at Medha myself, but Mr. McIver has sent me specimens of three species from the Kistna near Satara that are of considerable interest. Two of these may be called Mahseer, while the third is known locally as the Carnatic Carp.

***Barbus tor* (Ham. Buch.).**

(Plate III, figs. 3, 3a).

It is not yet possible to discuss the races or species of the Mahseer, of which six or seven probably exist in different parts of the Indian Empire, in a satisfactory manner. Specimens sent me from the Kistna River near Satara by Mr. McIver certainly differ both from the north Indian and the south Indian forms and probably represent an undescribed race, which has only 3 rows of scales above the lateral line and 12(3/9) dorsal fin-rays. Mr. McIver informs me that it grows to a large size.

***Barbus mussullah*, Sykes.**

(Plate III, figs. 4, 4a).

1841. *Barbus mussullah*, Sykes, *Trans. Zool. Soc., London* II, p. 356, pl. lxi, fig. 4.

Sykes's description of this fish is inadequate and his figure inaccurate, but he refers to and illustrates one trivial but apparently constant character that gives me confidence in identifying specimens sent by Mr. McIver. This character is the presence under the eye of a group of small tubercles not confined to one sex and visible with the aid of a lens in quite young fish.

A more important differential character, not recognized by Sykes but shown in his figure, is, however, to be found in the

structure of the mouth, the opening of which is much more oblique than in any race of *Barbus tor*. The extremity of the maxillary lies directly under the middle part of the eye. This feature is well shown on plate III. There are 13 (3/10) dorsal and 8 (3/5) anal fin-rays; 25-26 scales in the lateral line, 4 rows of scales above it and 3 below.

B. mussullah is common in the upper Kistna, where it occurs with the local race of *B. tor*. The Maharatta fishermen of Satara never fail to distinguish the two species. *B. tor* they call *Kudis*; *B. mussullah*, *Masundi*. Mr. McIver, to whom I am indebted for this information, has caught a specimen of the *Masundi* 21 lbs. in weight.

Barbus putitora (Ham Buch.).

(Plate III, fig. 5).

1822. *Cyprinus putitora*, Hamilton, *Fishes of the Ganges*, p. 303.

Having received some time ago a large *Barbus* from Gauhati in Assam that was evidently related to but distinct from any of the races or species at present included under the name *Barbus tor*, I have made a careful examination of it and have compared it with the specimens labelled by that name in the collection of the Indian Museum. From these specimens it differs not only in shape and proportions but also in having only two undivided rays in the dorsal fin and only 15 rays in the pectoral fins. As these characters are given by Hamilton among those proper to his *Cyprinus putitora*, I have little doubt that our specimen is identical with that form and must be called *Barbus putitora*. It may be redescribed as follows:—

D 10-11 (2/8-9). P. 15. V. 9. A 7 (2/5). L. 1 27. L. tr. $3\frac{1}{2}/2\frac{1}{2}$.

The habit is stout and though the body is somewhat compressed it may almost be described as subcylindrical; its depth is contained only a little more than 4 times in the total length. The length of the head is contained between $4\frac{1}{2}$ and $4\frac{3}{4}$ times in the total length and is thus distinctly less than the greatest depth of the body. The snout is blunt and very little declivous; the length of the part of the head in front of the eye is about $\frac{2}{3}$ of that of the part behind the eye. The upper profile of the head and body is feebly arched, the curve of the lower profile a little more marked. The mouth is protrusible and nearly horizontal the posterior end of the maxilla is in front of the eye; the lower jaw is shorter than the upper. The lips are thick and fleshy but not produced forwards; the lower lip is slightly retroverted in the middle line. There are 4 barbels; the anterior pair is much shorter than the posterior; the latter extend backwards to a point under the middle of the eyes. The nostrils are a little nearer the eyes than the tip of the snout. The eyes are rather small, their diameter being contained about $7\frac{3}{4}$ in the length of the head. The cheeks are quite smooth. All the fins are relatively small. The dorsal is short and about $\frac{2}{3}$ as deep as the

body. The first dorsal ray is stout and bony but short, the second, which is also bony, tapers to a fine point and is about $\frac{2}{5}$ as long as the head; it is quite smooth. The anterior root of this fin lies immediately above that of the ventrals. The pectorals are particularly small, their length is between $\frac{2}{3}$ and $\frac{3}{4}$ that of the head. The ventrals, from which they are widely separated, are considerably shorter; their tips do not quite reach the vent. The anal is distinctly pedunculate. The caudal peduncle is well differentiated but less than twice as long as deep; it is strongly compressed. The caudal fin is short; its upper lobe is distinctly sharper and more produced than the lower lobe. The scales are very large; sometimes notched in front. Their exposed parts are marked with delicate longitudinal striae. The lateral line is rather obscure.

The only specimen of this fish that I have seen was sent from Gauhati on the Brahmaputra by Mr. T. R. Phookun. It is 115 cm. long and is preserved stuffed, its number in our register being F 9654/1.

Barbus jerdoni, Day.

(Plate II, fig. 4, var. *maciveri*, nov.).

1889. *Barbus jerdoni*, Day, *op. cit.*, p. 312.

1889. *Barbus dobsoni*, *id.*, *ibid.*

As Day himself suggests in his *Fishes of India* (p. 568), the two forms included in the above synonymy are merely varieties or local races of the same species. The only constant difference that I can find between the specimens in his own collection are that the body is considerably deeper in *B. dobsoni* than in *B. jerdoni* and that there are more scales below the lateral line in the former. Mr. McIver has sent me specimens from the Kistna River near Satara that represent a third variety, which has the following differential characters:—

D. 13 (4/9). A. 8 (3/5). L. 1. 31-33. L. tr. $5\frac{1}{2}/3\frac{1}{2}$.

Depth of body $3\frac{2}{3}$ to 4 times in total length; length of head about $5\frac{2}{5}$ times in total length; diameter of eyes $3\frac{1}{2}$ times in length of head. The body is brownish above and the caudal, dorsal and anal fins are tipped with black. The specimens I have examined are small (not more than 151 mm. long), but Mr. McIver tells me that the form attains a weight of 20 to 25 lbs. I propose for it the name var. *maciveri*. The Maharatta name at Satara is *purgi*; Mr. McIver refers to the fish as the "Carnatic Carp of the Krishna."

Type-specimen of variety.—F 9576/1, *Zool. Survey of India (Ind. Mus.)*.

Family OPHIOCEPHALIDAE.

Ophicephalus gachua, Ham. Buch.

This widely distributed species, of which specimens were taken in the river at Medha and in artificial ponds at Khandalla,

is much more variable in the number of its dorsal and anal fin-rays than published descriptions indicate. The Assamese form *O. stewarti*, Playfair, and my own recently described *O. harcourt-butleri* from the Southern Shan States may ultimately prove to be no more than local races. In both of these the number of vertical fin-rays is variable. In *O. harcourt-butleri*¹ there are from 28 to 38 in the dorsal fin and from 16 to 25 in the anal. Dr. Chaudhuri tells me that in a series of *O. stewarti* from Shillong he finds the corresponding numbers to be 34 to 39 and 22-27. In the typical *O. gachua* the variation is at least as great as in the latter, but it will be better to defer a more precise statement until good series are examined from numerous localities.

Family GOBIIDAE.

Gobius bombayensis, sp. nov.

(Plate I, fig. 5).

A small species resembling *G. viridipunctatus*, Day, but with fewer vertical fin-rays and without enlarged canine teeth; allied to *G. chilensis*, Jenkins,² but with a much longer snout and smaller caudal fin.

D. 6-1/7-8. P. 17-18. A. 1/7. L.e. 28-29. L. tr. 7.

Size small; habit slender, slightly compressed. Total length about $4\frac{1}{4}$ the length of the head and about $5\frac{1}{4}$ the greatest depth of the body. Dorsal profile slightly arched. Caudal peduncle distinct, rather more than twice as long as deep. Head coarse; snout blunt, rather short, less than $\frac{1}{2}$ as long as the part of the head behind the eye, nearly twice as long as the eye. Mouth large, slightly oblique; the posterior extremity of the maxilla situated below the middle of the eye; lower jaw very slightly longer than the upper; teeth small; tongue notched in front, without teeth. Eye large and prominent, its length contained 5 times in the length of the head. Dorsal fin low, with none of the rays elongate.

Colouration.—Pale yellowish, irregularly blotched with black. Anterior dorsal fin infuscated, with a rather deep whitish border; posterior dorsal with three longitudinal rows of small dark spots; other fins irregularly infuscated, the caudal with obscure and irregular vertical dark bars.

The largest specimen examined is 42 mm. long.

Type-specimen.—F 9698/1, Zool. Survey of India (Ind. Mus.).

Locality.—The species is not uncommon in the Medha river at Satara.

¹ *Rec. Ind. Mus.*, XIV p. 54, fig. 2, pl. ii, fig. 7, pl. iv, figs. 16, 17 (1918).

² *Rec. Ind. Mus.*, V, p. 137, pl. vi, fig. 2.

VI. SOME FRESHWATER MOLLUSCS FROM THE BOMBAY PRESIDENCY.

By N. ANNANDALE, D.Sc., C.M.Z.S., *Director, Zoological Survey of India*, and B. PRASHAD, D.Sc., *Superintendent of Fisheries, Bengal, Bihar and Orissa*.

The molluscs discussed in these notes are for the most part common species of wide geographical range. This makes it the more necessary that their differential characters should be understood, exact localities put on record and the precise environment which each affects described. Unfortunately nothing was known as to the anatomy of the commonest Indian freshwater molluscs when Preston's volume in the official *Fauna of British India* was written, and very little attention was paid by him even to published records of locality. Two of the species we have to consider are of particular interest on account of their habitat. They are *Cremnoconchus syhadrensis*, a Littorinid which lives on inland cliffs at the edge of waterfalls, and *Ampullaria nux*, which, unlike other Indian species of its genus, frequents small hill-streams.

The following species were taken in the river at Medha:—*Melania tuberculata*, *M. scabra*, *Parreyssia cylindrica*, *P. corrugata* and *Lamellidens marginalis*. *Ampullaria nux* and *Cremnoconchus syhadrensis* were found on the hill-side at Khandalla.

We also discuss specimens from ponds at Khandalla, and from reservoirs in the Satara fort, at Karla in the Poona district and at Igatpuri in the Nasik district.

We may note here, though the fact is perhaps of archaeological rather than malacological interest, that single valves of *Arca granosa* are occasionally found in the Yenna. They are invariably pierced in the umbonal region and probably served as ornaments for some jungle tribe which has now disappeared or become civilized and ceased to affect such primitive decorations.

Family LIMNAEIDAE.

Genus *Limnaea*, Lamarck.

Preston, in his volume in the official *Fauna of British India*, gives descriptions of twenty-eight Indian species and varieties of this genus, but (although he describes *L. bowelli*, a Tibetan mollusc not found within the limits of the Indian Empire), he makes no reference to the peculiar forms of *L. lagotis*¹ long known to occur in Kashmir, the Kangra Valley and Baluchistan, or to *L. andersoniana*,² which Nevill reported from the Shan States of Burma as well as from Western China. One of us has recently added two

¹ See Nevill's *Hand List*, pt. I, pp. 234, 237, 239 (1889); also Hanley and Theobald's *Conch. Ind.*, pl. lviii, fig. 7 (1876).

² Nevill, *Fourn. As. Soc. Bengal*, (ii) XLVI, p. 26 (1877), and l., p. 142, pl. v, fig. 9.

further species¹ from the Shan States to the Indian fauna, namely *L. shanensis* of which several extinct phases as well as the living form have been described; and the highly peculiar *L. mimetica*.

The shell is extraordinarily plastic in *Limnaea* and it is of great importance that the genitalia, the radula and the structure of the upper jaw should, whenever possible, be examined in the identification of the species. In the genitalia we find the most constant differences in the relative lengths of the different parts of the main ducts, in the form of the penis-sheath and in the presence or absence of the spermathecal duct.

Limnaea acuminata, Lamarck.

(Plate V, fig. 1).

1890. *Limnaea acuminata* varr. *patula* and *rufescens*, Von Martens, *Conch. Mitth.* I, pp. 75, 76, pl. xiv, figs. 1-3.

We confine this name to the forms in which the outer margin of the aperture of the shell is regularly curved, thus excluding both *L. chlamys*, Benson and *L. amygdalum*, Troschel.

The radula (fig. 1) is rather broad. The lateral teeth have three distinct cusps; there are about nine rows of lateral teeth on each side of the central tooth, but there is no very abrupt difference between the lateral and the marginal teeth, of which there are at least twenty rows on each side. The central tooth is practically unicuspid, and the single cusp is narrowly produced. The lateral teeth are very broad, their central cusp is not much larger than the two lateral ones, which are subequal; the outer lateral cusp is considerably nearer the base of the projecting part of the tooth than the inner one. The marginal teeth have from three to six rather short and blunt cusps, the outermost of which is situated near the base of the projecting part.

The central piece of the horny upper jaw is broad and strongly convex, but hardly beak-like; it is of a dark brown colour.

The genitalia are of normal type. The duct of the hermaphrodite gland is short and coarse, never much longer than the gland itself, it does not appear to be swollen at the point at which the male and female ducts diverge. In the male duct the part between the prostate and this point of divergence is slightly longer than that between the prostate and the proximal end of the penis-sheath, which is of considerable length, sausage-shaped and rather narrow. The albumen and accessory glands are rather large in the specimens examined; they arise close together and are situated much nearer to the uterus than to the hermaphrodite gland. The oviduct is very short; the uterus is elongate and narrow; and the spermatheca, which is pear-shaped when fully mature, is almost sessile.

¹ Annandale, *Rec. Ind. Mus.*, XIV, pp. 107-109, pl. x, figs. 5, 8, 9, pl. xi, figs. 2, 3, 4 (1918).

This species was found in considerable abundance at Khandalla in pools containing an abundant aquatic vegetation but largely of artificial origin and formed by the damming of small hill-streams.

The shells bear a close general resemblance to Von Marten's figure of the var. *patula*, but vary considerably in the breadth of the body-whorl. Most of the adult specimens are not more than about 19 mm. long and about 10 mm. broad. Occasionally, however, very much larger and broader individuals occur in the ponds. The shells of such individuals are always eroded on the surface and have the apex more or less eaten away; if complete they would be about 30 mm. long and 18 mm. broad. The aperture of the shell is relatively large (about 21 mm. by 11 mm.). Such shells are evidently those of aged individuals which have survived the vicissitudes to which most of their contemporaries have succumbed.

The Oligochaete worm *Chaetogaster* was frequently observed on this mollusc at Khandalla.

The species is one of the commonest of the Indian *Limnaeae*, and has been found in many parts of Peninsular India and the Indo-Gangetic Plain.

Limnaea acuminata var. *nana*, nov.

(Plate IV, fig. 1; pl. V, fig. 2).

The shell of this form (pl. IV, fig. 1) is very small, rather thick, of a blackish colour and with the longitudinal striae very strongly developed. In outline it somewhat resembles the var. *rufescens*, Gray, as figured by Von Martens in the paper cited above, but the spire is relatively longer, the body-whorl more swollen, the columellar callus coarser and the aperture narrower and somewhat curved inwards posteriorly.

Measurements of type-specimen.

Length	9.3 mm.
Breadth	.. 5.6 mm.
Length of aperture	. 6 mm.
Breadth of aperture	3 mm.

Shells of this size are sexually mature. The radula (fig. 2, pl. V) differs from that of the typical form mainly in the greater irregularity of the shape of the teeth. Even in parts which are quite unworn the cusp of the central tooth is irregular and often asymmetrical. The cusps of the lateral teeth are shorter and the inner cusp is relatively smaller. In the marginal teeth the second and the innermost cusps are considerably enlarged.

The central piece of the horny upper jaw is narrower, paler in colour and apparently less convex than in the *forma typica*.

The genitalia (text-fig. 3) agree precisely with those of the typical form.

Type-specimen.—No. M 11397/2 in the register of the Zoological Survey of India (*Indian Museum*).

Locality.—Khandalla, Poona district, Bombay Presidency; altitude 2,500 ft., March, 1918.

We have thought it convenient to give this form a varietal name as the characters are constant in the series we have examined. We believe, however, that its peculiarities are due to the unfavourable conditions in which the individuals were living. They were found at the side of the railway line in a small ditch not more than a couple of feet wide and three or four inches deep. The bottom was muddy and there was a considerable but ephemeral vegetation of semi-aquatic plants. Some of the shells possess a kind of varix (pl. iv, fig. 1) across the middle of the body-whorl; this we believe to be probably due to a temporary cessation in shell-production at a time when the water in the ditch had completely

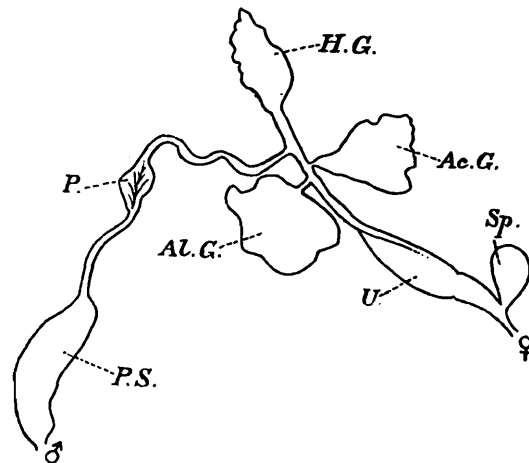


FIG. 3.—Genitalia of *Limnaea acuminata* var. *nana*.

Ac. G.=accessory gland. Al. G.=albumen gland. H. G.=hermaphrodite gland. P.=prostate. P. S.=penis-sheath. Sp.=spermatheca. U.=uterus.

dried up, and the animal had buried itself deeply in the mud, as molluscs of this genus do in periods of drought. The ditch was situated within a few hundred yards of the ponds in which the typical form of the species was found.

Limnaea chlamys, Benson.

(Plate V, fig. 3).

1836. *Limnaea chlamys*, Benson, *Fourn. As. Soc. Bengal*, V, p. 744.

1876. *Limnaea chlamys*, Hanley and Theobald. *Conch. Ind.*, pl. lxix, figs. 5, 6.

The radula and genitalia of this form seem to us sufficiently different from those of *L. acuminata* to justify specific separation. The shell may be distinguished by the obliquity of the body-whorl and by the peculiar curvature of the outer margin of the aperture.

The measurements of a specimen are as follows:—

Length	15 mm.
Breadth	9 mm.
Length of aperture	9 mm.
Breadth of aperture	6 mm.

The radula (pl. V, fig. 3) is very similar to that of *L. acuminata*, except that the central cusp of the lateral teeth is considerably longer, all the cusps of these teeth sharper, and in there being a second internal cusp resulting in four cusps in all; the fourth cusp is situated at a lower level than the others. The cusps of the marginal teeth are more regular and have a distinctly pectinate appearance. The central tooth is trilobed and distinctly asymmetrical.

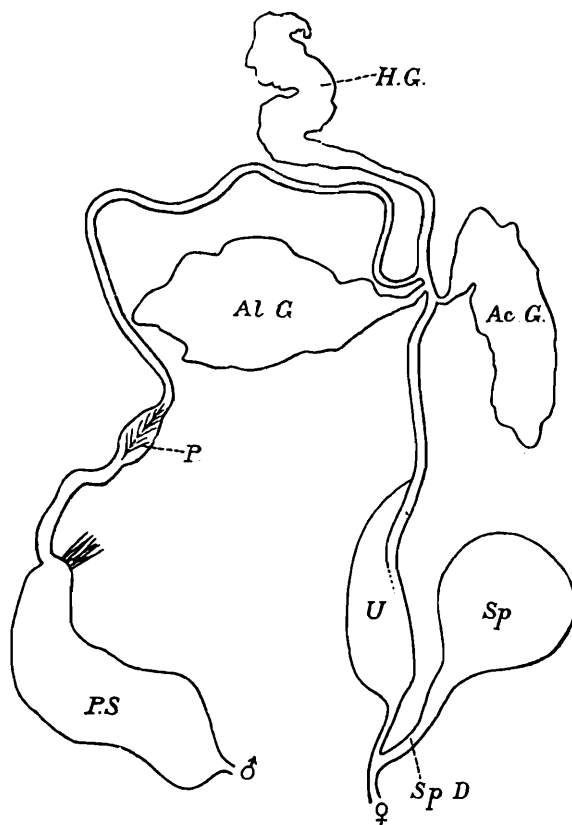


FIG. 4.—Genitalia of *Limnaea chlamys*, Benson.
Lettering as in fig. 3, p. 142. Sp. D.=spermathecal duct.

The central part of the horny upper jaw is broad, but the outer margin is less convex than in *L. acuminata*; its colour is paler than in that species.

The genitalia (text-fig. 4) of this species differ from those of *L. acuminata* mainly in the much greater length of the proximal part of the male duct and the hermaphrodite duct; in the position of the accessory and the albumen glands, which are situated close to the junction of the male and female systems rather nearer the hermaphrodite gland than the uterus, and in the considerable length of the spermathecal duct, which is as long or nearly as long as the spermatheca. The penis-sheath is also thicker.

A large series of specimens was obtained in one of the artificial ponds in the old fort on the hill-top immediately above the town of Satara. The bottom of this pond, which is shallow, is rocky but covered with a growth of minute green algae on which the molluscs were apparently feeding. The shells are all small and fragile, of a pale but bright yellowish colour, and with the microscopic sculpture less marked than is usually the case. The Oligochaete worm *Chaetogaster* was abundant on these molluscs also.

Limnaea pinguis, Dorhn.

(Plate V, fig. 4).

1876. *Limnaea pinguis*, Hanley and Theobald, *Conch. Ind.*, pl. lxx, figs. 7, 8, 10.

Two individuals of this form were found among a large series of *L. acuminata* from the ponds at Khandalla. The shells of

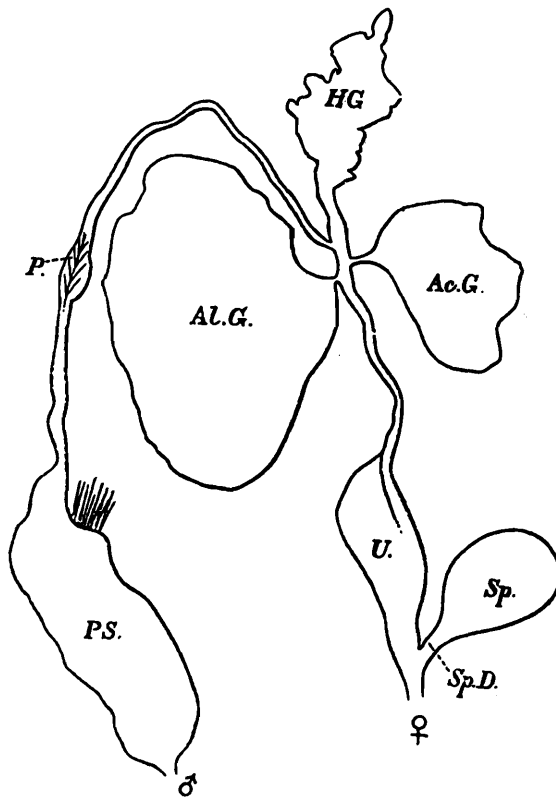


FIG. 5.—Genitalia of *Limnaea pinguis*, Dorhn.
Lettering as in figs. 3, 4, pp. 142, 143.

these two specimens are rather narrow and of small size; the longitudinal striae are very well developed and the shell is very pale in colour. *L. pinguis* may prove synonymous with *L. succinea*, Desh.

The measurements of one of the specimens are as follows:—

Length	.	21 mm.
Breadth	..	11 mm.
Length of aperture	.	12.5 mm.
Breadth of aperture	.	6.5 mm.

The radular teeth (fig. 4, pl. V) are coarser in this species than in the other two we have discussed. The central tooth is small, often distinctly asymmetrical and with either two or three lobes. The lateral teeth have three distinct cusps, but the innermost is strongly curved and bends outwards towards or even beneath the median cusp¹ in a very characteristic fashion; the central cusp is much larger than the outer one. There are only about six rows of lateral teeth. The marginal teeth have a considerable number of cusps the outermost of which is much coarser and nearer to the base than the others, especially towards the edge of the radula.

The middle piece of the horny upper jaw is broad and coarse and of a dark brown colour; the cutting edge is nearly straight.

In this species the genitalia (fig. 5) closely resemble those of *L. chlamys*, but all the ducts are shorter and the distal part of the male duct is hardly longer than the proximal part. The spermathecal duct, although distinctly present, is much shorter than the spermatheca.

Genus *Planorbis*, Geoffroy.

The Indian species of this genus are still very imperfectly known. The large collection of shells belonging to the Indian Museum has recently been examined by M. L. Germain of the Paris Museum but the transmission of the manuscript of his report upon it has been delayed by the war.

Planorbis exustus, Desh.

1918. *Planorbis exustus*, Annandale, *Rec. Ind. Mus.* XIV, p. 111, pl. xi, figs. 1, 1a.

This is certainly the most abundant species as well as the largest commonly found in the plains of India. It is, however, scarcer as a rule in hilly country. A young specimen was obtained in the ponds at Khandalla.

Planorbis labiatus, Benson.

1915. *Planorbis (Gyraulus) labiatus*, Preston, *Faun. Brit. Ind. Freshw. Moll.*, p. 119, fig. 5.

A specimen from the ponds at Khandalla agrees well with Preston's figures of the type-specimen.

Family MELANIIDAE.

Genus *Melania*, Lamarck.

Two species of this genus were found in abundance at the edge of the Yenna River at Medha, and at other places in the

¹ The innermost cusp is much larger and more distinct from the median cusp in a specimen from Madras (presented by the late Prof. Gwatkin) than in the one we have figured. Its outward curvature is, however, just as strongly marked and characteristic.

Satara and Poona districts. They are *M tuberculata* and *M scabra*, perhaps the two commonest and the most widely distributed of the Indian species.

Melania tuberculata (Müller).

(Plate V, fig. 5).

1918. *Melania tuberculata*, Annandale, *Rec. Ind. Mus.* XIV pp. 114, 115, pl. xii, figs. 1, 2.

In the paper cited one of us has recently discussed the variation and plasticity of the species. Shells from the Yenna River are of the typical form but pale in colour, with the reddish markings very conspicuous. Specimens from the Igatpuri Lake, an artificial reservoir situated at about the same altitude in the Nasik district, are a little stouter and have the sculpture deeper; they are as a rule still paler and have the reddish marks even more conspicuous, but there is a tendency for the older whorls to be blackened. Several individuals of a dwarfed type were found living in a small ditch at Khandalla with *L. acuminata* var *nana*, they resemble the form from the pools of brackish water at Port Canning figured (fig. 6*f*) in the paper cited above. They are darker in colour than others from the same district, but this appears to be due largely to a deposit formed on their surface. Most of the Medha shells are not more than 25 mm. long, but occasionally larger individuals of a somewhat more elongate type occur.

We give measurements of the largest shells from each of the three localities; none of them are much eroded.

	Length.	Breadth.	Length of aperture.	Breadth of aperture.
Medha	{ 25 mm.	8.7 mm.	8.8 mm.	4.3 mm.
	{ 31.4 mm.	10.3 mm.	9 mm.	5 mm.
Igatpuri	22 mm.	8 mm.	7.8 mm.	4.2 mm.
Khandalla	. 16 mm.	5.4 mm.	5.2 mm.	3 mm.

We figure the radular teeth (fig. 5, pl. v) of a specimen from Igatpuri. They are of the type normal in the genus, and differ (according to Heude's figure) from those of *M jacquetiana*, Heude,¹ a closely allied species if not a mere variety from China, in having more numerous denticulations on the central tooth. They also show minor differences from Jickeli's figure of a North African specimen.²

The species was found with *M scabra* in the Yenna River on mud in still pools. It was particularly abundant on shelves of rock covered with mud.

¹ Heude; *Mem. Hist. Nat. Chinois*, I. *Moll. D'Eau Douce*, p. 163, pl. xliii, fig. 5*r* (1890).

² Jickeli, *N. A. K. Leop-Carol. Ak. Naturf.* XXXVII (1), pl. iii, fig. 7 (1874).

Melania scabra (Müller).

(Plate V, fig. 6).

1874. *Melania scabra*, Brot, *Melaniaceen* in Martini und Chemitz, *Conch.-Cab.* (Ed. Kuster), p. 266, figs. 14, 15.

Brot places this species in the group or subgenus *Plotia*, in the definition of which he writes "Anfractibus superne angulatis et spinulosis." This applies exactly enough to most young shells, but, as Brot's own figures show, the spines and even the angulation of the whorls disappear with age, and are not equally developed even in all young specimens. In our series from the Medha River all intermediate stages are represented. In this locality the shells reach a large size, but at Karla in the Poona district a series of dwarfed shells was collected at the edge of a small partially artificial reservoir situated at the base of the hill in which is the well-known Buddhist cave monastery. Shells from the two localities do not differ in shape or sculpture.

We give measurements of two fully developed specimens from each locality. In all cases the apices are somewhat eroded.

	Length.	Breadth.	Length of aperture.	Breadth of aperture.
Medha	{ 29.3 mm.	13.2 mm.	12.6 mm.	8.2 mm.
	{ 28.2 mm.	12.1 mm.	11 mm.	7 mm.
Karla	{ 17 mm.	8.6 mm.	8.3 mm.	5.4 mm.
	{ 16.6 mm.	8.5 mm.	8.1 mm.	5.3 mm.

The radula (fig. 6, pl. v) differs little from that of *M. tuberculata*.

Though rarely as abundant as *M. tuberculata* and *M. variabilis*, this species has a wide range in the Indian Empire and as far east as New Guinea. There are specimens of the typical form in the collection of the Zoological Survey of India from Calcutta; Chaibassa, Chota Nagpur; the foot of the Garo Hills, Assam; Madras (many localities in the eastern districts), Bangalore (3,000 feet); Nemunangad, Travancore; Simla; Matelle, Ceylon; Kawkareik, Amherst District, Tenasserim, etc.

Genus Paludomus, Swainson.

The distribution of the genus in Peninsular India is somewhat peculiar. Numerous species have been described from the hill-streams of South India, and also from those of Ceylon on the one hand, and of Assam and Burma on the other. From the central and northern part of the Peninsula, however, only one species (*P. obesa*) is known, though many apparently suitable streams are to be found.

Paludomus obesa (Phillipi).

(Plate V, fig. 7).

This mollusc was found in considerable abundance on stones covered with algae in a small stream at Khandalla. The stream

was one of those which rushes down the hill-side, but the mollusc only occurred where it broadened out and its currents became less strong as it crossed a small plain. We figure (fig. 7, pl. v) the radular teeth of a specimen from Khandalla.

P. obesa seems to be the most widely distributed of the Indian species. It was described from the Bombay Deccan, but one of us collected a large series some years ago at Courtallum in South India. These specimens were examined by Mr. Preston, who, however, with his habitual indifference to geography, makes no reference to them. It was noted at the time that they replaced *P. annandalei*, Preston, an abundant species on the ledges above waterfalls on the western side of the Western Ghats at Tenmalai, where the railway crosses that range, as soon as the eastern watershed was reached. The range of *P. obesa* may, therefore, be described as consisting of the western part of the Indian Peninsular area, properly so called, as distinct from the Malabar Zone to the west and the Indo-Gangetic Plain to the north. Khandalla, however, lies technically within the limits of the Malabar Zone. We regard this species provisionally as distinct from *P. tanjoriensis*, etc., see Blanford, *Trans. Linn. Soc.*, XXIV, p. 173 (1863).

Family LITTORINIDAE.

Genus *Cremnoconchus* (Blanford).

1863. *Cremnobates*, Blanford, *Ann. Mag. Nat. Hist.* (3) XII, p. 184, pl. iv.
 1869. *Cremnoconchus*, Blanford, *Ann. Mag. Nat. Hist.* (4) III, p. 343.
 1871. *Cremnoconchus*, Stoliczka, *Proc. Asiat. Soc. Bengal*, p. 108, figs. 1-4.
 1878. *Cremnoconchus*, Blanford, *Journ. As. Soc. Bengal*, XXXIX (ii), p. 10.
 1887. *Cremnoconchus*, Fischer, *Conchyliologie*, pp. 708-709.

We have no doubt that Blanford and Stoliczka were right in referring this genus to the family Littorinidae. Blanford says (*loc. cit.* 1863): "Every character of shell, operculum and animal with the one exception of the pulmoniferous sac admits of the position I have assigned to it amongst the Littorinidae." As Stoliczka has shown, the gill is present, and the branchial chamber is less like that of the Pulmonata than Blanford imagined. The osphradium is present, but much reduced and almost papilli-form (pl. iv, fig. 3). As to the origin of the genus, which lives on inland cliffs kept moist by the spray from waterfalls, we can add nothing to Blanford's statement. "No question can exist as to the Western Ghats having been formed from a marine cliff in comparatively recent geological times. Whether *Cremnobates* be a lineal descendant of the Littorinas or Fossars then inhabiting the coast may perhaps not be an unfair subject for speculation."

A species has since been described from French Indo-China,¹ but the shell differs considerably from that of the Western Indian forms, and nothing is known of the soft parts.

¹ Bavay et Dautzenberg, *Journ. de Conchyliologie*, XLVIII, pp. 116, 449, pl. x, fig. 10 (1900).

Cremnoconchus syhadrensis (Blanford).

(Plate IV, figs. 2-4).

Two types of shells occur in a large series from the cliffs at Khandalla. The commoner of these agrees well with Blanford's figure (*op. cit.*, 1863, pl. iv), but in a few specimens the upper surface of the body-whorl is flattened and grooved much as in the same author's var. *canaliculatus* of *C. conicus*.

We have nothing to add to Blanford's description of the external characters, but his account of the branchial chamber is incorrect. As shown in fig. 3, a well developed gill is present. The orifice of the chamber bears a certain resemblance to that of the Pulmonates and can be completely closed. It appears, however, that the cavity is always filled with water and not air (see p. 119), and the roof is not highly vascular.

The radula (fig. 4, pl. iv) is that of a typical Littorinid. It is very long and narrow, but the tooth-formula is in our opinion 1. 2. 1. 2. 1. All the denticulations are very broad and rather blunt.

Khandalla appears to be the original locality of this species, and Blanford states that it is only found in the Western Ghats, in the neighbourhood of Bombay.

Family AMPULLARIDAE.

Genus **Ampullaria**, Lamarck.

Only a single species is represented in the collection.

Ampullaria nux, Reeve.

(Plate V, fig. 8).

1856. *Ampullaria nux*, Reeve, *Con. Icon.*, X, *Ampullaria*, pl. xxviii, figs. 132a, b.

Reeve in describing this species noted the peculiar development of the columellar callus, which forms a flat ridge nearly 2 mm. in diameter. This and the small size of the shell are probably correlated with the unusual habitat, for *A. nux*, unlike any other species of the genus with which we are acquainted, inhabits small mountain streamlets, in which it is important for it to be able to cling as tightly as possible to smooth rocks in rapid-running water. A single living specimen was obtained on the hill above Khandalla; it was clinging to the rocky margin of a small pool immediately below a waterfall. Numerous more or less broken shells were observed in the same streamlets. We figure the radular teeth of this specimen (fig. 8).

The operculum is long, rather narrow (13.3 mm. long by 8.5 mm. in a shell with the apex eroded 21 mm. long), thin and slightly translucent. The inner margin is practically straight, the outer margin strongly convex; its horny epidermis is thin and of a

brownish colour; the nacre outside the muscular scar is tinged with lilac. The sculpture of the scar somewhat resembles that on the operculum of *A. winkleyi* (Pilsbry),¹ being concentrically striate on the columellar side.

Hanley and Theobald record this species from Bhor Ghat, which is within two miles of Khandalla; we have seen a series of dead shells from a small stream at Igatpuri in the Nasik district.

Family UNIONIDAE.

A large number of fish, belonging to several distinct species, from the *Limnognathus* pool at Medha were found to have glochidia of this family embedded in their fins. Unfortunately in the present state of our knowledge it is not possible, except in a few cases recently dealt with by one of the present authors, to identify larval Indian Unionidae.

Genus *Parreyssia*, Simpson.

This genus is represented in our collection by two species from Medha, one of them a common form, the other apparently new.

Parreyssia cylindrica, sp. nov.

(Plate IV, figs. 6, 7).

A small species closely allied to *P. favidens* (Benson), but with a much broader and lower shell than any of the varieties of the latter.

Shell moderately small and thick, transverse-ovate, sub-cylindrical, with the umbo rounded and by no means prominent in unworn shells; dorsal margin nearly straight, anterior margin broadly rounded. Umbonal region sculptured with numerous low corrugated ridges which tend to run together to form V-shaped prominences; towards the posterior margin of the shell these ridges are transverse and curved; they extend downwards in a more or less distinct fashion, and even in old shells can be traced almost to the lower margin. Periostracum coarse, irregularly striate transversely, of a brownish colour, darker in older shells than in young ones, not at all polished. Nacre with a strong rosy-pink tinge. Hinges much as in *P. favidens* but less strongly developed. Pseudocardinal teeth prominent, strongly ridged, divided on both valves by a deep groove which slopes forwards and downwards. Lateral teeth slender but prominent, of considerable length, oblique, slightly arched; two on each valve, a vestigial tooth present in the form of a low ridge below the anterior part of the main lateral tooth on the right valve. Muscular impressions strongly developed, oval or sub-circular.

¹ *Proc. Acad. Nat. Sci. Philadelphia*, LIII, p. 189, pl. v, figs. 2, 3 (1901).

The measurements of four specimens are as follows:—

	Length.	Height.	Thickness.
1	44 mm.	25.5 mm.	18.4 mm.
2	35.1 mm	21 mm.	13.2 mm.
3	.. 22.5 mm.	13.6 mm.	9.4 mm.
4	. 17.2 mm.	10 mm.	6.9 mm.

Type-specimen.—No. M 11398/2 in the register of the Zoological Survey of India (*Indian Museum*).

Locality.—Yenna River, Upper Kistna watershed, at Medha; common, with *P. corrugata*, in the pool in which *Limnocyclus indica* occurs.

Parreyssia corrugata (Müller).

This species is even commoner in the Yenna River at Medha than the former one. The shells, which are much eroded, vary greatly in shape, some being much broader and less tumid than others. The external sculpture is always strongly but irregularly developed. The colour of the periostracum is dull brownish or greenish, and the nacre has a strong salmon-pink tinge.

The measurements of three specimens from Medha are as follows:—

	Length.	Height.	Thickness.
1	43.2 mm.	19.1 mm.	29.5 mm.
2	37 mm.	17.4 mm.	28.4 mm.
3	30 mm.	14.6 mm.	23.1 mm.

Genus *Lamellidens*, Simpson.

This genus is represented in the collection by two varieties of the commonest Indian species, *L. marginalis*.

Lamellidens marginalis (Lamarck).

There is a single small valve of this species, in rather bad condition, from the Medha River.

Lamellidens marginalis var. *cylindrica* (H. and T.).

(Plate IV, fig. 5).

1876. (*Unio marginalis* var. *cylindrica*, Hanley and Theobald, *Conch. Ind.*, p. 20, pl. xlv, fig. 1.

We assign to this variety with some doubt a series of shells from the Igatpuri reservoir in the Nasik district (alt. 2,000 feet). On the whole they resemble the figure in the *Conch. Ind.*, but are considerably smaller and have the anterior margin less broadly rounded and the posterior dorsal margin a little more elevated. The shell-substance has a distinct salmon-pink tinge and the epidermal membrane is translucent olivaceous with obsolescent dark radiating lines. The outline is very like that of *L. mainwaringii*, Preston, but the valves are much more inflated, there are differ-

ences in the dentition and the colour of the nacre is totally different. The outline is broader than that of *L. consobrina* (Lea), the shell much thinner, the epidermis paler, the pseudo-cardinal teeth smaller and less prominent and the laterals straighter.

The measurements of four shells are as follows:—

	Length.	Height.	Thickness.
1	56.5 mm.	30 mm.	18.7 mm.
2	53.4 mm.	28.6 mm.	18 mm.
3	52 mm.	27.6 mm.	18 mm.
4	.. 51.8 mm.	27.5 mm.	17.8 mm.

“ Not uncommon in shallow muddy bays, many specimens found in damp mud (after a night's light rain) in a drying creek. Some of these were a considerable distance from water, but they were in an active condition. These individuals were observed lying horizontally dorsal side uppermost in shallow and narrow grooves in the mud some four or five inches long and not quite deep enough to contain their shells. Probably they had been buried deeper in the mud and had come to the surface owing to the rain. When placed in a jar of mud they sank to the bottom and there lay horizontally ” (*field notes*).

VII. AQUATIC AND SEMI-AQUATIC RHYNCHOTA FROM THE SATARA AND POONA DISTRICTS.

By C. A. PAIVA, *Assistant, Zoological Survey of India.*

Specimens of the following species were collected by Dr. N. Annandale in the course of his tour:—

FAM. HEBRIDAE.

Hebrus bombayensis, sp. nov.

FAM. HYDROMETRIDAE.

Hydrometra vittata, Stål
Rhagovelia nigricans (Burm.).
Onychotrechus rhexenor, Kirk.
Ptilomera laticaudata (Hardw.).
Metrocoris stali (Dohrn.).

FAM. REDUVIIDAE.

Pirates arcuatus (Stål).

FAM. PELOGONIDAE.

Pelogonus marginatus (Latr.).

FAM. NEPIDAE.

Laccotrephes ruber (Linn.).
Laccotrephes griseus, Guer.

FAM. NAUCORIDAE.

Heleocoris elongatus, Montand.
Heleocoris obliquatus (Spin.).
Naucoris sordidus, Dist.

FAM. NOTONECTIDAE.

Enithares templetoni (Kirby).
Enithares lactea, sp. nov.

FAM. CORIXIDAE.

Corixa hieroglyphica, Duf

Family HEBRIDAE.

Hebrus bombayensis, sp. nov.

(Plate III, fig. 6).

One specimen from surface of a small pool at the edge of the river at Medha, ca. 2,200 feet, Yenna Valley, Satara district, 27-ii-4-iii-1918 and five specimens found running and flying on vertical

rocks covered with damp algae at the edge of a waterfall at Khandalla, ca. 2,500 feet, Poona district, 6-10-iii-1918.

The description is taken from two carded specimens from the latter locality.

Black with greyish-white and golden pubescence; apical margin of head, a spot before each eye and the basal margin more or less greyishly pubescent; antennae ochraceous, apically darker, first joint stout, longest, shorter than any two joints together, second joint shortest, widened at apex and tapering towards base, third and fifth joints subequal, longer than fourth, the three apical joints slender; head slightly tumid above, gently sloping towards the apex; lateral projections at bases of antennae pointed; disk of vertex with two shallow longitudinal grooves united posteriorly and extended as one to basal margin of head; pronotum with two shallow depressions on each anterior lateral area, and a central longitudinal depression on disk; a line of deep punctures on each side of the central depression and also on the basal margin of the pronotum; the depressed portions of the pronotum in fresh specimens are greyishly pubescent; scutellum with its basal area gibbous, beyond which it is foveate as far as apex; a short central longitudinal carina on depressed portion; clavus and corium covered with short golden pubescence; a large subtriangular patch at base of clavus and three spots on membrane arranged in a triangle, white or greyish-white; the outer spot on the membrane transverse, widening inwardly, the other two near the inner margin are rounded; legs ochraceous.

Length 1.75—2 mm.

Type. No. 8048/H.I. in the collection of the Zoological Survey of India.

Family HYDROMETRIDAE.

Hydrometra vittata, Stål.

One specimen from a small pool at the edge of the river at Medha and another from the edge of a waterfall at Khandalla.

A very common species and probably found all over India.

Rhagovelia nigricans (Burm.).

Two apterous specimens from under a rock at the edge of a stream at Khandalla.

As far as the Indian fauna is concerned this species has been recorded from Travancore and Ceylon and it is represented in our collection from Pinjore, Patiala State, base of Simla Hills, W Himalayas; Tura and Ganool River, Damalgiri, Garo Hills, Assam; Sanjai River, Chakradharpur, Chota Nagpur, 8-10-ii-18, "In large numbers under the shelter of a rock in the stream. N. A." We have also specimens from the mouth of the Jordan, Tiberias, and the plains of Gennesaret, Palestine, collected by Dr. Annandale. It appears to be very widely distributed.

Onychotrechus rhexenor, Kirk.

(Plate III, figs. 8, 8a)

A number of specimens were found running and leaping on vertical rocks covered with damp algae at the edge of a waterfall, and two specimens were taken from a rocky stream at Khandalla.

This species has hitherto been recorded only from S. India; Kanara (*colln.* Distant).

Ptilomera laticaudata (Hardw.).

Three specimens from the surface of small streams at Khandalla.

Metrocoris stali (Dohrn).

A number of specimens from the surface of small pools at the edge of the river at Medha and two from small rocky streams at Khandalla.

This and the preceding species are widely distributed.

Family REDUVIDAE.

Pirates arcuatus (Stål).

Three specimens from under stones at the edge of a stream, Khandalla.

Not an uncommon species.

Family PELOGONIDAE.

Pelogonus marginatus (Latr.).

One specimen from the edge of a stream at Khandalla. Within our limits the distribution of this species extends from Nepal to Ceylon and from Bombay to Burma.

Family NEPIDAE.

Laccotrephes ruber (Linn.).

One specimen from a small pool at the edge of the river at Medha.

Laccotrephes griseus (Guer.).

One specimen from same position and locality as the last. Both these species have a very wide distribution.

Family NAUCORIDAE.

Heleocoris elongatus, Montand.

A number of specimens from small rocky streams at Khandalla. "Very abundant, running about on and under stones below water and swimming when disturbed. N. A."

Recorded from Paresnath, 2,500 feet, iv-09, Bihar; Matherran, Bombay and "Indes Orientales." Also obtained by Dr. Gravely from the following localities in the Bombay Presidency:—Pophli, Vashishti Valley, Ratnagiri district, c. 400 ft., 1-2-v-1912; Tambi, Koyna Valley, Satara district, c. 2,100 ft., 24-26-iv-1912; and Nechal, W Ghats, Satara district, c. 2,000 ft., 30-iv-1912.

***Heleocoris obliquatus*, Montand.**

A number of specimens in various stages of development from small pools at the edge of the river at Medha. Also found clinging to the lower surface of stones in stream, Sanjai River Chakradharpur, Chota Nagpur. Previously recorded from Bombay and Lower Burma. This species was also obtained by Dr. Gravely at Medha in April, 1912.

***Naucoris sordidus*, Dist.**

A single specimen from a small rocky stream at Khandalla. This species has been recorded from the Calcutta tanks, and from Kerumaadi, S. end of Vembanaad Lake, Travancore, 6-xi-08 (N. A.).

Family NOTONECTIDAE.

***Enithares lactea*, sp. nov.**

(Plate III, fig. 7.)

Described from a single specimen from a small pool at the edge of the river at Medha, Satara district.

Head, pronotum, scutellum and hemelytra milky white; vertex of head tinged with pale orange yellow a somewhat large orange yellow spot just below apical margin of vertex; a faint, shallow, longitudinal groove within the margin of each eye, not extending beyond the middle of the vertex; eyes greyish, with light purplish reflections, converging towards their bases; length of vertex about equal to its greatest breadth at apex, shorter than the pronotum, which is shining almost smooth and with a few, very minute, scattered punctures; foveately excavate anterior pronotal angles more or less fuscous; length of pronotum at centre less than half its greatest breadth; scutellum much broader at base than long, with a distinct transversely impressed line near basal margin; corium nearly as long as head, pronotum and scutellum together; embolium tinged with very pale yellow, a dull fuscous spot at its basal angle; body beneath dull white; two small contiguous spots on centre of face, lateral margins of face below eyes, margins of clypeus, linear markings on trochanters and on the hind femora beneath, and segmental spots on underside of connexivum dark castaneous; ventral longitudinal carina of abdomen fringed with long black hairs, a fringe of paler hairs on lateral margin of abdomen; intermediate femora with a

strong tooth near apex, hind tibiae about twice the length of the hind tarsi, deeply grooved beneath with a fringe of fine black hairs inside groove; hind tarsi also fringed with black hairs beneath.

Type. No. 8064/H.I. in the collection of the Zoological Survey of India.

This species is very closely related to *E. indica* and *E. paivana* from which it differs chiefly in the total absence of any black markings on its upperside; the transversely impressed line near the base of the scutellum is sufficient to differentiate it structurally from any allied form.

***Enithares templetoni* (Kirby).**

Three specimens from small pools at the edge of the river at Medha, and three from small rocky streams at Khandalla. "Dives under water and clings to stones some inches below the surface. N. A." Evidently a very widely distributed species. Represented in the collection of the Zoological Survey of India from various localities in the Western Himalayas, Bombay Presidency, Ceylon and Southern Shan States.

Family CORIXIDÆ.

***Corixa hieroglyphica*, Duf.**

A number of specimens from small pools at the edge of the river at Medha.

VIII. SPONGES FROM THE SATARA AND POONA DISTRICTS AND FROM CHOTA (CHUTIA) NAGPUR.

I have already discussed Spongillidae from the Satara district in my paper on the sponges of the Malabar Zone (*Rec. Ind. Mus.* VII, pp. 383-397: 1912) and have referred to specimens from the Poona district in an earlier paper (*ibid.*, VI, pp. 225, 226: 1911); but when I wrote these papers I had not visited the districts myself, and observation of sponges in the natural surroundings is always important. The species that inhabit the beds of rocky streams are of particular interest, and I am now able to compare those that do so at Medha with those found in a very similar stream at Chakradharpur in Chota Nagpur near the centre of Peninsular India. I have not yet found any sponge in a small mountain torrent such as those at Khandalla, in which food is probably deficient; but when these streams are dammed to form ponds in which aquatic vegetation grows up, sponges soon make their appearance.

So far as my experience goes, Spongillidae that grow on the rocks of Indian streams are always encrusting forms. Massive sponges would be in danger of destruction in floods, and although

the lax branches of *Spongilla lacustris* may be observed hanging in the water of placid streams such as the Isis at Oxford, the only branched form from running water that I can call to mind in the tropics is the South American *Uruguayana*, in which the skeleton is of coralline hardness. In the creeks of the Gangetic delta *Spongilla alba* may seem to be a branched form even when the water is moved by sluggish currents. It is not really so, but an encrusting sponge covering the roots or stems of grasses.

The sponges of Indian streams vary considerably both in external appearance and in internal structure. As a rule they are either of a vivid leaf-green colour or of a dense purplish-brown or black. They may be either soft or extremely hard; they usually spread over considerable areas, but are sometimes confined to pockets in the rock. Their colour, whether black or green, is due to the presence of large numbers of minute organized bodies in their cells. These bodies probably represent in all cases a stage in the life history of a microscopic alga, but whether the green corpuscles are all specifically identical we do not know, and no investigation has been made of the purple corpuscles which cause the darker colour. Black or brown sponges occur together with green ones and though their colour has no generic significance, it appears to be, in spite of its quasi-parasitic origin, of specific importance.

All the green sponges from rocky streams with which I am acquainted have a peculiar type of circulatory system that is often to be found in thin encrusting sponges, not only among the Spongillidae but also in several marine Tetraxonid families. In this type the pores, which are usually of relatively large size, are arranged in more or less circular groups immediately over the mouths of relatively wide inhalent canals, which run vertically downwards to near the base of the sponge, giving off lateral channels which convey the incoming water to the ciliated chambers. The exhausted water returns through other channels of similar calibre to the surface of the parenchyma, where it enters relatively wide horizontal canals that ramify immediately below the dermal membrane, which forms their roof. Each system has an osculum situated near the centre of these ramifying channels. It is never of large size and is always protected by a conical dermal collar, which is highly contractile and disappears in preserved specimens. This type of circulatory system is found among marine sponges that encrust rocks in shallow water and is by no means peculiar to green species; among the Spongillidae it is also found in almost colourless lacustrine species that grow near the edge of lakes on the lower surface of stones. Its development has no taxonomic significance but appears to be correlated with growth in the form of a thin layer on smooth surfaces in situations in which there is considerable movement in the water and danger from the accumulation of silt.

I collected specimens of the following species in the Satara and Poona districts and in Chota Nagpur:—

<i>Spongilla lacustris</i> var. <i>proliferens</i> , Annand.	Artificial pond at Khandalla
<i>S. cinerea</i> , Carter	Streams near Chakradharpur
<i>S. perviridis</i> , sp. nov.	Stream at Medha; rocky artificial pools in Satara fort and at Karla in the Poona district.
<i>S. crateriformis</i> , Potts	Artificial pond at Khandalla.
<i>S. sumatrana</i> , Weber	Well at Medha.
<i>S. sumatrana</i> var. <i>rvularis</i> , nov.	Stream at Medha.
<i>S. sumatrana</i> var. <i>centralis</i> , nov.	Stream at Chakradharpur.
<i>S. carteri</i> , Carter	Reservoir in the Satara fort.
<i>Corvospongilla ultima</i> var. <i>spinosa</i> , Annand.	Stream at Medha.

Of these species I need only discuss *S. cinerea*, *S. perviridis*, and *S. sumatrana* with its varieties.

***Spongilla (Euspongilla) cinerea*, Carter.**

(Plate VI, figs. 1, 1a, 1b).

1911. *Spongilla cinerea*, Annandale, *Faun. Brit. Ind., Freshw. Sponges*, etc., p. 79, fig. 10.

This sponge, which appears to be very rare, has been known to me until recently merely from Carter's description, from a dried schizotype of the original specimen from a tank at Bombay and from some very imperfect material from Nasik. Living specimens were, however, obtained by Dr. Gravely and myself in Chota Nagpur some months ago and I am now able to differentiate from Carter's species a closely allied form (here described under the name *S. perviridis*) that I formerly believed to be a mountain phase of it.

S. cinerea may be distinguished from all other species of the subgenus *Euspongilla* yet known by three characters:—

- (1) Its dense purplish-brown or black colour.
- (2) Its very finely spinose or subspinose skeleton-spicules.
- (3) The great regularity of its skeletal structure.

To take these characters in order. The colour is due to the presence in the cells of both the parenchyma and the dermal membrane¹ of minute organized bodies resembling the green

¹ This is also the case in *Corvospongilla ultima* var. *spinosa*.

corpuscles of many freshwater sponges in structure but of a deep purple colour, which is not soluble in spirit.

The spinosity of the megascleres is so faint that it is apt to escape notice altogether unless they are examined under a very high power of the microscope. The tips are smooth.

The regularity of the skeleton is due mainly to the compact formation and large number of the primary radiating or vertical spicule-fibres, which run upwards through the sponge for considerable distances without branching and are joined together by much less regular cross-fibres or by groups of spicules. The vertical fibres contain a considerable amount of binding substance.

The gemmules are small and very numerous in all the specimens I have examined. They have a thick pneumatic layer in which the air-spaces are very minute, and a slender, straight, projecting foraminal tubule.

In February, 1918 Dr. Gravely and I found specimens at two localities in the Singbhum district of Chota Nagpur, in a rocky stream close to Chakradharpur and in a pool of muddy water, evidently part of a sluggish stream in the rains, on the road between that place and Chaibassa.

At Chakradharpur the sponge was growing on the rocky bed of the stream in clear running water. It was essentially of encrusting habit but in little pockets in the rock showed a tendency to adopt a cushion-like form and was then a centimetre or more thick. The oscula were small on the flat rock but in the pockets become larger (about 5 mm. in diameter). In all cases they opened into wide vertical exhalent canals and horizontal subdermal exhalent canals were absent. The sponge was very soft and of a deep purple-brown colour. Our specimens from a pool on the Chaibassa road were attached to the lower surface of bricks at the base of the piers of a bridge. They had a cushion-like form and were harder and blacker than those from the stream. Their oscula were small and branching horizontal exhalent channels were conspicuous on the surface of the parenchyma.

***Spongilla (Euspongilla) perviridis*, sp. nov.**

(Plate VI, figs. 2, 2a, 2b).

1912. *Spongilla cinerea*, Annandale (*nec* Carter), *Rec. Ind. Mus.* VII, pp. 137, 387.

This sponge, though closely related to *S. cinerea*, can always be distinguished by the following characters:—

- (1) Purple corpuscles are absent from both parenchyma and dermal membrane and are replaced in the former only by green corpuscles.
- (2) The skeleton-spicules are more distinctly spiny, but also have smooth extremities.
- (3) The skeleton is much less regular.
- (4) The oscula are always small and surrounded by radiating exhalent channels.

Type-specimen.—P 59/1 *Zoological Survey of India (Ind. Mus.)*.

Distribution.—I have examined specimens from the Kumaon lakes in the Western Himalayas as well as from the Koyna and Yenna rivers in the Satara district and from artificial reservoirs in the Satara fort and at Karla in the Poona district. At the last-named place I found the surface of the water densely covered with gemmules from dried sponges exposed on rocks.

***Spongilla (Stratospongilla) sumatrana*, Weber.**

1890. *Spongilla sumatrana*, Weber, *Zool. Ergebn. Nederl. Ost.-Ind.*, 1, p. 38, pl. iv, figs. 6-10.

S. sumatrana has not hitherto been recognized as occurring in British India, though reported from both Sumatra and the Nile. In describing *S. indica* and *S. gravelyi* I pointed out their close relationship to this species, but in the absence of linking forms was obliged to regard them as specifically distinct. Linking forms have, however, now been found and specimens of the *forma typica* discovered in Indian territory. The species seems to be an extremely plastic one and at least five varieties may be recognized. The species as a species must, therefore, be defined in somewhat general terms. I believe that the following description should be adequate.

Sponge thin and encrusting, of a bright green colour except when in deep shade or very muddy water, with small oscula and horizontal ramifying subdermal exhalent channels, with a hard but very friable skeleton formed of large numbers of macroscleres without well-defined spicule-fibres, with short slender macroscleres the majority of which are spiny, with slender amphioxous or amphistrongylous free microscleres that are always densely covered with short spines and are usually abundant in the dermal membrane, with short, compact amphistrongylous gemmule-spicules also covered with short spines; gemmules small, spherical, covered with a single layer of microscleres arranged mosaic wise in a single layer in an outer horny membrane, with a short, nearly straight foraminal tubule.

forma typica.

In this form the skeleton-spicules are sharply pointed and irregularly spiny; there are two kinds of free microscleres, one larger and more sharply pointed than the other; the gemmule-spicules are very short and stout, uniformly spiny and either straight or slightly curved. The gemmules are free. The skeleton is very compact.

The form was described from Lake Singkarah in Sumatra. I found small patches of dried sponge on the walls of a well at Medha that agree with a co-type sent me by Prof. Max Weber. The nilotic variety described by Weltner¹ seems to differ from the

¹ "Die Coelenteraten und Schwämme des Süßen Wassers Ost-Afrikas" in Mobius' *Ost.-Afrika*, IV (1908).

forma typica merely in slight differences in the measurements of the spicules.

var. *rivularis*, nov.

(Plate VII, fig. 2).

The skeleton-spicules are stouter and as a rule less sharply pointed than in the *forma typica*; the gemmule-spicules are relatively longer, more variable and often more irregular in outline; the skeleton is less compact; the gemmules are either free or fixed by means of their outer spiculiferous coat at the base of the sponge.

Type-specimen.—P 66/1 *Zool. Survey of India (Ind. Mus.)*.

Locality.—Rocks in the river Yenna at Medha.

I could not distinguish living specimens from *S. perviridis*, side by side with which they were growing.

var. *centralis*, nov.

(Plate VI, fig. 3; plate VII, fig. 1).

The skeleton-spicules, though remaining long and relatively slender, are for the most part distinctly blunt at the tips. Otherwise the form resembles the var. *rivularis*.

Type-specimen.—P 71/1, *Zool. Survey of India (Ind. Mus.)*.

Locality.—Rocky bed of a stream at Chakradharpur, Chota Nagpur.

var. *indica*, Annandale.

(Plate VII, fig. 3).

1908. *Spongilla indica*, Annandale, *Rec. Ind. Mus.*, II, p. 25, figs. 1, 2.

1911. *Spongilla indica*, *id.*, *Faun. Brit Ind.*, tom. cit., p. 100, fig. 17.

Most of the skeleton-spicules are blunter and shorter than in the last variety; the gemmule-spicules are on an average much smaller and more slender; the skeleton is more compact and the gemmules are as a rule fixed at the base of the sponge.

Localities.—Nasik and Igatpuri in the Nasik district, Bombay.

var. *gravelyi*, Annandale.

1912. *Spongilla gravelyi*, Annandale, *Rec. Ind. Mus.*, VII, p. 385, fig. 1.

The skeleton-spicules are relatively long, slender, sharply pointed and sparsely spined; the gemmule-spicules have a peculiar curvature and are often knobbed at the end; the gemmules are free.

Locality.—Koyna river at Taloshi, Satara district, Bombay.

In distinguishing these varieties reference should be made to the figures here reproduced or cited. I have avoided giving detailed descriptions as it is possible that intermediate forms exist and it seems best in dealing with the varieties of a plastic species not to be too exact.

EXPLANATION OF PLATE I.

Frog and Fish from Bombay Streams.

***Ixalus bombayensis*, sp. nov.**

FIG. 1.—Type-specimen (adult male) from N. Kanara, × 2.

***Nemachilus evezardi*, Day.**

FIG. 2.—Adult specimen from hill streamlet at Khandalla (nat. size).

„ 2*a*.—Ventral surface of head and chest of same specimen (enlarged).

***Nemachilus anguilla*, sp. nov.**

FIG. 3.—Type-specimen (adult male) from the R. Yenna at Medha, × 2.

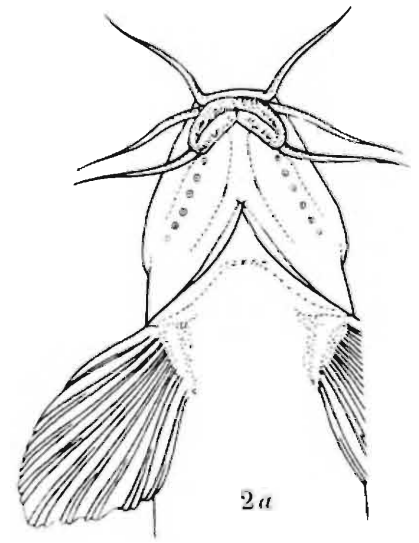
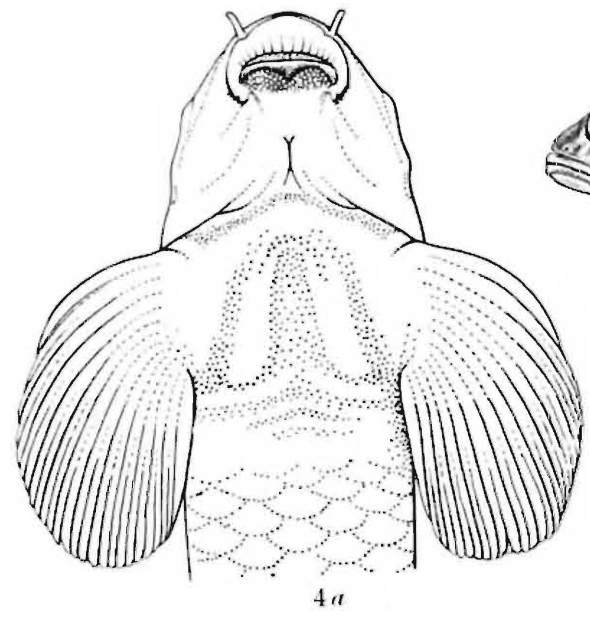
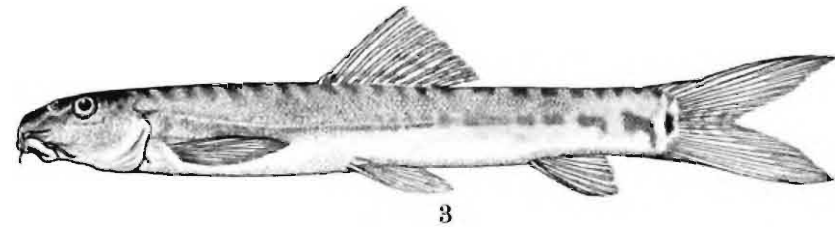
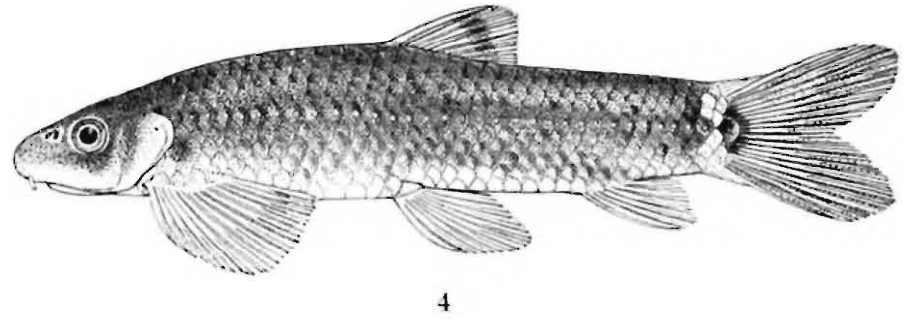
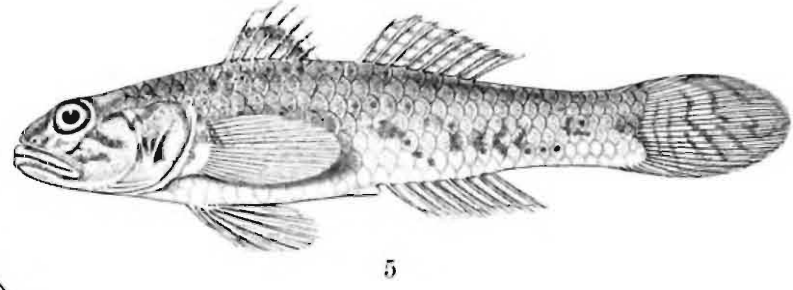
***Psilorhynchus tentaculatus*, sp. nov.**

FIG. 4.—Type-specimen from hill streamlet at Khandalla, × 2.

„ 4*a*.—Ventral surface of head and chest of same specimen (further enlarged).

***Gobius bombayensis*, sp. nov.**

FIG. 5.—Type-specimen from Medha (enlarged).



A. C. Chowdhary, del.

Photo-engraved & printed at the Offices of the Survey of India, Calcutta, 1918.

FRESHWATER FISH AND FROG FROM BOMBAY STREAMS.

EXPLANATION OF PLATE II.

Indian species of *Discognathus*, etc.

Discognathus lamta, Day.

FIG. 1.—Adult male from the R. Yenna at Medha (slightly reduced).

„ 1*a*.—Ventral surface of head and chest of same specimen (slightly enlarged).

Discognathus nasutus (McClell.).

FIG. 2.—Adult male from Pachmarhi, Central Provinces (same scale as fig. 1).

„ 2*a*.—Ventral surface of head and chest of same specimen (enlarged).

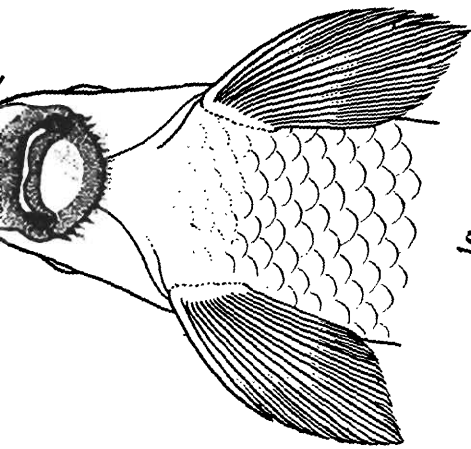
Discognathus gravelyi, sp. nov.

FIG. 3.—Type-specimen (adult male) from He-Ho, S. Shan States (same scale as fig. 1).

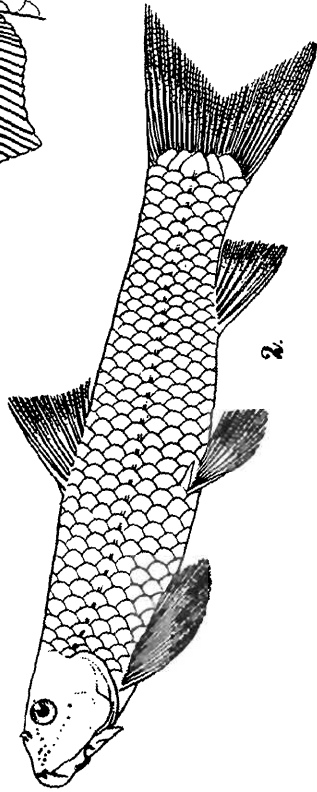
„ 3*a*.—Ventral surface of head and chest of same specimen (enlarged).

Barbus jerdoni var. *maciveri*, nov.

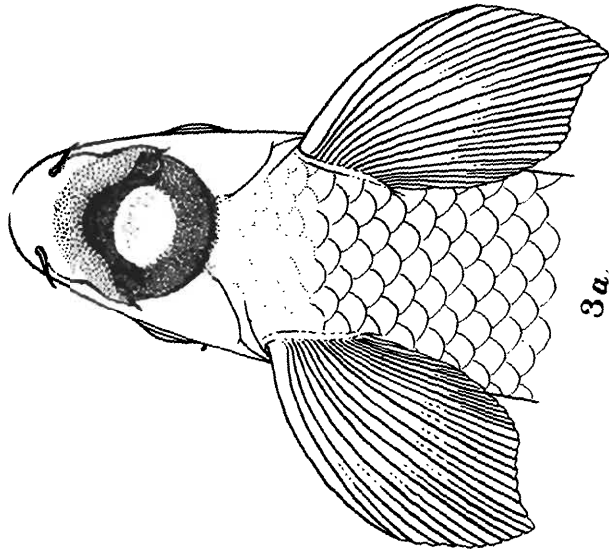
FIG. 4.—Type-specimen of variety (young) from R. Kistna near Satara (reduced).



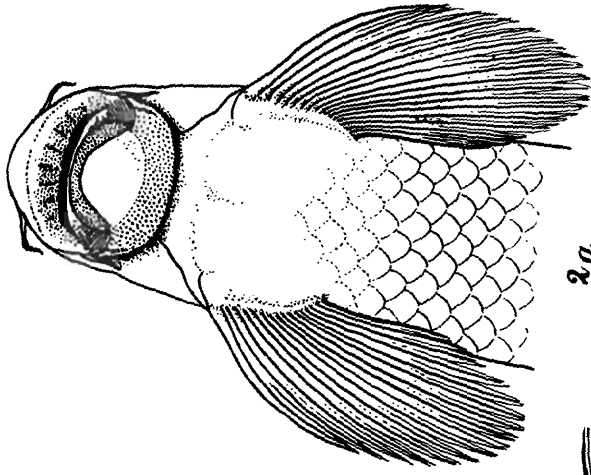
1a.



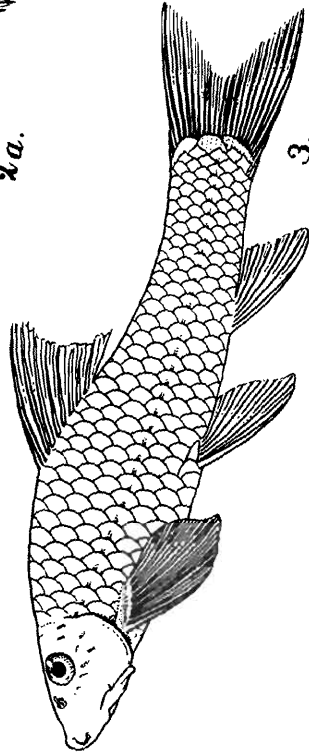
2.



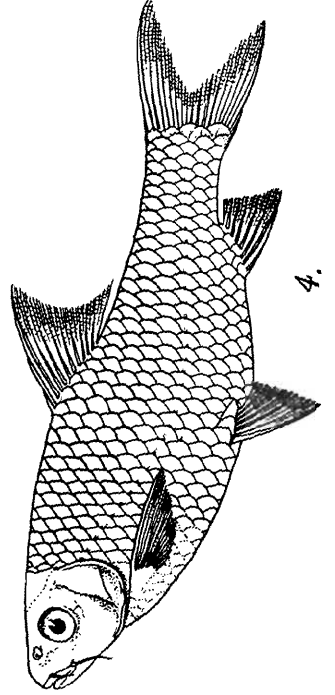
3a.



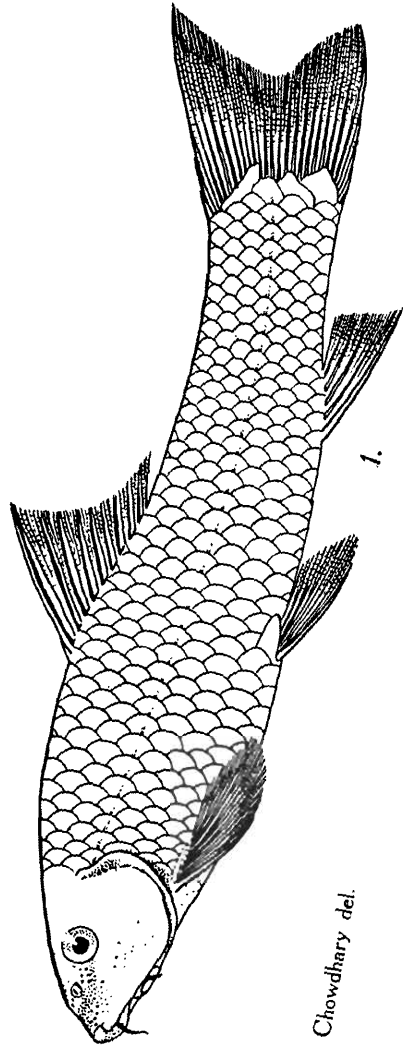
2a.



3.



4.



1.

A. Chowdhary del.

INDIAN SPECIES OF *DISCOGNATHUS*, ETC.

EXPLANATION OF PLATE III.

Fish and Aquatic Rhynchota, mostly from Bombay Streams.

Nemachilus anguilla, sp. nov.

FIG. 1.—Ventral surface of head and chest (enlarged).

Psilorhynchus tentaculatus, sp. nov.

FIG. 2.—Pharyngeal teeth (highly magnified).

Barbus tor (Ham. Buch.).

FIGS. 3, 3*a*.—Head of young specimen from the R. Kistna near Satara (about nat. size).

Barbus mussullah, Sykes.

FIGS. 4, 4*a*.—Head of young specimen from the R. Kistna near Satara (about nat. size).

Barbus putitora (Ham. Buch.).

FIG. 5.—Adult specimen from Gauhati, Assam (much reduced).

Hebrus bombayensis, Paiva, sp. nov.

FIG. 6.—Enlarged dorsal view of type-specimen from Khandalla.

Enithares lactea, Paiva, sp. nov.

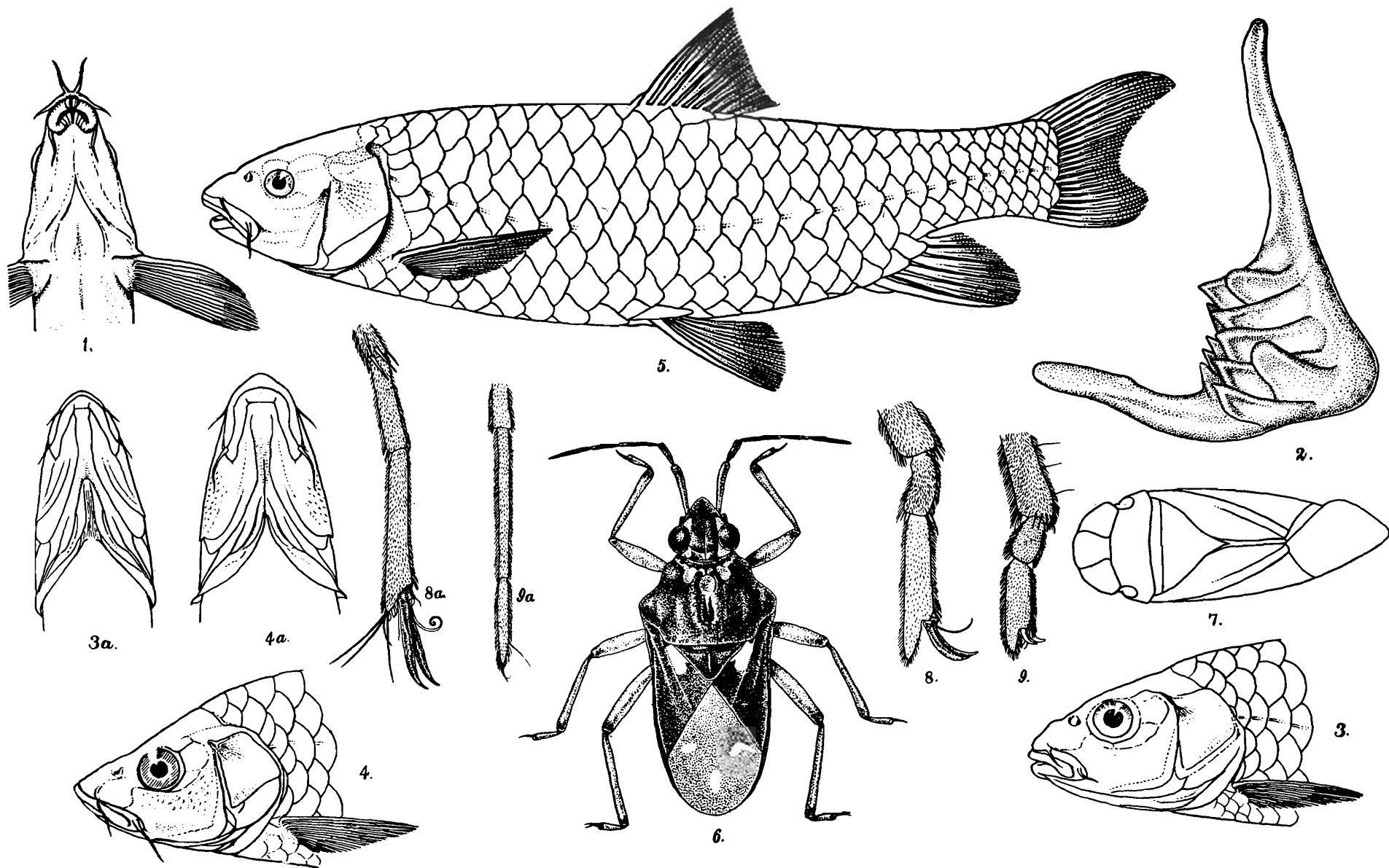
FIG. 7.—Outline of dorsal surface (enlarged).

Onychotrechus rhexenor, Kirk.

FIGS. 8, 8*a*.—Front and hind feet (enlarged).

Gerris tristan, Kirk.

FIGS. 9, 9*a*.—Front and hind feet (on same scale as figs. 8, 8*a*).



A. Chowdhary & D. Bagchi del.

FRESHWATER FISH AND WATER-BUGS MOSTLY FROM BOMBAY.

EXPLANATION OF PLATE IV.

Freshwater Molluscs from Bombay.

Limnaea acuminata var. *nana*, nov.

FIG. 1.—Photograph of type-specimens from Khandalla, $\times 4$

Cremnoconchus syhadrensis (Blanford).

FIG. 2.—Living mollusc crawling on side of glass jar above water showing film of water it carries with it, opening of branchial chamber, etc. : enlarged.

„ 3.—Animal (♀) removed from shell and with the branchial chamber slit open to show gill (*a*) and osphradium (*b*) : enlarged.

„ 4.—Radular teeth (highly magnified).

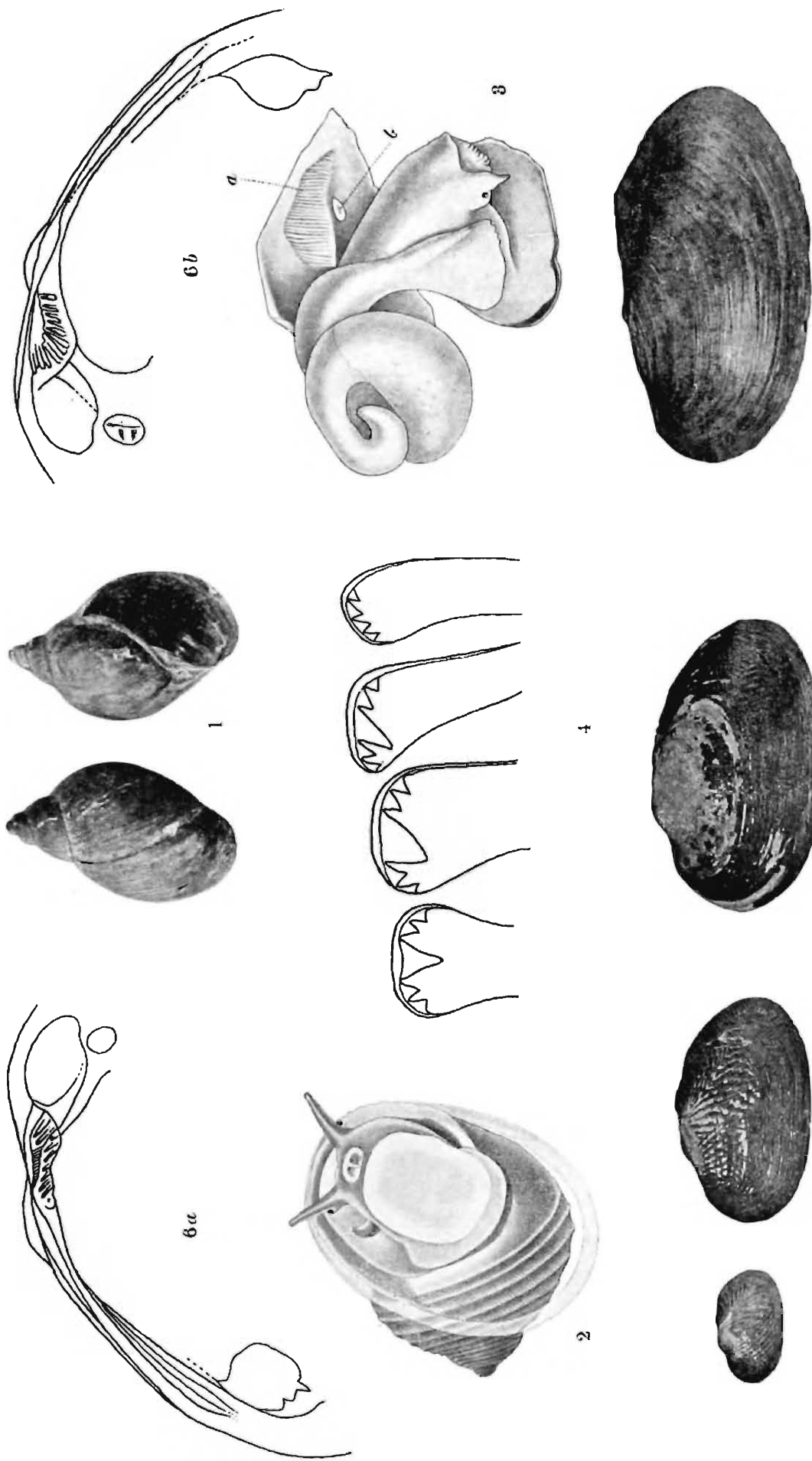
Lamellidens marginalis var. *cylindrica*, H. and T.

FIG. 5.—Shell from reservoir at Igatpuri provisionally assigned to this variety (nat. size).

Parreyssia cylindrica, sp. nov.

FIG. 6.—Type-series of shells from the R. Yenna at Medha (nat. size).

FIGS. 7, 7*a*.—Enlarged view of hinge, etc. in the two valves of an adult shell.



5

6

Photo-engraved & printed at the Offices of the Survey of India, Calcutta, 1918.

FRESHWATER MOLLUSCS FROM BOMBAY.

S. C. Mondul, photo.

EXPLANATION OF PLATE V

Radular teeth of freshwater molluscs from Bombay.

The teeth of the different forms of *Limnaea* proceed in each figure from the centre outwards in the natural order. Most of the lateral teeth are omitted, only the innermost one on each side being shown. Only a few of the marginal teeth on one side are figured. *a* = central tooth with innermost lateral tooth on either side. *b* = marginal teeth.

Limnaea acuminata, Lamarck.

FIG. 1.—Teeth of the *forma typica*, × 500. Specimen from Khandalla.

,, 2.—Teeth of the var. *nana*, × 500. Specimen from Khandalla.

Limnaea chlamys, Benson.

FIG. 3.—Teeth, × 500. Specimen from Satara fort.

Limnaea pinguis, Dorn.

FIG. 4.—Teeth, × 500. Specimen from Khandalla.

Melania tuberculata (Müller).

FIG. 5.—Teeth, × 250. Specimen from Igatpuri, Nasik district.

Melania scabra (Müller).

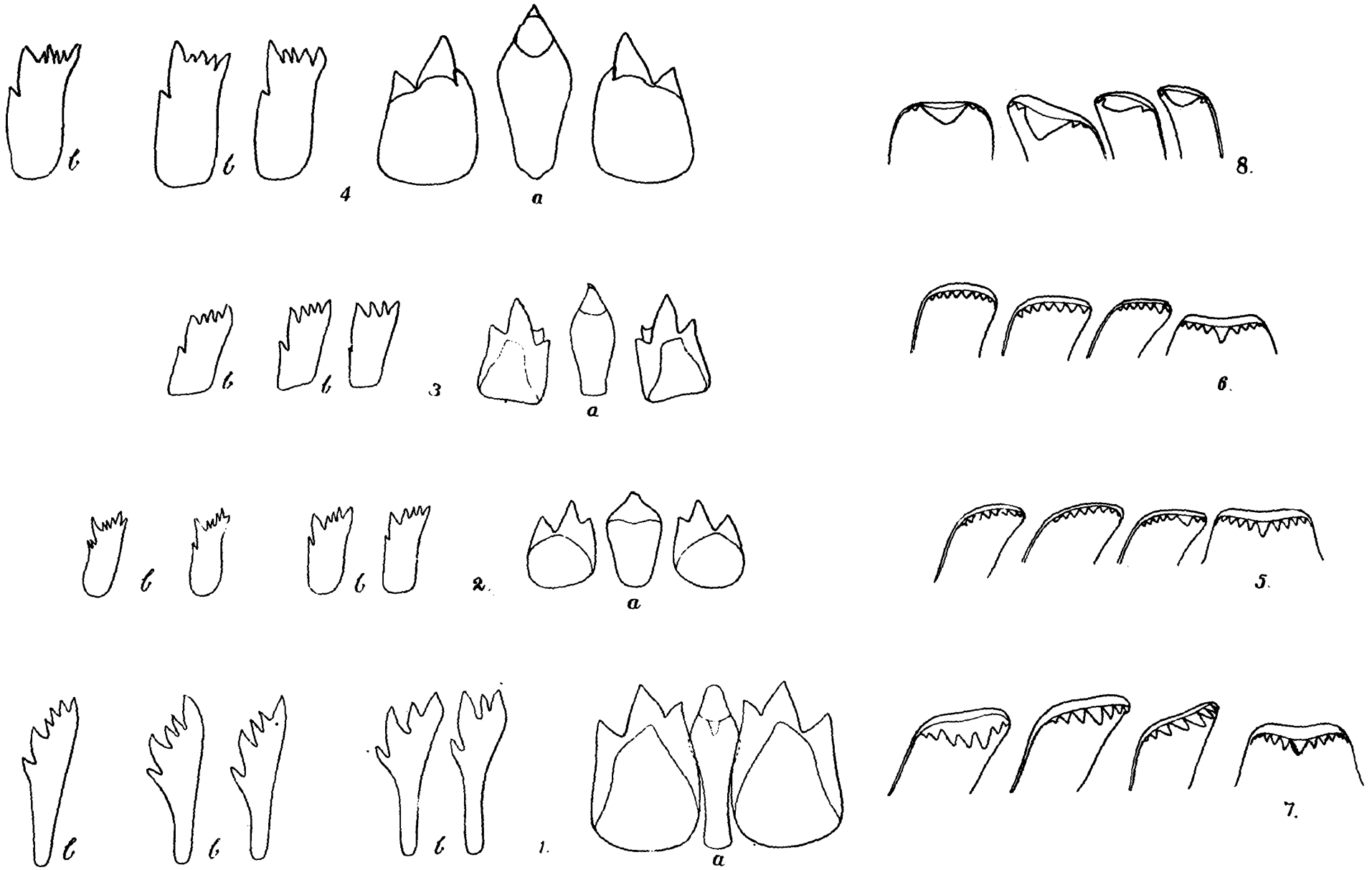
FIG. 6.—Teeth, × 250. Specimen from the Yenna R. at Medha.

Paludomus obesa (Philippi).

FIG. 7.—Teeth, × 250. Specimen from Khandalla.

Ampullaria nux, Reeve.

FIG. 8.—Teeth, × 75. Specimen from Khandalla.



D. Bagchi del.

RADULAR TEETH OF FRESHWATER MOLLUSCS.

EXPLANATION OF PLATE VI.

Freshwater sponges from Bombay and Chota Nagpur.

***Spongilla cinerea*, Carter.**

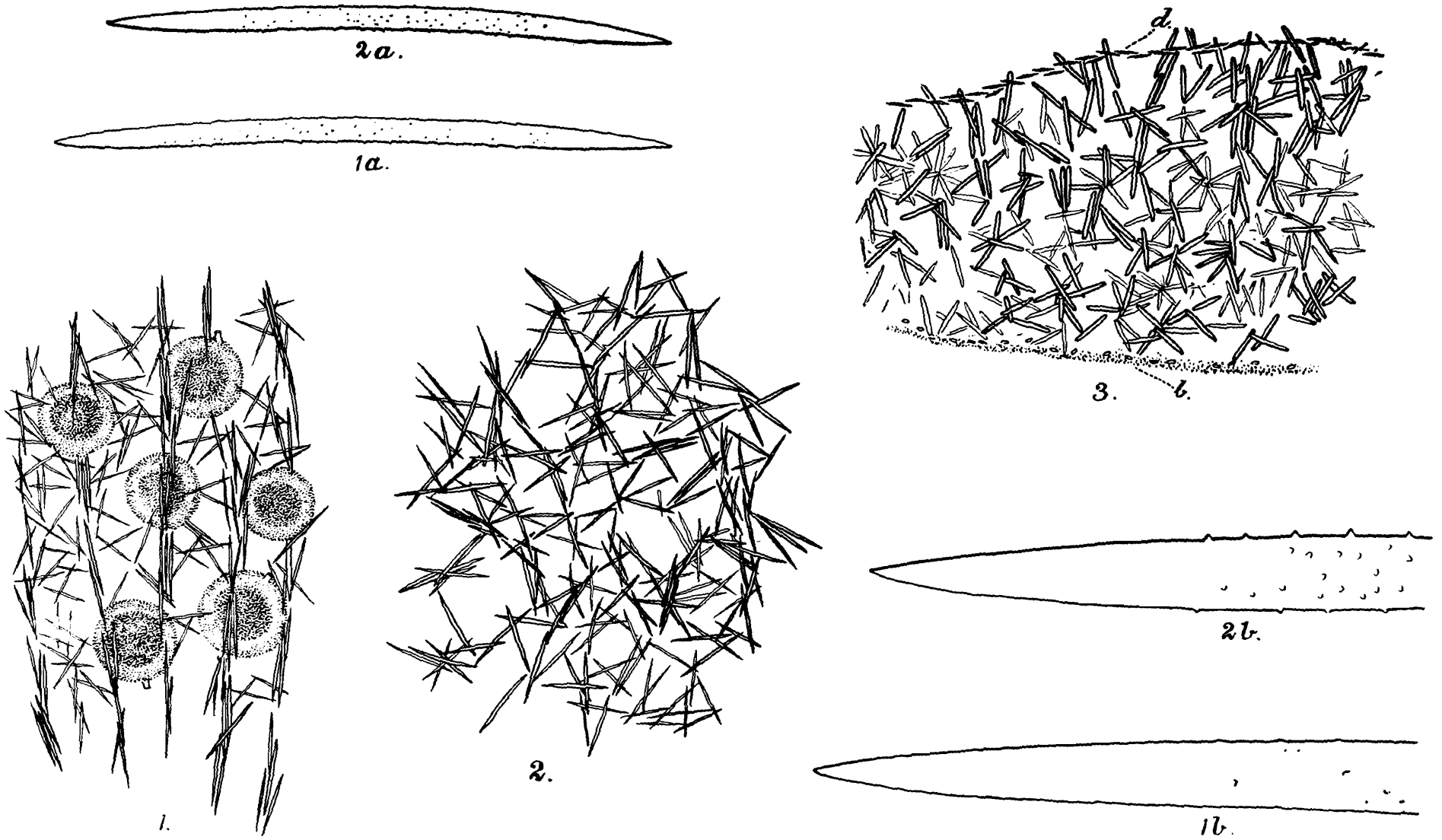
- FIG. 1.—Vertical section through middle region of skeleton with gemmules *in situ*, $\times 30$. Schizotype from Bombay I.
,, 1a.—Typical skeleton-spicule, $\times 250$.
,, 1b.—Part of same spicule, $\times 750$.

***Spongilla perviridis*, sp. nov.**

- FIG. 2.—Vertical section through middle region of skeleton, $\times 30$. Specimen from Yenna R.
,, 2a.—Typical skeleton-spicule, $\times 250$.
,, 2b.—Part of same spicule, $\times 750$.

***Spongilla sumatrana* var. *centralis*, nov.**

- FIG. 3.—Vertical section through skeleton, $\times 30$. *b* = basal membrane with microscopic algae. *d* = dermal membrane with free microscleres. Specimen from Chakradharpur.



A. C. Chowdhary del.

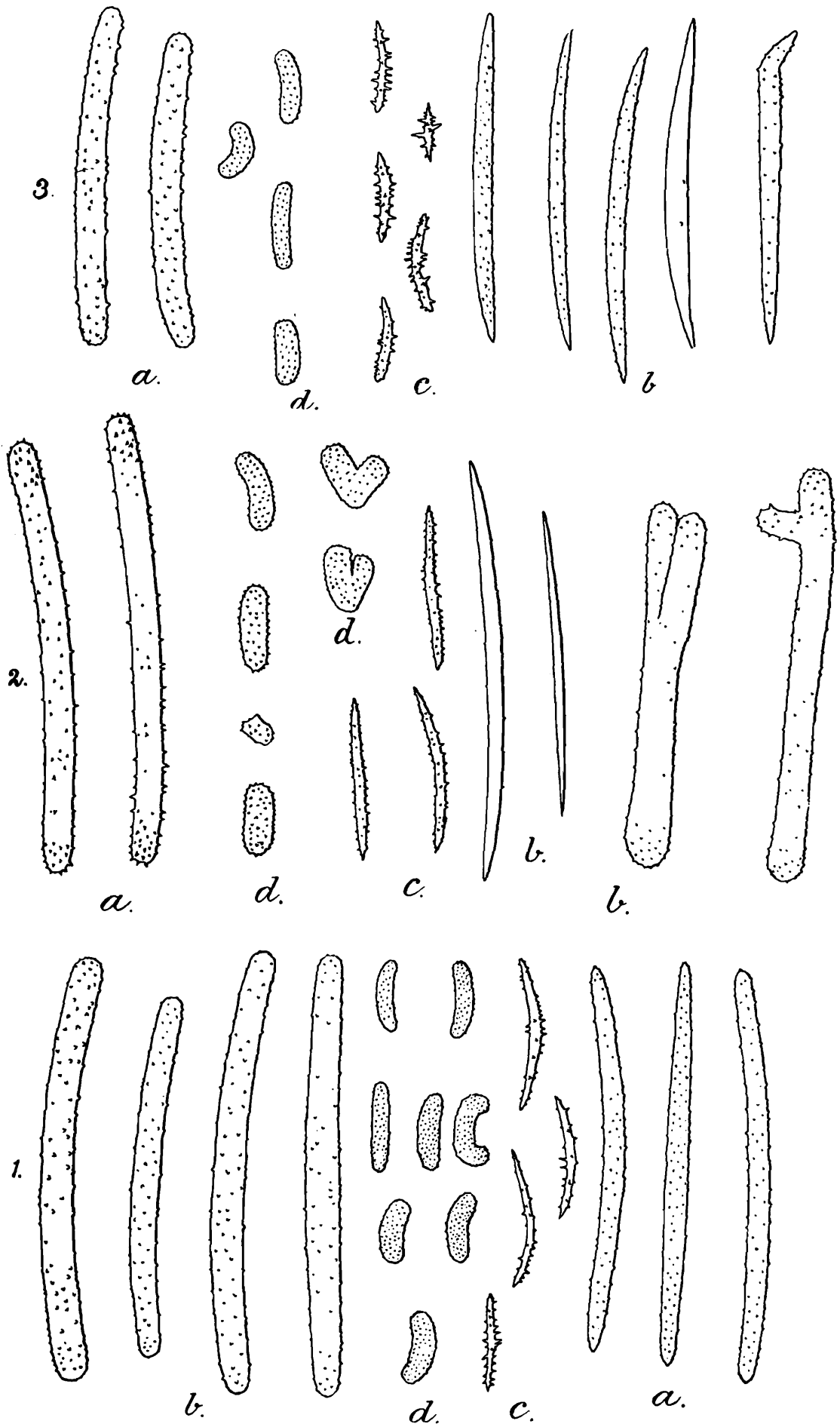
FRESHWATER SPONGES FROM BOMBAY, ETC.

EXPLANATION OF PLATE VII.

Spicules of Indian varieties of *Spongilla sumatrana*, Weber

a = typical macroscleres. *b* = other macroscleres. *c* = free microscleres.
d = gemmule-spicules.

- FIG. 1.—*Spongilla sumatrana* var. *centralis*, nov., × 250.
,, 2.—*Spongilla sumatrana* var. *rivularis*, nov., × 250.
,, 3.—*Spongilla sumatrana* var. *indica*, Annand., × 250.



VII ON A NEW SPECIES OF *DISCOGNATHUS* FROM THE KANGRA VALLEY

By B. PRASHAD, D.Sc., Superintendent of Fisheries, Bengal Fisheries Laboratory, Indian Museum, Calcutta.

(Published by permission of the Director of Fisheries, Bengal).

(With two text-figures).

The identification of the various Indian species of the genus *Discognathus* has always been a matter of great difficulty. The task has, however, been made much easier by the admirable treatment of the subject by Dr. Annandale. This paper, of which I had the privilege of consulting the manuscript and the original drawings, is published in the present volume of the "Records" immediately previous to this note (pp. 125-138). I am also deeply indebted to Dr. Annandale for his valuable advice regarding this species of fish and for going through the manuscript. The specimens of this fish were sent to me by L. Devi Ditta Mal of the Punjab Fisheries Department and to him also my best thanks are due.

Discognathus kangrae, sp. nov.

This species differs from the other Indian species of the genus in the proportions of the different parts of the body, in the shape and size of the mental disc, the situation of the eye, the shape of the tail and the dorsal fin.

D. 11 (2/9). P. 16. V 9. A. 7 (2/5). L.l. 34. L.t. 4/5.

The total length is about $4\frac{1}{3}$ times the greatest depth of the body and less than 4 times the length of the head. The diameter of the eye, which is situated nearer the operculum than the snout, is contained a little less than 8 times in the length of the head. The interorbital space is slightly convex, about $3\frac{1}{2}$ times the diameter of the eye. The snout has in the adult male a large number of tubercles, some with small conical spines, arranged in two to three rows on the lateral sides of the head. There is a fairly deep groove of a semicircular outline on the dorsal surface of the head, extending along the sides up to the nostrils, but there is no projection. The nostrils are large and prominent. The dorsal profile from the anterior edge of the dorsal fin is nearly straight up to the eyes, whence it suddenly slopes forwards; behind the dorsal fin the profile is slightly concave. The upper lip is fairly broad and the lower lip is very much enlarged with an ovoid mental disc. There are four barbels, the posterior pair at the margins of the mouth being much smaller than the anterior ones.

The ventral surface is convex with scales extending forward on the chest in the form of a triangle. The pectoral fins are much shorter than the head and do not extend nearly to the ventrals; they are set obliquely on the sides of the body but much nearer the ventral surface than in some other species. The caudal fin is deeply forked; the two lobes are nearly of the same size. The dorsal fin originates further forwards than the ventrals and is

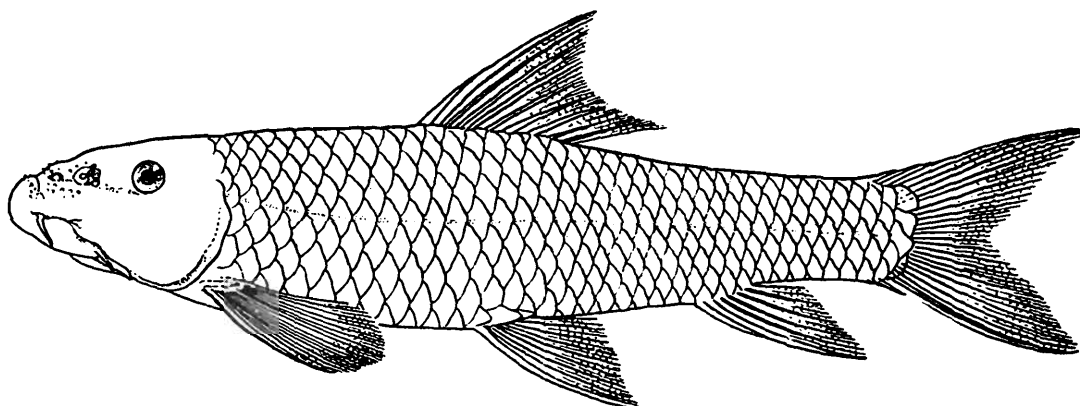


FIG. 1.—*Discognathus kangrae*, sp. nov.
Type specimen (adult male) from the Kangra Valley (slightly reduced).

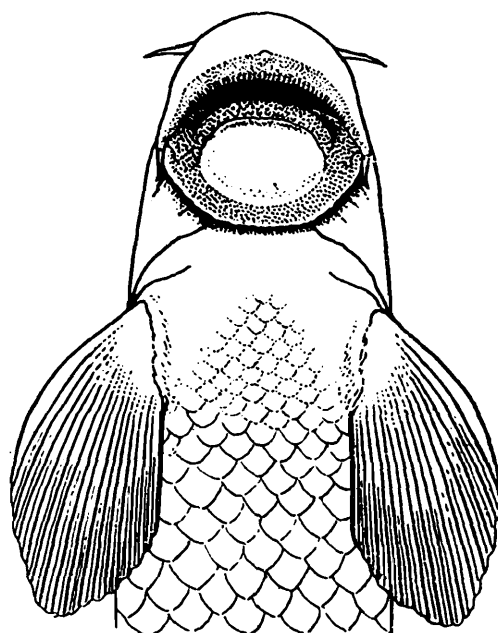


FIG. 1a.—*Discognathus kangrae*, sp. nov.
Ventral surface of head and chest of same specimen.

much shorter than the maximum depth of the body; the first unbranched ray is well developed but not ossified; the second is fairly thick, much larger than the first but like it not ossified; it is shorter than the head. The specimens are of a uniformly bluish-grey colour, the ventral surface being yellowish.

The largest specimen measures 14 cm. in length.

Type-specimen.—F. ⁹⁹⁹/₁ Zoological Survey of India (Ind. Mus.).

Locality.—In a hill-stream at Jaugal-khad, Kangra district, Punjab. Four specimens.

The present species comes near *D. lamta*, but the shape of the snout, the body as a whole and the tail fin, the position and insertion of the pectoral fins and the structure of the mental disc are sufficient to mark it off as a distinct species.

In Dr. Annandale's key (*loc. cit.*) the species would be distinguished from the typical *D. lamta* and *D. jerdoni* by the length of the head being not more than one fourth of the total length.



MISCELLANEA.

BIRDS.

Two interesting Albinos.

Through the courtesy of the authorities of the Indian Museum two very interesting albino specimens of birds have been sent home to me for examination.

The first of these is a very curious semi albino Red-vented Bulbul (*Molpastes haemorrhous bengalensis*). The whole head, fore-neck and nape are white, a few of the anterior feathers edged black and others next to them again pale brown or greyish-brown. The bill is quite black, and the feet, though now discoloured, appear also to have been black in life.

I should presume this to be a case of partial temporary albinism, possibly started by the bird, a captive one, rubbing its head and neck against the bars of its cage in attempting to escape when first confined. The feathers of the forehead are edged with orange pink, this colour extending to some of the lateral crest feathers and the tiny orbital plumes and this is really the most remarkable feature about the bird, for this is red naturally in this Bulbul in these parts. I have examined the pigment very closely under a powerful glass but have no reason to imagine it to be artificial.

The specimen No. 25456 was presented to the Indian Museum by Baboo Madhusudan Mullick.

The second bird is a specimen of the common Indian Myna, *Acridotheres tristis*, presented to the Museum by A. C. Tunstall, Esqr., from Tocklai, Assam. This is an example of *constitutional albinism* as compared with *accidental albinism* in the Bulbul. The whole bird is white with the exception of the lores and feathers round the eye which are black as in a normal bird. Below the whole plumage is suffused with rufous buff and the chin, earcoverts and throat are dark and almost normal in tint; above the feathers of the head are tipped dull fulvous brown and those of the back, rump and upper tail coverts with the same but paler. The wing-quills are white-shafted but the rectrices have them dark. The bill and feet are yellow but appear in life to have been paler and more lemon yellow than in a normal bird. It is not easy to say whether this specimen is losing or acquiring pigment; I incline to the former opinion as the wings which are newly moulted are all pure white.

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Upper Norwood,

15-viii-18.

