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# SOME EARTHWORMS FROM KASHMIR, BOMBAY, AND OTHER PARTS OF INDIA.

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The present paper contains an account of some Oligochaeta recently received for identification from the Indian Museum. In part these have been collected by the officers of the Zoological Survey, and in part sent to the Museum by other naturalists,—Prof. J J. Asana of Ahmedabad and Prof. J P. Mullan of Bombay. The collection of the last-named contained some interesting specimens.

## THE EARTHWORMS OF KASHMIR.

Our knowledge of the worms of Kashmir has hitherto been meagre in the extreme. In the Report on the Natural History Results of the Pamir Boundary Commission, published in 1898 (1) Alcock states: "Three species of earthworms were obtained, one in the Kishenganga Valley at 8100 ft., one in the Gilgit River Valley at over 7000 ft., and one in the Yasin Valley at 8000 ft. Specimens of all of these were sent to Mr. F. E. Beddard, F.R.S., who writes as follows concerning them: 'They are entirely European, i.e. Palaearctic species; they belong, in fact, to the usual British forms. This is of interest, as being an approximation to discovering the limits of the Oriental region for worms.'"

Michaelsen in 1909 (3) identified three species (*Eisenia rosea* (Sav.), *Helodrilus* (*Allolobophora*) *caliginosus* subsp. *trapezoides* (Ant. Dug.), and *Helodrilus* (*Bimastus*) *parvus* (Eisen) in collections received from the Indian Museum; and I had a *Limnodrilus*, species unrecognizable, sent to me from one of the high lakes (9). Thus the only identified species of Oligochaeta from this region are the three recorded by Michaelsen.

This is perhaps surprising, seeing that Kashmir is a favourite summer resort, and is visited annually by large numbers of travellers from all parts of India, and indeed from other parts of the world also. There are possibly two reasons for the paucity of the collections. One is that Kashmir is a holiday country, and zoologists who visit it are doubtless concerned rather in providing for themselves a change of interests than in pursuing their usual occupation;—at least this has been the case with myself. The other is that it has been recognized that Kashmir belongs to the Palaearctic region, and not to the Oriental, which is of greater interest to Indian naturalists.

The present small collection contains only three identifiable species, of which two have been previously recorded, while one is new. These all belong to the Lumbricinae, a Palaearctic group.

## THE RANGE OF THE LUMBRICINAE.

The Lumbricinae are a recently evolved and dominant group of earthworms, which possesses great powers of adaptation to new surroundings, and of which numerous species have been carried by man and have established themselves all over the world.

The occurrence of these peregrine species of Lumbricinae gives no clue, therefore, to the zoogeographical affinities of the region where they are found; and since Beddard's and Michaelsen's records are entirely of these "world-wanderers," it would have been permissible to regard Kashmir as possessing no proper earthworm fauna of its own, and therefore as not to be included in the territory of any particular family or group of Oligochaeta.

Some little time ago, however, I described a new species of Lumbricine from Murree in the Himalayas (10), a few miles only from the southern border of Kashmir. In addition, one of the

species here recorded from Kashmir appears to be new, and therefore possibly endemic. These justify the inclusion of this region, at least provisionally, in the territory of the Lumbricinae.

Simla, the summer capital of India, and the surrounding area in the W Himalayas, swarm, as might be expected, with peregrine Lumbricines, from which no zoogeographical conclusions can be drawn. But here too a new and possibly endemic Lumbricine is now found to occur (*Helodrilus (Dendrobaena) kempfi*, v. *infra*); the W Himalayas may thus probably be added to the proper territory of the Lumbricinae. The extreme outpost of the subfamily appears to be Calcutta, whence *Helodrilus (Bimastus) indicus* was described some years ago by Michaelsen (3). These four species are the only endemic Lumbricinae so far known in India.

#### THE POLYPHYLETIC ORIGIN OF THE GENUS *MEGASCOLEX*.

That the genus *Megascolex* is polyphyletic, i.e. that different species of the genus have arisen in different places, at different times, and from different ancestors, is already recognized. Michaelsen (5) has pointed out the close relation of certain S. Indian species of *Megascolex* to certain S. Indian species of *Notoscolex* (the group of *Megascolex travancorensis* to that of *Notoscolex ponmudianus*), and argues that these species of *Megascolex* have in all probability arisen from the local representatives of *Notoscolex*. There is also a similar correspondence between species of *Notoscolex* and species of *Megascolex* in another restricted area, the N. Island of New Zealand; here, too, the inference is that the latter have arisen from the former. I have shown (II) that a worm which is by definition a *Megascolex* has descended from some species of *Perionyx*, in a region more than a thousand miles away from the proper Indian *Megascolex* territory; and have in the same paper given some reason for thinking that certain species of *Megascolex* may be descended from still another genus *Spenceriella*.

Perhaps the clearest case of an independent origin of a species of *Megascolex*, however, is that of *Megascolex horai*, described below. The worm has certain remarkable peculiarities; it is unique in the genus in having the male pores on segment xvii, one segment in front of the normal position for the genus; and both male and female organs are found, on dissection, to be shifted one segment forwards. There are also well marked and stalked calciferous glands in segments x, xi and xii; such stalked calciferous glands scarcely occur elsewhere amongst the Indian species of *Megascolex*.

Now a small group of species of *Notoscolex* has exactly these same characters; and here too the species (*Notoscolex oneilli*, *stewarti*, and *striatus*) are peculiar in these respects in their genus. The species of *Notoscolex* were found in the Abor country in the Assamese Himalayas; *Megascolex horai* was taken at Cherrapunji, also in Assam (though not in the Himalayas), more than a thousand

miles from the proper Indian *Megascolex* region. There can be no doubt that while the majority of species of *Megascolex* have arisen from *Notoscolex* elsewhere, this species has had an independent origin from a local species of *Notoscolex* in Assam.<sup>1</sup>

#### SOME OTHER SPECIES OF INTEREST.

A new *Drawida* and a new *Perionyx* are also to be recorded from Assam, and a new *Eudichogaster* from Bombay.

It has been interesting to rediscover *Eutyphoeus orientalis* (Bedd.) with its peculiar penial setae, and *Octochaetus beatrix* Bedd., in which I have found small penial setae, previously overlooked.

Both the new species of Lumbricinae illustrate the fact, brought out by Michaelsen (4), that the subgenera of *Helodrilus* may run into each other, and have no sharp limits. Thus one of the species, which I assign to the subgenus *Allolobophora* agrees with *Bimastus* in having no spermathecae; while the other, which I place in *Dendrobaena*, agrees with *Allolobophora* in the characters of the seminal vesicles.

#### Family MONILIGASTRIDAE.

##### Genus *Drawida* Mich.

##### *Drawida nepalensis* Mich.

Dehra Dun, compound of the Forest Research Institute (serial No. 111 of 27.viii.1921).

Dorsal pores are usually absent in the genus *Drawida*, but I have previously noted (10) that in this species vestiges are present, in the form of gaps in the muscular layers of the body-wall. These vestiges were very obvious in the present specimens, though there were no actual perforations. They occurred from furrow 4/5 onwards.

##### *Drawida rosea*, sp. nov.

Cherrapunji, Assam; under stones and in muddy pools around Dak Bungalow. S. L. Hora. 28.x.1921. A single specimen.

*External Characters*:—Length 102 mm. Maximum diameter 3 mm. Segments 149. Colour grey, but with a faint pinkish tinge dorsally.

Prostomium prolobous.

Dorsal pores absent, but vestiges are visible in the middle of the body.

Nephridiopores in the line of the lateral setae.

The setae are closely paired,  $aa=4/5$   $bc$ ;  $dd=4/7$  of the circumference. The setae begin on segment ii.

The clitellum embraces segments x-xiii, but xiv and perhaps ix are slightly altered.

<sup>1</sup> On the fusion of the genera *Notoscolex* and *Megascolex* by Michaelsen cf. Michaelsen (6) and Stephenson (11).

The male pores are situated on small somewhat irregular transversely elongated papillae at the hinder border of segm. x; they are immediately outside—almost in—the line of setae *b*. Immediately behind the papillae of the male pores, on the anterior part of segm. xi, are a pair of smaller and rounder papillae. The midventral region between the four papillae is somewhat sunken, and darker in colour.

The female pores are minute, in furrow 11/12, in line with setae *ab*.

The spermathecal pores are conspicuous, with swollen margins, in furrow 7/8, between the lines of setae *ab* and *cd*, but nearer the latter. The upper end of the pore reaches the line *cd*.

*Internal Anatomy* :—Septa 5/6–8/9 are much thickened.

There are four gizzards, in segm. xiii–xvi, all well developed.

The last heart is in segm. ix.

The testis sacs are large, elongated in shape, and extend into segm. ix, though their greater part is in x; they reach as far back as septum 10/11, and are slightly constricted at septum 9/10. The vas deferens lies on the posterior face of septum 9/10; it is narrow, and thrown into numerous coils.

The prostates are elongated, cylindrical, and bent on themselves; the ental end is rather thicker, and there is no separate duct; the surface is soft and “glandular.” The vas deferens enters near the ental end.

Segm. xi is narrow antero-posteriorly, but there is no ovarian chamber; segm. xi is fully opened up on opening the body in the usual way. The segment was full of genital products and the female organs were not separately distinguishable. The ovisacs are large, stoutly and irregularly ovoid in shape, and extend back to septum 13/14.

The spermathecal ampulla is spherical; the duct forms coils on the posterior face of the septum. The atrium is large—not very much smaller than the ampulla; it is a pear-shaped sac, the lower and narrower portion marked by a number of slight annular constrictions, and prolonged into a narrow, bent, duct-like tube, joined at its termination by the spermathecal duct.

*Remarks* :—The relations of this species seem to be to *D. nepalensis* and *papillifer*.

#### Family MEGASCOLECIDAE.

#### Subfamily MEGASCOLECINAE.

#### Genus *Megascolex* Templeton.

#### *Megascolex konkanensis* Fedarb.

Bombay. Coll. Prof. J. P. Mullan.

The actual male pores are not usually visible; in these specimens they appear to be on the transverse ridge which runs across the male area on each side, nearer the outer than the inner margin of the area.

**Megascolex mauritii** (Kinb.).

Bombay. Coll. Prof. J. P. Mullan.  
Ahmedabad. Coll. Prof. J. J. Asana.

**Megascolex horai**, sp. nov.

Cherrapunji, Assam; under stones and in muddy pools around Dak Bungalow. 28.X.1921. S. L. Hora. A single specimen.

*External Characters*:—Length 110 mm. Diameter 2.5 mm. Segments 188. Colour yellowish grey, no difference between dorsal and ventral surfaces. A long thin worm.

Prostomium slightly epilobous (?).

Dorsal pores begin in furrow 10/11.

The setae are disposed in rings; they are of fair size, and form fairly regular longitudinal lines. In front of the male pores the ventral break is equal to 3-4 *ab*, in the middle and hinder parts of the body to 2½-3 *ab*. The dorsal break is equal to 2-3 *yz* anteriorly, but is much smaller behind the genital region (1¼-1½ *yz*). The following numbers were counted: v/26, ix/27, xii/32, xix/32, and in the middle of the body 28.

The specimen was apparently not fully mature. There was no clitellum, and no genital papillae or markings of any kind.

The male pores are on segm. xvii, on papillae, in line with setae *b*, about one-fifth of the circumference apart.

The female apertures are not visible.

The spermathecal pores are in furrows 6/7 and 7/8, in or just internal to the line of *b*, about one-fifth of the circumference apart.

*Internal Anatomy*:—Septum 4/5 is thin, 5/6 is very thin, 6/7 is thin and attached to the ventral body-wall behind the normal site of insertion,—on the left side nearly at the level of furrow 7/8; the following septa as far as 13/14 are perhaps slightly strengthened, but not much; 7/8 is displaced backwards in the same way as 6/7, 8/9 is attached slightly behind its normal line of insertion, but the rest are not displaced. All the septa as far back as 12/13 are strongly convex backwards.

The gizzard is in segm. vi, firm and barrel-shaped.

Calcareous glands are present in segms. x, xi and xii; they are of moderate size, are stalked, and the margins may be lobulated. The intestine begins in xv.

The last heart appears to be in segm. xii.

There are tufted nephridia in segm. v. In the body generally the micronephridia are arranged in a single transverse row in each segment.

Testes and funnels are present in segms. ix and x. Seminal vesicles are found in xi only, they were small in size in the present specimen.

The prostates are small—perhaps not fully developed, they are lobular and deeply bifid on the outer border. The duct is bent round sharply at its ectal end.

Ovaries and perhaps funnels were seen in segm. xii.

The spermathecae are small sacs sessile on the body-wall, without duct. There is a single diverticulum, narrow and tubular, as long as or not quite so long as the ampulla; it arises from the inner side of the sac where it joins the body-wall.

There are no penial setae.

Genus **Pheretima** Kirb. em. Mich.

**Pheretima elongata** (E. Perr.).

Bombay. Coll. Prof. J. P. Mullan.

**Pheretima hawayana** (Rosa).

Dehra Dun; compound of the Forest Research Institute (serial no. 111 of 27.viii.1921).

**Pheretima heterochaeta** (Mich.).

Sariya Tal, about three miles from Naini Tal to the west, and at a lower level than Naini Tal; from underneath stone on the banks of the lake. A single specimen. Dr. B. Prashad.

Cherrapunji, Assam; under stones and in muddy pools around Dak Bungalow. 28.x.1921. S. L. Hora. Several specimens.

Two of the latter batch of specimens showed certain abnormalities, which led to my examining them more closely.

In one specimen, the number of segments counted on the dorsal surface was one greater than those seen ventrally, this was due to the presence of a spiral groove in the anterior part of the body. There were other spiral abnormalities further back, behind the genital region. The clitellum was incomplete on the right side from above the lateral line of the body to the midventral line, it embraced segments xiv-xvi. The male pore was on xviii on the left side, and on xx on the right. There was a papilla midventrally situated on xvii. Internally, and reckoning by the segments seen on the dorsal surface (the above appearances are described as seen from the ventral surface), the spermathecae are situated between segms. 6/7, 7/8, 8/9 and 9/10; that in 7/8 on the right side has a double ampulla with a single duct and diverticulum, the last heart is in segm. xiv. Seminal vesicles are present in xii, xiii and xiv on the right side, and in xii and xiii on the left. Ovaries and their funnels are present in xiv on the left, and in xiv, xv, xvi and xvii on the right. The prostate of the right side is absent; the male duct ends in xxi.

In the other specimen there were two male pores on the right side, on segms. xviii and xix, each smaller than normal. Internally, the prostate was small on the left side, and there was none on the right. On the right side, both vasa deferentia were continued into the anterior prostatic duct; there was a second prostatic duct in xix, but unconnected with the vasa deferentia. The right anterior prostatic duct was slightly stouter than the one behind it.

***Pheretima houletti* (E. Perrier).**

Bombay. Coll. Prof. J. P. Mullan.  
 Dehra Dun; compound of Forest Research Institute (serial No. III of 27·viii·1921).  
 Cherrapunji, Assam; under stones and in muddy pools around Dak Bungalow. 28·x·1921. S. L. Hora. Two specimens.

***Pheretima posthuma* (L. Vaill.).**

Dehra Dun; compound of Forest Research Institute (serial No. III of 27·viii·1921).

***Pheretima suctoria* Mich.**

Bombay. Coll. Prof. J. P. Mullan.

As the species has been met with only once previously, and as the present specimen shows a few variations from the description given by Michaelsen (3), I add the following notes:—

Length 205 mm. Diameter 6 mm. Colour a dark brown dorsally, paler ventrally. Prostomium small, epilobous 4/5; the grooves at the sides of the prostomium are hardly different from the numerous other longitudinal grooves round the mouth on the first segment; the backwardly extending process (tongue) of the prostomium not cut off by a groove behind. Dorsal pores from 13/14, perhaps a rudimentary pore in 12/13,—a deepening of the intersegmental groove in the middorsal line.

The setae are larger on the anterior segments (ii–vi).

The characteristic male area may be described as follows:— On segment xviii, taking up the whole length of the segment, are a pair of raised circular disc-like areas with well defined margins; the interval between these discs is less than the diameter of one of them, and shows seven setae intervening. There are also one or two setae on the inner and outer edges of the discs,—i.e. the setal ring is continued a little way into the discs at each side. The male pore is situated at the centre of the disc on a tiny papilla; and a faint ridge runs transversely across each disc in the line of the setae and of the male pore, behind the ridge, and also transverse in direction, is a slight depression. The discs are light in colour.

Michaelsen places the male pores at the outer border of the discs, about one-third of the circumference apart. This did not seem to be the case here, and from internal examination also the male apertures cannot be so far apart as that,—scarcely, I think, as much as one-fourth of the circumference apart.

The female pore appeared to be single, in a small depression.

Septum 4/5 was slightly thickened; 5/6, 6/7 and 7/8 were very stout, 10/11 was moderately thick, 11/12 and 12/13 decreasingly so.

The testis sacs were large, and came up laterally round the alimentary canal on each side, leaving the dorsal surface of the gut uncovered. In segm. xi the sacs enclose the hearts and cover in the seminal vesicles also, in x they enclose the hearts (though

at first sight this appears not to be the case; but the large dark vessel running superficial to the sac is not the proper heart).

The prostatic duct is looped or coiled; it is thin at first, but becomes stout towards its ectal end.

I found no ovisacs.

The spermathecae differ from those of Michaelsen's specimens (fig. 1). The ampulla is ovoid; the duct, nearly as long as the ampulla, is narrow at first, then swells and becomes shining and firm. The diverticulum is as long as the ampulla and duct together; it arises from the ectal end of the duct, and is narrow and tubular; its inner (ental) portion consists of a number of short closely adpressed loops and has a crenulated appearance, the ectal portion becomes smooth and shining towards its termination.

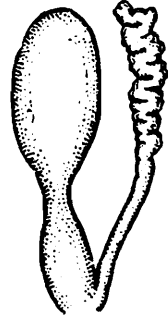


FIG. 1.—*Pheretima suctorica*; spermatheca.

### Genus *Perionyx* E. Perr.

#### *Perionyx excavatus* E. Perr.

Mashobra, Simla Hill States. 13.vi.1921. S. L. Hora. Two specimens and a few fragments.

Below Kufri, Simla Hill States; near stream, under stones and in moss. 28.ix.1921. Dr. S. W. Kemp. Four specimens, two quite immature.

#### *Perionyx modestus*, sp. nov.

Cherrapunji, Assam; under stones and in muddy pools, around Dak Bungalow. 28.ix.1921. S. L. Hora. A number of specimens.

*External Characters*:—A long specimen measures 167 mm., but sexual specimens are found down to 85 mm. Diameter, max. 4 mm. Segments 174. Colour deep purple dorsally, lighter, of a violet tint, ventrally. The body is somewhat flattened dorso-ventrally.

Prostomium epilobous  $\frac{1}{2}$ ; tongue not closed behind.

Dorsal pores begin from furrow 4/5.

The setae are in rings, and are more closely set ventrally. The dorsal break is either absent or very small ( $zz = ca. 1\frac{1}{4} yz$ ); the ventral break is absent or very small behind the genital region, and small ( $ca. 1\frac{1}{4} ab$ ) in front of the genital region. The following numbers were counted: v/ ca. 38, ix/41, xii/40, xix/42, and 42 in the middle of the body.

There was no clitellum to be seen in any of the specimens.

The male pores are on segm. xviii, the anterior and posterior borders of which are bowed forwards and backwards respectively. The segment presents a transverse groove, usually shallow but occasionally deep. The pores are short longitudinally placed slits at the ends of the groove; they are not far from the midventral line, in line with about the fourth seta on each side.

The female pores were not visible.

The spermathecal apertures are in furrows 7/8 and 8/9, near together, about in line with the third seta on each side.

There are no other genital marks.

*Internal Anatomy*:—Septa 6/7 and 7/8 are slightly thickened, 8/9 and 9/10 moderately so.

The gizzard is vestigial, in segment v. There are no calciferous glands; but the oesophagus is dark in colour, with transverse vascular striations, in segms. xii and xiii. The intestine begins to widen out behind the prostates.

The last heart is in segm. xiii.

The nephridia all end in the same line.

Testes and funnels are free in segms. x and xi. Seminal vesicles are present in segms. xi and xii, they fill the length of their segments, and are apposed to their fellows in the middorsal line.

Prostates are present in segm. xviii, but are very small; the duct is stout in relation to the size of the gland, is muscular and shining, and almost straight.

Ovaries and funnels are present in segm. xiii.

The spermathecae, in segms. viii and ix, are small elongated sacs, with no distinguishable duct, and a minute wartlike diverticulum near their base (not present in all).

There are no penial setae.

### Subfamily OCTOCHAETINAE.

#### Genus *Octochaetus* Bedd.

#### *Octochaetus beatrix* Bedd.

Bombay. Coll. Prof. J. P. Mullan.

The original description of this species was given by Beddard (2) in 1902. In 1914 I described as a new species a worm which I called *Octochaetus dasi* (8), but I now believe that this is identical with Beddard's species. The following notes fill in a few gaps in our knowledge.

Prostomium epilobous  $\frac{1}{2}$ , the tongue is very narrow, and not cut off behind.

The setae in the present specimen were spaced as follows:—in the middle of the body, and behind the genital region  $ab=1/3$   $aa=2/5$   $bc=2/3$   $cd$ ; on segm. ix  $ab=\frac{1}{2}$   $aa=\frac{1}{2}$   $bc=2/3$   $cd$ ;  $dd=2/3$  of the circumference.

The male area is a somewhat quadrilateral depression with rounded angles, small, rather deep, midventrally on segms. xvii-xix, it indents the posterior border of the clitellum, and is comprised within the lines of setae *a*. Small papillae are seen in the line of *b*, on the borders of the depression, in segms. xviii and xix, perhaps the porophores of the male and posterior prostatic apertures respectively, there is not distinct papilia or aperture on xvii. No seminal grooves were visible.

The female pore or pores are indicated by a small midventral depression on the anterior part of segm. xiv.

The spermathecal pores are two pairs, on minute papillae close to the middle line, the least trifle in front of the setal zones of segms. viii and ix.

Septum 5/6 is somewhat strengthened; the next is 8/9, slightly thickened; 9/10, 10/11, and 11/12 are somewhat strengthened, 12/13 very slightly so, and the rest are thin.

Previous statements regarding the absence of penial setae appear to be mistaken. There was very little to indicate their presence; but an endeavour to isolate and mount the sac was successful in revealing one. This was very small, .6 mm. long, and 13 $\mu$  thick at its middle; the shaft has a slight double curve, and the tip is fairly sharply pointed; the ornamentation consists of a few irregular indentations of the margin near the free end (fig. 2). No copulatory setae from the spermathecal segments could be obtained.



FIG. 2.—*Octochaet-  
tus beatrix*; penial  
seta:  $\times 460$ .

### Genus *Erythraeodrilus* Steph.

#### *Erythraeodrilus kempfi* var. *bifoveatus* (Steph.).

Bombay. Coll. Prof. J. P. Mullan.

I accept Michaelsen's recent separation of this and allied species from the genus *Hoplochaetella*, and their union with *Erythraeodrilus* (7). It now seems to me that the difference between the two species that I formerly described separately as *kempfi* and *bifoveata* (10) is scarcely sufficiently marked to justify their being kept apart.

### Genus *Eutyphoeus* Mich.

#### *Eutyphoeus orientalis* (Bedd.).

Dehra Dun; compound of Forest Research Institute (serial No. 111 of 27.viii.1921).

This species, obtained from near Calcutta by Beddard and from Dehra Dun by Fedarb, has not been seen since 1898. It is interesting to find it now in a batch of worms from Dehra Dun, one of the previously recorded localities. The following details may be noted:—

On segm. xvii are a pair of grooves or cracks, shaped like square brackets — [ ] — overhung on their outer side by a thickened ridge; the male pores, with penial setae projecting, are in the posterior corners of the brackets. The longitudinal part of the grooves, and the pores themselves, are a little outside the line of setae *b*.

The spermathecal apertures are transverse slits with their centre between *b* and *c*, but nearer *c*,—the outer end of the slit reaches the line of *c*.

The spermathecae are somewhat ovoid sacs; the duct is very short and stout, from the under surface of the ampulla; the margin of the ampulla is crenated. The diverticula are two, attached to the beginning of the duct and rather on its posterior side; they appear to have one, two, or three small chambers.

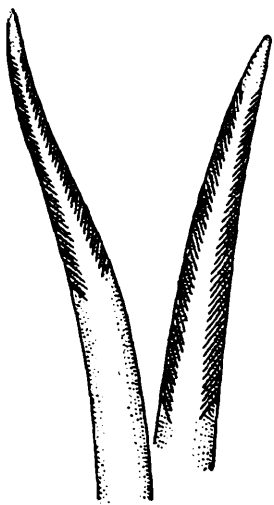


FIG. 3.—*Eutyphoeus orientalis*; penial setae:  $\times 300$ .

The peculiar penial setae are  $2\frac{1}{2}$  mm. long. and  $26\mu$  thick in the middle, the shaft is almost straight, and the tip is bluntly pointed. The oblique markings, closely set along the borders of the distal end of the seta, are interpreted by Beddard as "chevron-shaped ridges"; but the appearance is almost as if there were a cleavage along the oblique lines (fig. 3).

### *Eutyphoeus waltoni* Mich.

Dehra Dun; compound of Forest Research Institute (serial No. 111 of 27.vii.1921).

### Genus *Eudichogaster* Mich.

#### *Eudichogaster mullani*, sp. nov.

Bombay. Coll. Prof. J. P. Mullan.

*External Characters*:—Length 134 mm. Diameter 6 mm. Segments 200. Colour a light and even grey, no difference between dorsal and ventral surfaces. Anterior end rather bulbous. Secondary annulation on the anterior segments; iv and v biannular, vi triannular, vii and onwards to the clitellum with four, five or even more annuli.

Prostomium small and prolobous; a median dorsal groove divides segm. i throughout its length.

Dorsal pores very small, the first in furrow 12/13; perhaps a small or rudimentary pore in 11/12.

Setae are not visible in segments ii-iv, and only a few are seen in v and vi. In the middle of the body  $ab=2/7$   $aa=2/5$   $bc=2/3$   $cd$ , and  $dd=ca. 4/7$  of the circumference; behind the genital region  $ab=1/4$   $aa=1/3$   $bc=4/7$   $cd$ , while  $dd=2/3$  of the circumference; in the anterior segments the ratios are about the same as these last.

The clitellum is not distinctly developed, but perhaps extends over  $\frac{1}{2}$ xiii- $\frac{1}{2}$ xvii.

The midventral region of segments xvii–xix is depressed, the depression extending laterally from the line of setae *b* on one side to an equivalent extent on the other; in the bottom of the depression is an irregular slightly raised rough patch. The prostatic pores are perhaps on four small papillae at the angles of the depression, in or very slightly outside the line of setae *b*, and very slightly anterior to the setal zone of xvii and very slightly posterior to that of xix respectively.

On the anterior border and behind the posterior border of the rough patch in the depressed area, in other words posteriorly on segments xvii and xix respectively, and in the midventral line, are two papillae of small size, each appearing to have a pore in its centre.

The female pores were not seen.

On segment viii is a roughened patch, slightly elevated and extended in a transverse direction on each side to a little beyond the line of seta *d*; it is narrow antero-posteriorly, and does not embrace the anterior two-fifths of the segment, nor, except between the lines of setae *b* and *c*, the posterior fifth either. Both pairs of setae are thus included in the patch. The spermathecal apertures are not visible, but from internal examination they are two pairs, behind furrows 7/8 and 8/9, but slightly in front of the setal zones of segments viii and ix, between the lines of setae *b* and *c*, but nearer to that of *b*.

*Internal Anatomy*:—Septum 4/5 is thin, 5/6 and all succeeding septa as far as 10/11 are moderately strong, 8/9 and 9/10 being the thickest of the series; 11/12 is somewhat thickened, and the rest are thin.

The gizzard in segment v is large, spherical, and very firm; that in vi is rather smaller. Calciferous glands are present in segments xi and xii; they are dark in colour, ovoid or kidney-shaped, well set off from the gut, not stalked but attached by one edge. The intestine begins in segm. xv.

The last heart is in segm. xii.

Behind the genital region the micronephridia are arranged in a transverse row in each segment, about nine on each side; there is no marked difference in size, the most internal being a little smaller than the rest and a little closer together. At the hinder end of the body the arrangement is much the same; there are about seven nephridia on each side, and the innermost of the series is scarcely larger than the rest—a little larger than the one next to it.

Testes and funnels are free in segms. x and xi. Seminal vesicles are present in segms. ix, x and xii, in xii they are small, in ix smaller still, and in x there was one only, on the right side, and this was quite minute.

The prostates, in segms. xvii and xix, are small; the glandular part is disposed in a few loose coils or loops, the duct is thin, of the same diameter as the glandular part, but muscular and shining.

The spermathecae are in segments viii and ix; the ampulla is small and ovoid; the duct is short, and relatively wide. The diverticulum is a small wart-like swelling on the side of the duct.

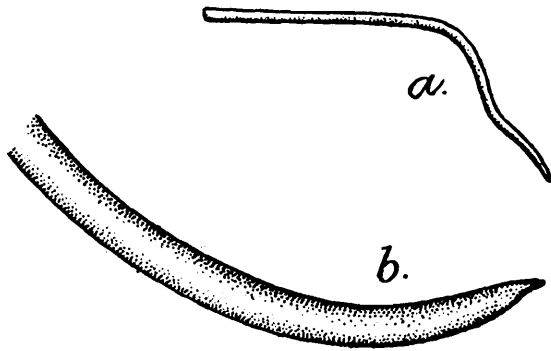


FIG. 4.—*Eudichogaster mullani*; copulatory seta; a, whole seta:  $\times 50$ ; b, tip of seta:  $\times 300$ .

Copulatory setae are found on segm. viii, in the site of the ventral bundles. In length, measured across the bend, they are 7 mm. or more, and their thickness at the middle is  $16\mu$ . The distal half is either curved through a quarter of a

circle, or bent and twisted more irregularly. The tip ends in a blunt point, there is no ornamentation (fig. 4).

#### Family LUMBRICIDAE.

##### Subfamily GLOSSOSCOLECINAE.

##### Genus *Pontoscolex* Schmarda.

##### *Pontoscolex corethrurus* (Fr. Müll.).

Ahmedabad. Coll. J. J. Asana. Several specimens.

##### Subfamily LUMBRICINAE.

##### Genus *Helodrilus* Hoffm.

##### *Helodrilus* (*Allolobophora*) *caliginosus* subsp. *trapezoides* (Ant. Dug.).

Sariya Tal, about three miles to the west of Naini Tal, and at a lower level than Naini Tal; from underneath stone on the banks of the lake.

Dr. B. Prashad. Two specimens, one mature, one immature.

Sukla Tal, almost a mile to the west of Naini Tal; 7000 ft.; from the margins of the lake. Dr. B. Prashad. Several specimens.

Gandarbal, Kashmir; ponds in the course of a shallow irrigation streamlet. Ca. 6000 ft. 14.vi.1921. Dr. B. Prashad. Two specimens.

Anchar Lake, Kashmir (an extensive marshy and weedy area in the course of the Sind River). 29.vi.1921. Dr. B. Prashad. A number of specimens.

##### *Helodrilus* (*Allolobophora*) *prashadi*, sp. nov.

Gandarbal, Kashmir; ponds in the course of a shallow irrigation streamlet. Ca. 6000 ft. 14.vi.1921. Dr. B. Prashad. Several specimens.

*External Characters*:—Length 62 mm. Diameter 3 mm. Segments 133. Colour grey, with a slightly pinkish tinge.

Prostomium proepilobous.

Dorsal pores begin in furrow 4/5 or 5/6.

The setae are closely paired;  $aa$  is nearly twice  $bc$ ;  $ab$  is greater than  $cd$ ;  $dd$  is less than half the circumference.

The clitellum extends from part of segment xxiii or segment xxiv to xxxii or xxxiii (= 9 to more than 10). The clitellum is saddle-shaped, and the clitellar region is swollen, and flattened ventrally. "Ridges" or "walls" are present on segms. xxix-xxxi; and the ventral setae in these segments are implanted on minute papillae.

The male pores are seated on very prominent papillae, hemispherical in shape on xv and encroaching also on xiv and xvi, the centres of the papillae are just outside the line of setae  $b$ .

Female pores were not visible. Spermathecal pores are absent.

The ventral setae of segment xii, and sometimes those of segments xi and x, are situated on papillae.

*Internal Anatomy*:—Septum 5/6 is thin, 6/7, 7/8 and 8/9 are much thickened, 9/10 is fairly thick, and succeeding septa as far as 13/14 gradually diminish in thickness; the rest are thin.

The gizzard comprises two segments, xvii and xviii.

Testes and funnels are free in segms. x and xi. Seminal vesicles are present in ix, x, xi and xii, those in x are the smallest, though they are not much smaller than those in ix; those in xi and xii have a nodular surface, indeed they are almost racemose, being composed of small spherical lobules.

Spermathecae are absent.

The lateral setae of segments xi and xii are seen on internal dissection to be contained in large sacs. On examination they are found to be .76 mm. long, and almost straight, they are fairly sharply pointed, and the distal portion is grooved as in the clitellar setae of *Lumbricus terrestris*.

*Remarks*:—This species disagrees with the great majority of the subgenus, and resembles *Bimastus*, in having no spermathecae. This peculiarity has been recorded by Michaelsen in the case of *H. (A.) agatschiensis* (4).

### ***Helodrilus (Dendrobaena) kempii*, sp. nov.**

Kufri, Simla Hill States; 7800 ft. Oct. 1921. Dr. S. W. Kemp. Two specimens, one mature.

*External Characters*:—Length 91 mm. Diameter 6 mm. Segments 128. Nonpigmented, light grey in colour.

Prostomium epilobous  $\frac{1}{2}$ , the tongue not cut off behind.

Dorsal pores from furrow 9/10.

The setae are small; anteriorly  $ab = \frac{1}{3}$   $aa = \frac{1}{2}bc = cd$ , behind the male apertures the intervals between the individuals of a pair begin to widen, and behind the clitellum this separation becomes greater still, so that in the middle of the body the setae are no longer paired. Here  $ab = \frac{1}{2}-\frac{3}{5}$   $aa = 1\frac{1}{4}-1\frac{1}{2}$   $bc = 2 cd$  or nearly,  $dd = \frac{1}{3}-\frac{2}{5}$  of circumference.

The nephridiopores are just above the line of setae *b*.

The clitellum is saddle-shaped, and extends over segms. xxix–xxxiv (= 6). The ridges of puberty are indistinct, and appear to be coextensive with the clitellum, or perhaps exclude the last segment and half of the first.

The male pores are on segm. xv; they appear as transverse slits which extend from the line of setae *b* to that of *c*, with tumid anterior and posterior lips which cause the limits of segment xv to bulge forwards and backwards.

The spermathecal apertures are in furrows 9/10 and 10/11, in the line of setae *d*.

*Internal Anatomy*:—Septum 4/5 is thin, 5/6 -- 15/16 are thickened, 6/7–8/9 most so, the rest only slightly.

The gizzard takes up two segments; xvii and xviii. There are oesophageal pouches in segm. x, the calciferous glands in xi form large lateral widenings of the oesophagus which, however, are not set off from the tube; they are continued back, but are less prominent, in xii, and are not distinguishable behind this.

The last heart is in xii, but this is much smaller than the one in xi, and is at a deeper level.

Testes and funnels are free, in segms. x and xi. There are four pairs of seminal vesicles, in segms. ix–xii, all of quite moderate size, those of segm. x are equal in size to those of ix.

Spermathecae are present in segms. x and xi as small round sacs sessile on the body-wall.

The ventral setae of segm. xv are slightly modified. The points are apparently softened, the characteristic feature is a faint sculpturing of the distal portion of the shaft by a numerous series of transverse markings, slightly jagged and convex towards the insertion of the seta (fig. 5).



FIG. 5.—*Helodrilus (Dendrobaena) kempi*; genital seta from segm. xv:  $\times$  ca. 200.

markings, slightly jagged and convex towards the insertion of the seta (fig. 5).

### *Helodrilus (Bimastus) constrictus* (Rosa).

Mashobra, Simla Hill States. 13.vi.1921. S. L. Hora. A single specimen, incomplete behind.

### *Helodrilus (Bimastus) parvus* (Eisen).

Sukha Tal, almost a mile to the west of Naini Tal; ca. 7000 ft. From the margins of the lake. Dr. B. Prashad. Five specimens. Chenar Bagh Nullah (a very shallow slow-running stream with a sandy, and muddy bottom), Srinagar, Kashmir. 6–8.vi.1921. Dr. B. Prashad. A single specimen.

Genus *Octolasion* Örley em. Rosa.

*Octolasion lacteum* (Örley).

Mashobra, Simla Hill States. 13.vi.1921. S. L. Hora. Two specimens, immature, probably belonging to the above species.

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## INDIAN MYSIDACEA.

By WALTER M. TATTERSALL, D.Sc., Keeper of the  
Manchester Museum.

The following report deals with collections of Mysidacea sent to me from the Indian Museum for identification. The greater part of them were collected by Dr. S. W. Kemp in three localities, Kilakarai and Pamban, at the northern end of the Gulf of Manaar and at Port Blair in the Andaman Islands. At the latter place Dr. Kemp made collections at eight different stations and in order to save repetition I give here a list of these stations with full particulars, merely giving the station number under each species.

### PORT BLAIR, ANDAMAN ISLANDS.

#### *List of stations at which Mysidacea were obtained.*

- St. 3. 19-ii-15. North Bay, ca. 1 fm. Muddy sand.  
St. 5. 21-ii-15. Brigade Creek, 2-5 fms. Bottom composed of mud with much decaying vegetable matter.  
St. 7. 22-ii-15. Off jetty, Ross I., 1½-2 fms. Sand and a little weed.  
St. 8. 23-ii-10-iii-15. Between Ross I. and Aberdeen, 2-10 fms. Bottom very varied, principally sand, weed, small living corals, dead coral fragments and sponge.  
St. 11. 27-ii-15. Channel N. of Viper I., 1-2 fms. Mud.  
St. 13. 1-iii-15. Reef at N. end of Ross I., shore collecting. Dead coral.  
St. 19. 7-iii-15. Semiramis Bay and off Perseverance Pt. Fine mud.  
St. 21. 11-iii-15. Mid-channel, N. W. of Ross I., 10-12 fms. Muddy sand.  
St. 32. Feb., March, 1921. Ross Channel, 2-9 fathoms.

Full particulars of all other localities are given under each species.

Our knowledge of the Mysidacea of Indian waters has until within the last ten years been of the scantiest nature. Wood-Mason, Alcock and Anderson recorded the following deep-sea and bathypelagic species from the collections of the "Investigator":—

<i>Gnathophausia calcarata</i> G. O.	<i>Gnathophausia zoëa</i> Will.-Suhm.
Sars. (= <i>G. bengalensis</i> Wood-Mason.)	(= <i>G. sarsi</i> Wood-Mason.)
	<i>Eucopia australis</i> Dana.
<i>Gnathophausia gracilis</i> Will.-Suhm. (= <i>G. brevispinis</i> Wood-Mason and Alcock)	<i>Eucopia sculpticauda</i> Faxon.
	<i>Pctalophthalmus armiger</i> Will.-Suhm.

In 1906 I recorded *Siriella paulsoni* Kossmann from Ceylon and between 1908 and 1914 I have described six other species of Mysidae from the brackish waters of the coast of India:—

<i>Rhopalophthalmus egregius</i> Hansen.	<i>Potamomysis assimilis</i> Tattersall.
<i>Gastrosaccus muticus</i> Tattersall.	<i>Indomysis annandalei</i> Tattersall.
<i>Gastrosaccus simulans</i> Tattersall.	<i>Mesopodopsis orientalis</i> (Tattersall).

In the course of his report on the Siboga Mysidacea Hansen (1910) records the following species from the Bay of Bengal:—

<i>Siriella gracilis</i> Dana.	<i>Gastrosaccus bengalensis</i> Hansen.
<i>Siriella aequiremis</i> Hansen.	
<i>Hemisiriella parva</i> Hansen.	<i>Pseudanchialina pusilla</i> G. O. Sars.
<i>Anchialina grossa</i> Hansen.	
	<i>Pseudanchialina inermis</i> Illig.

Zimmer (1915 (3)) described the Mysidae collected by Dr. Duncker during a voyage from Ceylon to New Guinea. No exact localities are given for the following species, which may or may not have been taken in Indian waters:—

<i>Anchialina frontalis</i> Zimmer.	<i>Leptomysis apiops</i> G. O. Sars?
<i>Anchialina penicillata</i> Zimmer.	<i>Diopromysis perspicillata</i> Zimmer.
<i>Gastrosaccus bengalensis</i> Hansen.	<i>Uromysis armata</i> Hansen.
<i>Gastrosaccus dunckeri</i> Zimmer.	<i>Lycomysis pusilla</i> Zimmer.

Of these forms, *Anchialina frontalis* is, in my opinion, a synonym of *A. grossa* Hansen, *Leptomysis apiops* of *L. xenops*, sp. nov., described below, and *Lycomysis pusilla* of *L. spinicauda* Hansen.

Finally Colosi (1920) has recorded *Doxomysis zimmeri* Colosi, from Ceylon.

The total number of species of Mysidacea known from Indian waters is therefore 27.

In the present report I record 38 species of which twelve have been recorded previously from India, sixteen are described as new to science and ten are new to the Indian fauna. These last species are:—

<i>Lophogaster intermedius</i> Hansen.	<i>Siriella dubia</i> Hansen.
<i>Siriella brevicaudata</i> Paulson.	<i>Anchialina typica</i> (Kröyer).
<i>Siriella quadrispinosa</i> Hansen.	<i>Gastrosaccus pacificus</i> Hansen.
<i>Siriella vulgaris</i> Hansen.	<i>Erythroops minuta</i> Hansen.
<i>Siriella affinis</i> Hansen.	<i>Hypererythroops spinifera</i> (Hansen.)

The new species described below are:—

<i>Siriella hansenii</i> .	<i>Mysidopsis indica</i> .
<i>Gastrosaccus kempi</i> .	<i>Mysidopsis kempi</i> .
<i>Erythroops nana</i>	<i>Leptomysis xenops</i> .

<i>Afromysis macropsis.</i>	<i>Neomysis hodgarti.</i>
<i>Prionomysis stenolepis</i> (gen. nov.)	<i>Idiomysis inermis</i> (gen. nov.)
<i>Doxomysis anomala.</i>	<i>Heteromysis proxima.</i>
<i>Doxomysis littoralis.</i>	<i>Heteromysis zeylanica.</i>
<i>Neomysis indica.</i>	<i>Heteromysis gymnura.</i>

The total number of species of Indian Mysidacea is therefore brought up to 53 species.

Much remains to be done with the deep-water fauna of Indian waters and many deep-sea species will doubtless be added to the list. Extended knowledge of the distribution of the shallow-water forms is desirable, and when it is remembered that the majority of the species reported here were collected during two short expeditions only, the results, if continuous observation and collection were possible, are distinctly promising.

The failure of earlier expeditions to tropical waters to obtain shallow-water Mysidacea is not due, as one was almost beginning to suspect, to the fact that these forms are absent from tropical waters, but entirely to a lack of knowledge of how to collect them. They are much smaller than the species from temperate and Arctic regions and easily pass through dredges and trawls. They require to be collected by means of special hand-nets made of mosquito netting used vigorously among the weeds on the shores below low-water mark. The results recorded below are a testimony to the successful use of such means by Dr. Kemp.

In examining this collection the most striking fact which presented itself was its strong Mediterranean facies. Out of twenty genera, no fewer than twelve are represented in the fauna of the Mediterranean, and I have frequently had to refer to Sars' work on the Mediterranean Mysidae for the nearest described form to many of the new species noted here. Several of them, indeed, are so closely allied to Mediterranean species that it was only necessary to refer to Sars' work and to tabulate the differences found in the Indian species. These facts will be more clearly brought out by a study of the following list in which are given the Indian forms and their Mediterranean allies:—

Indian species.	Mediterranean species.	
<i>Lophogaster intermedius.</i>	<i>L. typicus.</i>	
<i>Siriella vulgaris.</i> }	{ <i>S. norvegica.</i>	
„ <i>affinis.</i> }		<i>S. clausii.</i>
		<i>S. jaltensis.</i>
<i>Anchialina typica.</i> }	<i>A. agilis.</i>	
„ <i>grossa.</i> }		
<i>Gastrosaccus dunckeri.</i> }	<i>G. sanctus.</i>	
„ <i>muticus.</i> }		
„ <i>kempi.</i> }		
„ <i>pacificus.</i> }		
„ <i>bengalensis.</i> }	<i>G. normani.</i>	
<i>Erythroops minuta.</i>	<i>Erythroops serrata.</i>	
„ <i>nana.</i>	„ <i>elegans.</i>	

Indian species.	Mediterranean species.
<i>Mysidopsis indica</i> .	<i>M. gibbosa</i> .
<i>Leptomysis xenops</i> .	<i>L. apiops</i> .
<i>Mesopodopsis orientalis</i> .	<i>M. slabberi</i> .
<i>Neomysis indica</i> .	<i>N. longicornis</i> .
<i>Potamomysis assimilis</i> .	<i>P. pengoi</i> .
<i>Heteromysis harpax</i> .	<i>H. microps</i> .

The superficial resemblance between the Mysidacean fauna of the two regions is thus seen to be most striking and the fact is further emphasised if actual numbers are considered, for by far the greatest numbers of specimens belong to those species which are related to Mediterranean forms.

My thanks are due to Dr. Annandale for the opportunity of examining and reporting on this collection and to Dr. Kemp for his successful efforts to obtain Mysidae at my request. I am greatly indebted to my wife for the figures illustrating this report.

#### Suborder LOPHOGASTRIDA.

#### Family LOPHOGASTRIDAE G. O. Sars.

#### Genus *Lophogaster* M. Sars.

#### *Lophogaster intermedius* Hansen.

*Lophogaster intermedius*, Hansen, 1910, p. 14, pl. 1, figs. 1a-1e.

*Locality*.—'Investigator' St. 532: Mergui Archipelago, 62 fathoms, 16-iv-13.

68 specimens, 10-20 mm.

*Distribution*.—Only known from specimens captured by the 'Siboga' in the waters of the East Indian Archipelago.

#### Suborder MYSIDA.

#### Family MYSIDAE Dana.

#### Subfamily SIRIELLINEAE Norman.

#### Genus *Siriella* Dana.

#### *Siriella henseni*, sp. nov.

Text-figs. 1a-c, 2.

*Locality*.—Pamban, Gulf of Manaar, from weeds, 0-2 fathoms, February, 1913. Sixty specimens, 4-7 mm. (Types.)

*Description*.—A *Siriella* belonging to Hansen's group I and allied to *S. quadrispinosa* Hansen and *S. nodosa* Hansen.

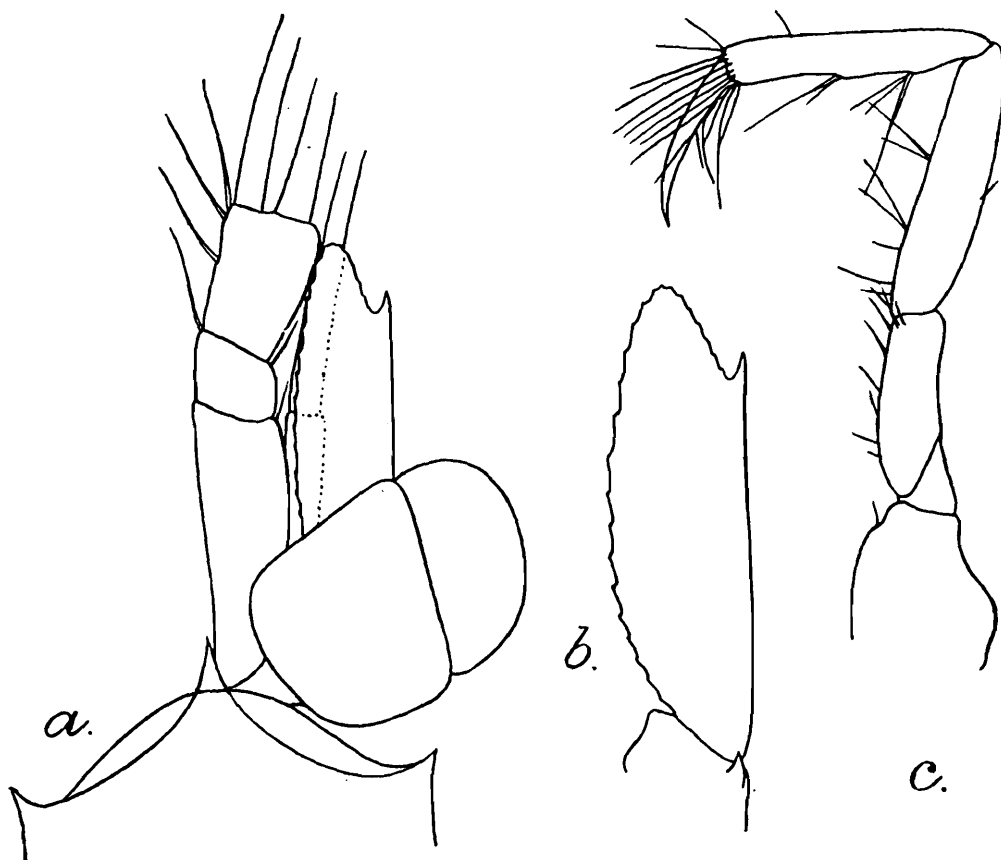
Carapace in both sexes without protuberances or tubercles, hardly at all produced into a frontal plate, anterior margin broadly and evenly rounded, leaving exposed a small spiniform pseudo-rostral process.

Antennal scale subequal in both sexes, reaching the distal end of the antennular peduncle in the female, not quite extending thus far in the male, three and a half times as long as broad, terminal lobe not quite so long as broad, slightly overreaching the terminal spine of the outer margin.

Tarsus of the thoracic legs without a secondary joint.

Pseudobranchial rami of the second to the fourth pleopods of the male spirally twisted, the terminal setae of the fourth pair not modified.

Telson short, not extending to the distal end of the proximal



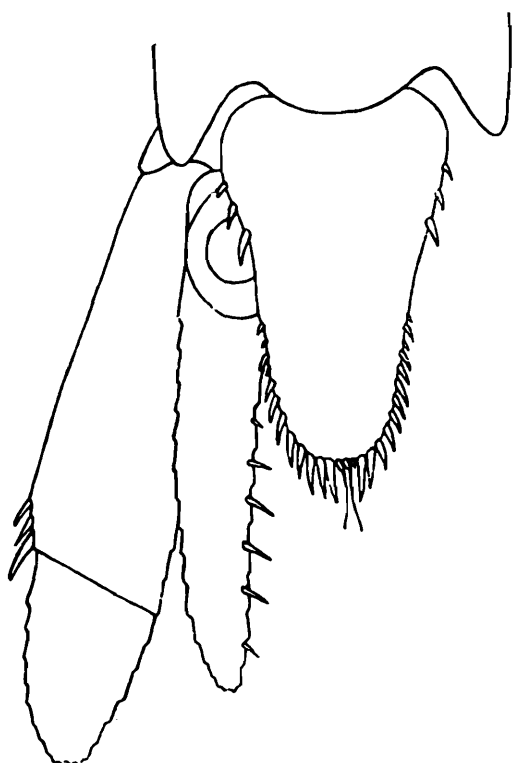
TEXT-FIG. 1.—*Siriella hanseni*, sp. nov.

*a*, anterior end of female; *b*, antennal scale, *c*, third thoracic limb, endopod. All  $\times 65$ .

joint of the exopod of the uropods, scarcely one and a half times as long as broad at the base, apex broadly rounded, almost truncate, and armed in the middle line with three equal small spinules and a pair of plumose setae longer than the spines flanking them, three large spines on the lateral margins of the telson at the base, distal portion of the lateral margins armed with about 12 spines gradually increasing towards the apex, the three spines on each side of the apex not much longer than the preceding spines and more or less subequal in size.

Inner uropod shorter than the outer, its inner lower margins with about ten somewhat distantly placed spines without any

small spines between them, extending from the anterior edge of the statocyst almost to the apex.



TEXT-FIG. 2.—*Siriella hanseni*, sp. nov.  
Telson and uropods:  $\times 65$ .

Outer uropod with the proximal joint more than twice as long as the distal, its outer margin with three or four spines at the distal end only; terminal joint one and a quarter times as long as broad.

*Remarks.*—This species is distinguished by (i) the absence of a rostral projection (ii) the unjointed tarsus of the thoracic limbs and (3) the size and armature of the telson and uropods. It is most closely allied to *S. quadrispinosa* and *S. nodosa*, but the combination of the three characters named will serve to distinguish it from both these species. It also shows many

points of resemblance to *S. brevicaudata* described below, but differs in the relative size and the armature of the telson. Both species agree in the absence of a rostral projection and the unjointed tarsus of the thoracic legs.

### *Siriella brevicaudata* Paulson.

Text-figs. 3a-h, 4a-f.

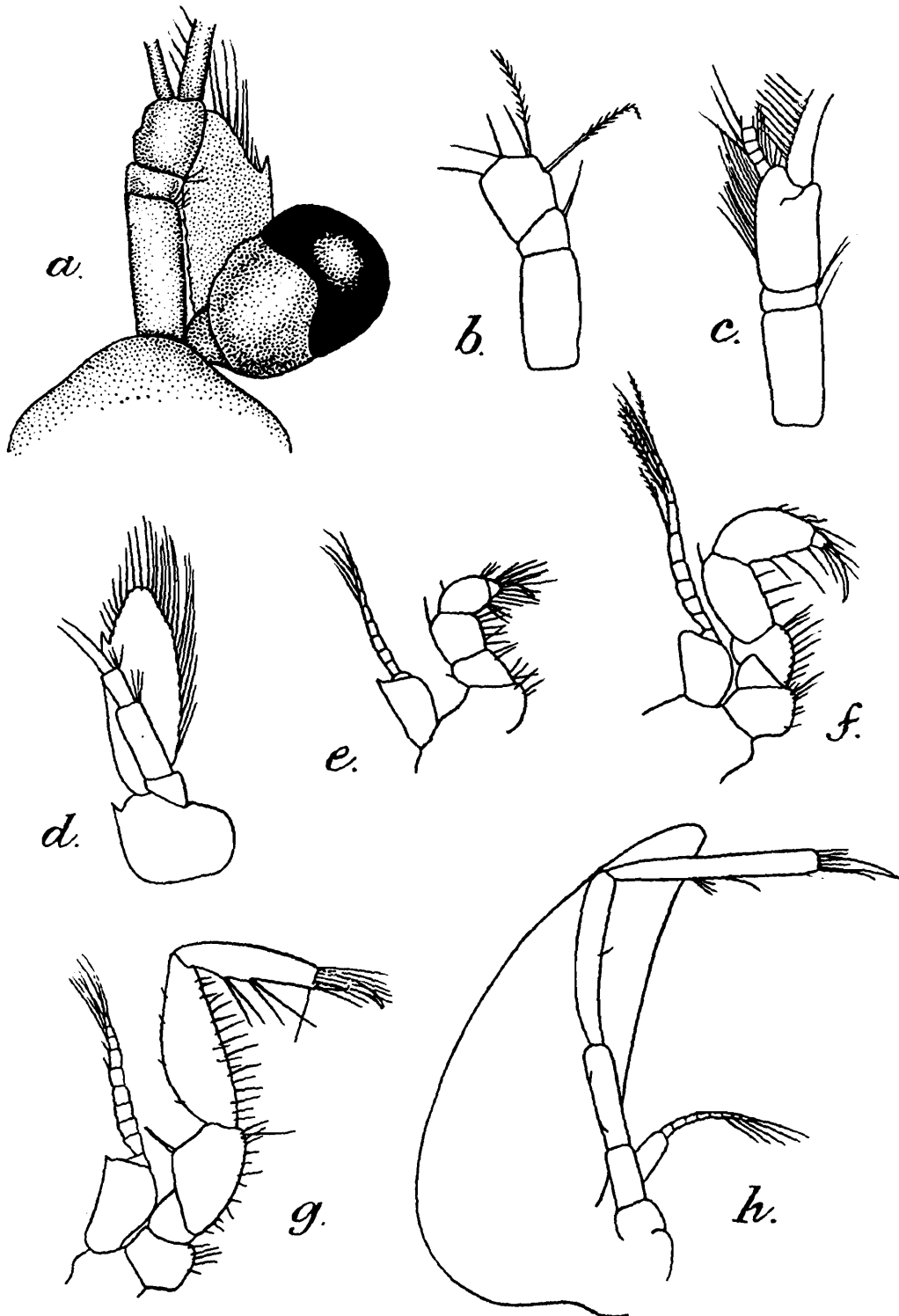
- Siriella brevicaudata*, Paulson, 1875 (1), p. 30, pl. i, figs. 15-16.  
 " " Paulson, 1875 (2), p. 123, pl. xx, figs. 1a-m.  
 " " Czerniavsky, 1882, p. 109.  
 " " Czerniavsky, 1883, p. 32.

*Localities.*—Kilakarai and Pamban, Gulf of Manaar, from weeds, 0-2 fathoms, February 12th-25th, 1913. Abundant, adult males and females, 6 mm. long.

*Remarks.*—The rediscovery of this species, not recorded since Paulson originally described it in 1875 from specimens taken in the Red Sea, is a matter of great interest. Paulson's original description is in Russian and I am obliged to rely on his figures, but these specimens agree so closely with Paulson's figures that I am confident of the correctness of my determination.

In his 'Siboga' report (1910) Hansen arranges the Asiatic species of *Siriella* into four groups, but he does not include *S. brevicaudata* in his list. It belongs to his group I and is specially distinguished in that group by the size and armature of the telson, its chief character being reflected in its specific name.

It seems advisable to give a brief description of the species.  
 Body moderately robust. Carapace short, leaving the last three thoracic segments exposed in the mid-dorsal line, and barely

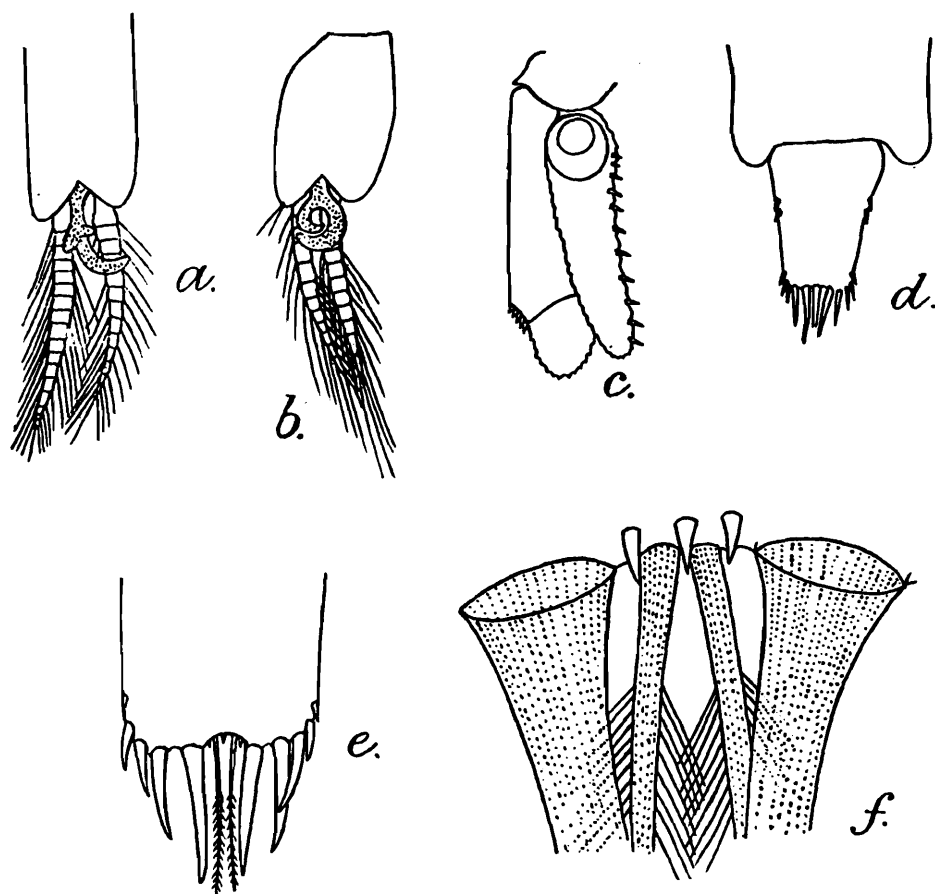


TEXT-FIG. 3.—*Siriella brevicaudata* Paulson.

*a*, anterior end of female; *b*, antennular peduncle of female; *c*, antennular peduncle of male; *d*, antennal scale and peduncle; *e*, first thoracic limb; *f*, second thoracic limb; *g*, third thoracic limb; *h*, eighth thoracic limb. All  $\times 33$ .

reaching the penultimate segment laterally. Frontal plate only slightly produced in both sexes as a broadly and evenly rounded semicircular plate with slightly upturned margin and a median

depression in the mid-dorsal line. In the median line of the cephalothorax about midway between the cervical groove and the anterior end of the frontal plate there is a trace of a tubercle, more marked in the female than in the male but much less prominent than Hansen figures in *S. nodosa*. Cervical groove well marked, especially on the posterior margin. Eyes moderately large, pigment black. Antennular peduncle exhibiting sexual differences, the last joint in the male being longer and thicker than in the female and bearing the usual brush of setae. Antennal scale reaching the distal end of the antennular peduncle in the female,



TEXT-FIG. 4.—*Siriella brevicaudata* Paulson.

*a*, first pleopod of male; *b*, second pleopod of male; *c*, uropods; *d*, telson; *e*, apex of the telson; *f*, apex of the telson from below. *a-d*  $\times 33$ , *e*  $\times 65$ , *f*  $\times 400$ .

falling somewhat short of this in the male, three times as long as broad, terminal lobe about one quarter of the scale in length and as broad as long, outer margin terminating in a strong spine, one prominent spine on the outer distal corner of the joint from which the scale springs. First and second thoracic limbs (gnathopods) stout, with the dactylus remarkably long, robust and strongly curved. Third thoracic limbs much more robust than the remainder due to the expanded merus and carpus. Posterior thoracic limbs much more slender and linear, tarsus unjointed. Telson remarkably short, when in position not extending much

beyond half way down the uropods, one and a half times as long as broad at its base, proximal portion of the lateral margins with two or three spines, apex broadly truncate or even slightly emarginate, its breadth equal to half the total length of the telson; distal portions of the lateral margins and the apex together bearing about five or six pairs of spines, the innermost pair of spines at the apex equal in length to three quarters of the breadth of the apex, the remaining spines grading smaller in size, the fifth and sixth spines quite small. The centre of the apex bearing the usual pair of plumose setae which are longer than the innermost spines, and, hidden in dorsal view but visible under the high power of the microscope ( $\frac{1}{8}$ ) in ventral view, are three very small spinules, corresponding to the three small spines usually present in that position, but greatly reduced in size and at first sight apparently absent. Uropods about twice as long as the telson, the endopod slightly shorter than the exopod, with a row of 10-12 spines along the entire margin, regularly graded in size with no smaller spines between; proximal joint of the exopod about three times as long as the distal, with a group of five spines at the distal end, the rest of the margin naked, distal joint about as long as broad. Pseudobranchial rami of the second to the fourth pairs of the pleopods of the male spirally twisted. Third and fourth pairs of male pleopods with the endopod and exopod subequal in length and having a normal armature of plumose setae, none of which are modified. Length of adult males and females 6 mm.

This species falls into Hansen's group I, characterized by the spirally-twisted pseudobranchial rami of the second to the fourth pleopods of the male and the unmodified nature of the setae on the terminal parts of these pleopods. It is distinguished specially by the very short telson and its peculiar armature of spines and by the very reduced size of the three spinules at its apex between the innermost long pair of spines.

It has been a source of great satisfaction to rediscover Paulson's species and to find that it is a good species which its original discoverer described and illustrated adequately. The species was quite easy to recognise from Paulson's figures, but in view of the rarity of his work I have thought it well to redescribe and figure it here and to indicate its true position in the light of recent work. As far as I can make out Hansen's group I contains at present about 12 species. Of this group *S. thompsoni* and *S. gracilis* differ from the rest in having the endopod of the uropods longer than the exopod. The four species *S. clausii*, *S. jaltensis*, *S. norvegica* and *S. brookii* are distinguished from the remainder in having more than half of the outer margin of the proximal joint of the exopod armed with spines. The remaining species in this group are *S. quadrispinosa*, *S. nodosa*, *S. vulgaris*, *S. affinis*, *S. watasei* and *S. longipes* (the last two doubtfully placed here), and *S. brevicaudata* is most closely allied to the two first-named forms.

*Distribution*.—Known previously only from the Red Sea.

**Siriella quadrispinosa** Hansen.

*Siriella quadrispinosa*, Hansen, 1910, p. 32, pl. ii, figs. 5a-i.

*Locality*.—Pamban, Gulf of Manaar, from weeds, 0-2 fathoms. February 24th, 1913. Four males and two females; largest male, 7.5 mm., largest female, 5.5 mm.

*Remarks*.—These specimens are in substantial agreement with Hansen's description and figures. They differ mainly in having the spines on the outer margin of the proximal joint of the exopod of the uropod never more than six in number and confined to the distal third of the margin. In the smaller specimens the inner pair of spines at the apex of the telson is equal in size to the outer pair but in larger specimens these spines are as figured by Hansen.

*Distribution*.—Hitherto only known from the 'Siboga' specimens taken among the Islands of the East Indies, near Saleyer.

**Siriella vulgaris** Hansen.

*Siriella vulgaris*, Hansen, 1910, p. 34, pl. iii, figs. 2a-k.

*Locality*.—Port Blair; Andaman Islands.

St. 3. Seventeen specimens, 4-7 mm.

St. 11. Seven specimens, 4-7 mm.

St. 13. One male, 7 mm.

St. 19. One male and two females, 6.5-7.5 mm.

St. 21. Two males and one female, 6-7 mm.

St. 32. Two males, fourteen females.

'Investigator' St. 556:—12° 40' N., 98° 26' 30" E, one specimen.

*Distribution*.—Found at 21 stations in the East Indian Archipelago by the 'Siboga.' Hansen states that it is common near the shores throughout the area explored by the 'Siboga.' It is evidently a common species at Port Blair in the shallow waters down to 12 fathoms.

**Siriella affinis** Hansen. ?

*Siriella affinis*, Hansen, 1910, p. 35, figs. 3a-i.

*Locality*.—Kilakarai, Gulf of Manaar, from weeds, 0-2 fathoms, February 1913. Four males and four females, 5-7 mm.

*Remarks*:—I am doubtful about the identification of these specimens. They belong to Hansen's group I and are closely allied to *S. vulgaris* and *S. affinis*. From the former they are distinguished by the much smaller terminal lobe to the antennal scale and by having only 3-5 spines on the outer uropod. In these respects and indeed in most of their characters they agree with *S. affinis* but they differ as follows: (1) the male specimens agree with the females in the characters of the rostral plate and antennal scale, Hansen described marked difference between the sexes in these characters, (2) the large spines on the lower inner

margin of the inner uropods have smaller spines in between them, so that the spines as a whole are arranged in series of 3-5. Hansen gives no particulars on this point in his text but his figure does not show the intermediate spines. In other respects the specimens agree with *S. affinis* and provisionally I record them under that name.

*Distribution*.—Known only from the waters of the East Indian Archipelago.

### *Siriella dubia* Hansen.

Text-figs. 5a, b.

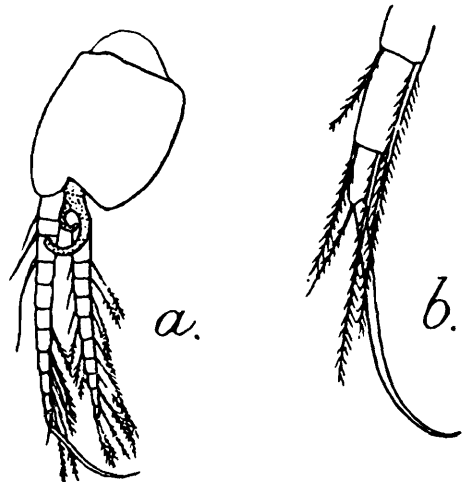
*Siriella dubia*, Hansen, 1910, p. 44, pl. v, figs. 4a-e.

*Locality*.—Port Blair, Andaman Islands, Station 19. Eight specimens: largest female, 8 mm., largest male, 7.5 mm.

*Remarks*.—These specimens differ in one important feature from the description and figures of Hansen. There are three small spines, equal in size to one another, between the inner pair of large terminal spines at the apex of the telson, in addition to the usual pair of plumose setae. Hansen particularly emphasizes the absence of these spines in his single specimen but the present specimens are so very closely in agreement with Hansen's description and figures that I can only suppose that the spines were overlooked or broken off in his type.

All the specimens have four spines on the outer margin of the proximal joint of the outer uropod in the positions indicated in Hansen's figure 4d, with the addition of an extra spine between the two proximal ones of his figure, as mentioned in his text. The serrations on the proximal margin of the outer uropod are in reality the bases of plumose setae, which have become detached. Several of my specimens still retain some of these plumose setae, so evidently the serrations do not indicate the base of broken spines. In the smallest specimen, 4.5 mm. long, the outer and inner uropods are equal in size; there is a progressive difference in size between the two uropods, with an increase in the total length of the animal.

The last joint of the antennular peduncle in the male is longer and stouter than in the female and furnished with the usual brush of setae. In the adult male, therefore, the antennal scale is shorter than the antennular peduncle, whereas in the female it



TEXT-FIG. 5.—*Siriella dubia*, Hansen.

a, fourth pleopod of the male,  $\times 33$ ; b, distal joints of the exopod further enlarged,  $\times 100$ .

extends to the level of the distal end of that appendage. In young specimens the terminal lobe of the scale is not so long as in fully grown animals.

In the male the pseudobranchial rami of the second to the fourth pleopods are spirally twisted. In the fourth pair of pleopods, the endopod and exopod are about equal in size and the endopod is only slightly modified. The terminal joint bears two setae, a short plumose seta, and a very long stout seta slightly curved and not plumose.

The presence of the three small spines at the apex of the telson brings this species more into line with the normal species of the genus, but the peculiar form of the outer uropod and the unusual shape and spinulation of the telson are unique.

*Distribution.*—Hansen's single specimen was taken off the coast of Obi Major in the East Indian Archipelago. No other records are known.

### ***Siriella paulsoni* Kossmann?**

*Siriella paulsoni*, Tattersall, 1906, p. 160, pl. i, figs. 3-7.

*Localities.*—Pamban, Gulf of Manaar, exposed reef, from pools. One female, 10 mm.

Kilakarai, Gulf of Manaar, from weeds, 0-2 fathoms. One female, 12 mm.

*Remarks.*—These specimens belong certainly to the same species as the single female I recorded from Ceylon under this name. In view of the recent advances in our knowledge of this genus I now think it doubtful whether the species is really the same as that described by Kossmann. Certainty on this point can only be obtained when male specimens are available for examination. In the meantime I record the present specimens under *S. paulsoni* to indicate that they are the same as the Ceylon specimen.

### **Genus *Hemisiriella* Hansen.**

#### ***Hemisiriella parva* Hansen.**

*Hemisiriella parva*, Hansen, 1910, p. 47, pl. vi, figs. 2a-c.

„ „ Colosi, 1918, p. 6.

„ „ Zimmer, 1918, p. 16, text-figs. 5-7.

„ „ Colosi, 1920, p. 236, pl. xviii, figs. 2a.

*Locality:*—Port Blair, Andaman Islands.

St. 3. One young specimen.

St. 19. Three males and three females, 5-6.5 mm.

St. 21. Seventeen specimens.

*Remarks.*—These specimen agree rather with Zimmer's description than with Hansen's. Particularly is this so with the form of the eyes which are longer and narrower than Hansen shows them.

*Distribution.*—Waters of the East Indian Archipelago and Bay of Bengal (Hansen); Bay of Bengal (Colosi); Java (Zimmer). These specimens were all taken in plankton. It is therefore interest-

ing to find it in quite shallow waters, obtained by dredging and in shore-collecting.

Subfamily *RHOPALOPHTHALMINAE* Hansen.

Genus *Rhopalophthalmus* Illig.

*Rhopalophthalmus egregius* Hansen.

*Rhopalophthalmus egregius*, Hansen, 1910, p. 49, pl. vi, figs. 3a-k, pl. vii, figs. 1a-d.

„ „ Nakazawa, 1910, p. 255, pl. viii, figs. 12, 22.

„ „ Tattersall, 1915, p. 151.

„ „ Colosi, 1918, p. 6.

„ „ Colosi, 1920, p. 237, pl. xviii, figs. 3a, b.

*Localities*.—Port Blair, Andaman Islands.

St. 3. Two specimens.

St. 11. Many specimens.

St. 19. Four specimens.

Off Puri Beach, Orissa, India, 4-4½ fathoms, muddy sand, one male, 15 mm.

Vasco Bay, Mormugao Bay, Portuguese India, sixteen specimens.

Bay N.W. of Nazareth Point, Mormugao Bay, Portuguese India, four specimens.

Chicolna Bay and stream at its southern end, Mormugao Bay, Portuguese India, abundant.

'Investigator' St. 604:—11°17'20"N., 98°29'40"E., five specimens.

'Investigator' St. 556:—12°40'N., 98°26'30"E., two specimens.

*Distribution*.—East Indian Archipelago (Hansen); Japan (Nakazawa); Chilka Lake, India (Tattersall), Torres Straits and off New Zealand (Colosi). The last two records of Colosi are very interesting and indicate a very wide geographical range in the Indian and Pacific Oceans.

Subfamily *GASTROSACCINAE* Norman.

Genus *Anchialina* Norman.

*Anchialina typica* (Kröyer).

*Anchialus typicus*, Kröyer, 1861, p. 53, pl. ii, figs. 7a-l.

*Anchialina typica*, Hansen, 1910, p. 52, pl. vii, figs. 2a-k.

„ „ Hansen, 1912, p. 196.

„ „ Colosi, 1918, p. 7.

„ „ Colosi, 1920, p. 237.

*Localities*.—Port Blair, Andaman Islands.

St. 3. One male, one female, two young.

St. 8. One male.

St. 19. One female.

St. 21. One male, one female.

Kilakarai, Gulf of Manaar, from weeds, 0-2 fathoms, February, 1913. Two males and two females.

'Investigator' St. 556:—12° 40' N., 98° 26' 30" E., six specimens.

The largest specimen of either sex measured 5 mm.

*Distribution*.—Hansen (1910 and 1912) has given a synopsis of the known distribution of this species, which is known from the tropical Atlantic, West Indies, Gulf of Siam, East Indian Archipelago and the Hawaiian Islands. The only record subsequent to Hansen's paper is that of a single male from the Caribbean Sea by Colosi (1918 and 1920). Gough's record from the English Channel (*Publ. de Circonstance*, No. 33, 1906, p. 105) is interesting but requires confirmation.

### *Anchialina grossa* Hansen.

#### Text-fig. 6.

*Anchialina grossa*, Hansen, 1910, p. 54 pl. vii, figs. 3a-n, pl. viii, figs. 1a-d.

*Anchialina grossa*, Hansen, 1912, p. 196.

„ *frontalis*, Zimmer, 1915 (3), p. 159, text-figs. 1-6.

*Locality*.—Port Blair, Andaman Islands.

St. 3. Three specimens.

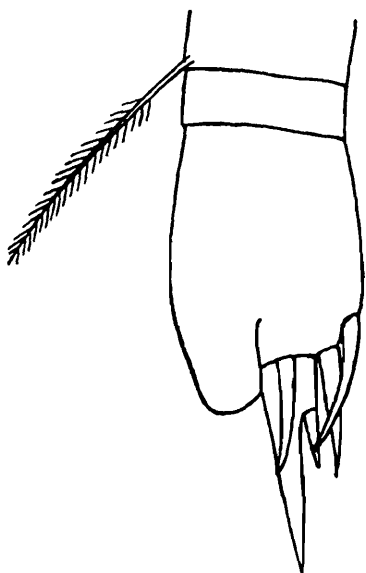
St. 8. Twenty-six specimens.

St. 19. Two specimens.

St. 21. Three specimens.

St. 32. Four males, five females.

Altogether eighteen males and twenty-five females; the largest male 9 mm., largest female 6.5 mm.



TEXT-FIG. 6.—*Anchialina grossa*, Hansen.

Distal end of the exopod of the third pleopod of a young male, × 200.

*Remarks*.—The specimens agree closely with Hansen's description and figures. *A. frontalis*, as described by Zimmer, differs from *A. grossa* (1) in the telson which is only two and a half times as long as broad whereas in *A. grossa* it is three times as long as broad; (2) in the antennal scale, which is twice as long as broad as against two and a third in *A. grossa*; and (3) in the proportions of the antennal peduncle. These differences are very small and Zimmer was led to institute his species mainly on the structure of the third pleopod of the male. I give herewith a figure of the distal end of the outer branch of the third pleopod of an immature male of *A. grossa* measuring 8 mm. It differs remarkably from the fully grown

state and agrees very closely with Zimmer's figure of the same appendage in *A. frontalis*. This male specimen does not appear to be quite fully grown. In the proportions of the telson and scale it agrees with *A. grossa*. A study of my specimens of *A. grossa* seems to indicate, however, that Zimmer's male of *A. frontalis* was not fully grown. Hansen (1910) has given a figure of the distal portion of the exopod of the third pleopod of an immature male of *A. grossa* which shows a stage earlier in development to the one I figure here. I suggest, therefore, that *A. frontalis* will prove to be founded on not quite adult males of *A. grossa*.

*Distribution*.—Waters of the East Indian Archipelago, Bay of Bengal, Gulf of Siam (Hansen, 1910); Gilbert Islands (Hansen, 1912).

Zimmer's specimens of *A. frontalis* were taken during a voyage from Ceylon to the Dampier Straits, New Guinea and therefore in the same waters as *A. grossa*.

### Genus *Gastrosaccus* Norman.

#### *Gastrosaccus dunckeri* Zimmer.

*Gastrosaccus dunckeri*, Zimmer, 1915 (3), p. 165, text-figs. 13-18.

*Locality*.—Off Puri Beach, Orissa, 4-4½ fathoms, 57 specimens.

*Remarks*.—This species belongs to the same group of species of the genus as *G. sanctus* and is very closely allied to that species. It is distinguished mainly by the remarkably well-developed lobes on the carapace and the shape and armature of the telson. The lobes on the carapace are larger than in any other species of the genus. They extend forward to the centre of the dorsal surface of the carapace and are acutely pointed in shape.

*Distribution*.—Zimmer's specimens came from the Duncker collection made during a voyage from Ceylon to New Guinea.

#### *Gastrosaccus muticus* Tattersall.

*Gastrosaccus muticus*, Tattersall, 1915, p. 152, text-fig. 1.

*Locality*.—Off Puri, Orissa, 4-4½ fathoms, muddy sand. Eight adult females, 7 mm.

Several localities in the Matlah River, Gangetic Delta, abundant.

*Remarks*.—There are no male specimens, but from the form and armature of the telson, which in all the specimens has fourteen spines on its lateral margin, and by the possession of a fringe of six to nine filaments on the posterior median dorsal margin of the carapace, I feel certain that these specimens belong to the same species as that which I have described from the Chilka Lake. No other records are known.

A single mutilated female specimen in this collection from

Kilakarai, Gulf of Manaar, possibly belongs to this species or to *G. simulans*. The telson and uropods are broken so that certainty on this point is impossible.

### *Gastrosaccus simulans* Tattersall.

*Gastrosaccus simulans*. Tattersall, 1915, p. 155, text-fig. 1c.

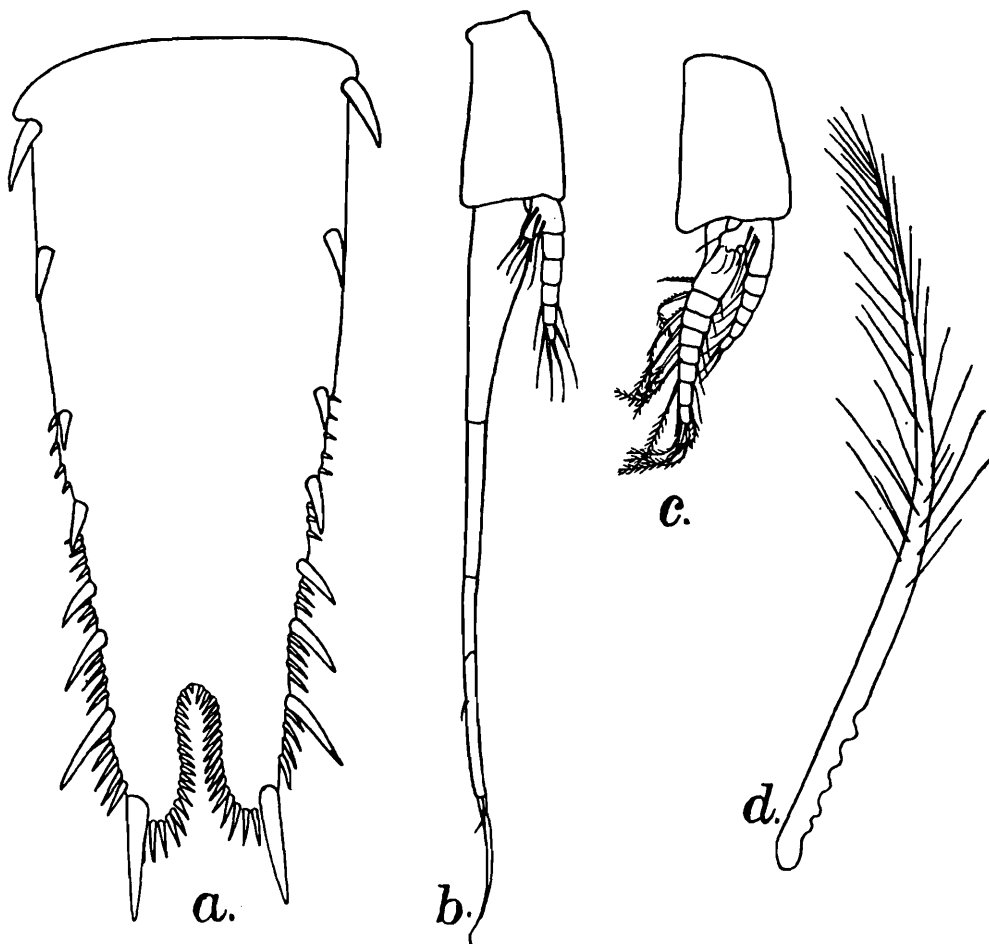
*Locality*.—Vasco Bay, Mormugao Bay, Portuguese India, one female.

*Remarks*.—In the absence of male specimens, this example seems to agree well with the species which I described from Puri Beach. No other records are known.

### *Gastrosaccus kempi*, sp. nov.

Text-figs. 7a-d.

*Locality*.—Off Puri, Orissa 4-4½ fathoms, 24-iii-16, muddy sand. Two males, 9 mm., one female, .9 mm. (Types.)



TEXT-FIGURE 7.—*Gastrosaccus kempi*, sp. nov.

a, telson,  $\times 65$ ; b, third pleopod of male,  $\times 33$ ; c, second pleopod of male,  $\times 33$ , d, one of the setae from the exopod of the second pleopod of the male, further enlarged.

*Description*.—This new species belongs to the same group of

species as *G. sanctus* and is very closely allied to that species. It will be best to refer to Sars' description and figures of *G. sanctus* (1877) and to point out the differences between the two forms.

*G. kempi* agrees with *G. sanctus* in general form and in the details of the appendages of the head and thorax but differs in the following points:—

(1) There are no lobes or lappets on the dorsal hinder margin of the carapace.

(2) The antennal scale is slightly more than three times as long as broad, the terminal spine on the outer margin not quite extending as far forward as the apex of the terminal lobe. A suture across the terminal lobe is present.

(3) There are fifteen marginal spines on the outer uropod and fourteen spines on the inner lower margin of the inner uropod.

(4) Telson somewhat less than two and a half times as long as broad, cleft about one eighth of the total length, eight spines on each lateral margin, the terminal spines about one-sixth of the total length of the telson, *about 3–5 small spinules between the spines of the lateral margin from the third to the eighth (terminal) spine*. This last character is unique in the genus.

(5) First, fourth and fifth pleopods of the male exactly as in *G. sanctus*. Second pair with the endopod composed of seven joints, exopod of eight joints, half as long again as the endopod, slightly curved, the proximal joints armed with peculiar plumose setae. Third pair with the endopod six-jointed, not as long as the first joint of the exopod. Latter very elongate, with the terminal spines extending to the base of the telson, four-jointed, the second and fourth joints each longer than the third, fourth joint terminated by a long feathered spine, almost as long as the joint, and a small simple spine.

The form and spinulation of the telson will serve to distinguish this species from any hitherto described. I know of no other species which has subsidiary spinules between the large spines arming the margin of the telson. Otherwise it agrees closely with *G. sanctus* except for the absence of lobes on the carapace and minor details in the number of spines on the telson and uropods.

### ***Gastrosaccus pacificus* Hansen.**

Text-figs. 8a, b.

*Gastrosaccus pacificus*, Hansen, 1912, p. 198, pl. 2, figs. 3a-g.

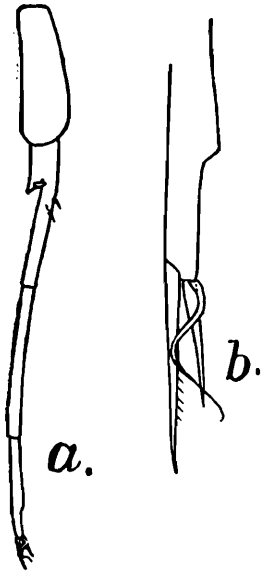
*Locality*.—Port Blair, Andaman Islands.

St. 3. Five males, four females.

St. 7. Two males, one female.

St. 32. One male.

*Remarks.*—This species is very closely allied to *G indicus* and the only real difference indicated by Hansen lies in the structure of the third pleopod of the male. I figure herewith one of these pleopods to indicate its form in these specimens and to complete Hansen's description, since the distal part of the exopod was missing in his specimens. The exopod is three-jointed, the second joint slightly longer than the first and one and a half times as long as the third. The basal joint bears on the outside a sharply pointed triangular process and on the inside two spines (Hansen figures three). The third joint narrows suddenly at about two-thirds of its length and terminates in three setae, one long with a few subsidiary hairs, a second somewhat shorter and smooth and a third slender lash-like seta twisted as shown in the figure. All the specimens showed this peculiar feature.



TEXT-FIG. 8.—*Gastrosaccus pacificus*, Hansen.

*a*, third pleopod of the male,  $\times 33$ ; *b*, joint of the same,  $\times 100$ .

*Distribution.*—Gilbert Islands (Hansen).

### *Gastrosaccus bengalensis* Hansen.

*Gastrosaccus bengalensis*, Hansen, 1910, p. 58.  
 " " Zimmer, 1915 (3), p. 164.  
 " " Zimmer, 1918, p. 15.

*Locality.*—Port Blair, Andaman Islands.

St. 8. Two males.

St. 32. One male.

*Distribution.*—Bay of Bengal (Hansen); voyage from Ceylon to New Guinea, and off Formosa (Zimmer).

## Subfamily MYSINAE.

### Tribe ERYTHROPINI.

### Genus *Erythrops* G. O. Sars.

### *Erythrops minuta* Hansen.

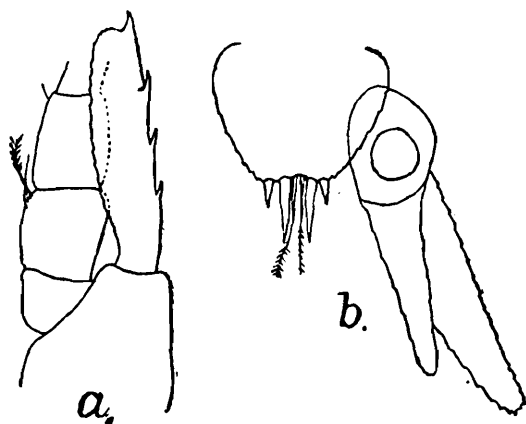
Text-figs. 9*a*, *b*.

*Erythrops minuta*, Hansen, 1910, p. 63.

*Locality.*—Kilakarai, Gulf of Manaar, from weeds, 0-2 fathoms, February, 1913. Five males, 3 mm.

*Remarks.*—These specimens agree with Hansen's description but since the author has not published any figures illustrating this species, I give herewith a figure of the antennal scale and of the telson and uropods to illustrate the salient characters of the species. The distal part of the lateral margins of the telson is minutely serrulate.

*Distribution.*—Gulf of Siam (Hansen).



TEXT-FIG. 9.—*Erythrops minuta*, Hansen. a, antennal scale and peduncle; b, telson and uropods. Both  $\times 65$ .

### *Erythrops nana*, sp. nov.

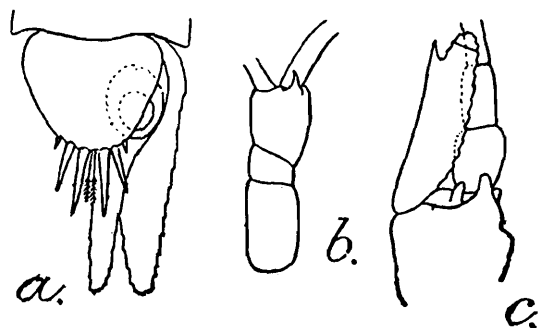
Text-figs. 10 a-c.

*Locality.*—Port Blair, Andaman Islands, St. 3. Three females, one male, 3 mm. (Types.)

*Description.*—Frontal plate produced into a short, pointed rostral process. Eyes small, depressed, scarcely broader than the eyestalks. Antennal scale scarcely as long as the antennular peduncle, four times as long as broad, outer margin smooth, terminating in a strong spine distally, beyond which the terminal lobe of the scale projects considerably; terminal lobe longer than broad with a distal articulation. Telson broader than long, posterior margin nearly half as long as the greatest breadth, with three pairs of spines and a median pair of plumose setae; the inner pair of spines longer than the next pair while the outer pair are quite small; the lateral margins of the telson unarmed.

Uropods more than twice as long as the telson, inner and outer branches equal in length, no spines on the lower inner margin of the inner uropod and its inner margin not serrulate.

The specimens are very mutilated but the remaining appendages do not call for special comment. They agree in the main with those of *Erythrops elegans*, the species to which *E. nana*



TEXT-FIG. 10.—*Erythrops nana*, n. sp. a, telson and uropods; b, antennular peduncle; c, antennal peduncle and scale. All  $\times 65$ .

is most nearly allied. It differs from this species in the shorter antennal scale, in the armature of the apex of the telson which has an extra pair of spines, and in the equal outer and inner

uropods. It is distinguished from *E. minuta* in having the outer margin of the antennal scale smooth and not serrate, as well as in having an extra pair of spines on the telson.

Genus **Hypererythrops** Holt and Tattersall.

**Hypererythrops spinifera** (Hansen).

Text-figs. IIA-i.

*Erythrops spinifera*, Hansen, 1910, p. 62, pl. 9, figs. 3a-c.

*Locality*.—Port Blair, Andaman Islands.

St. 3. Two males, two females.

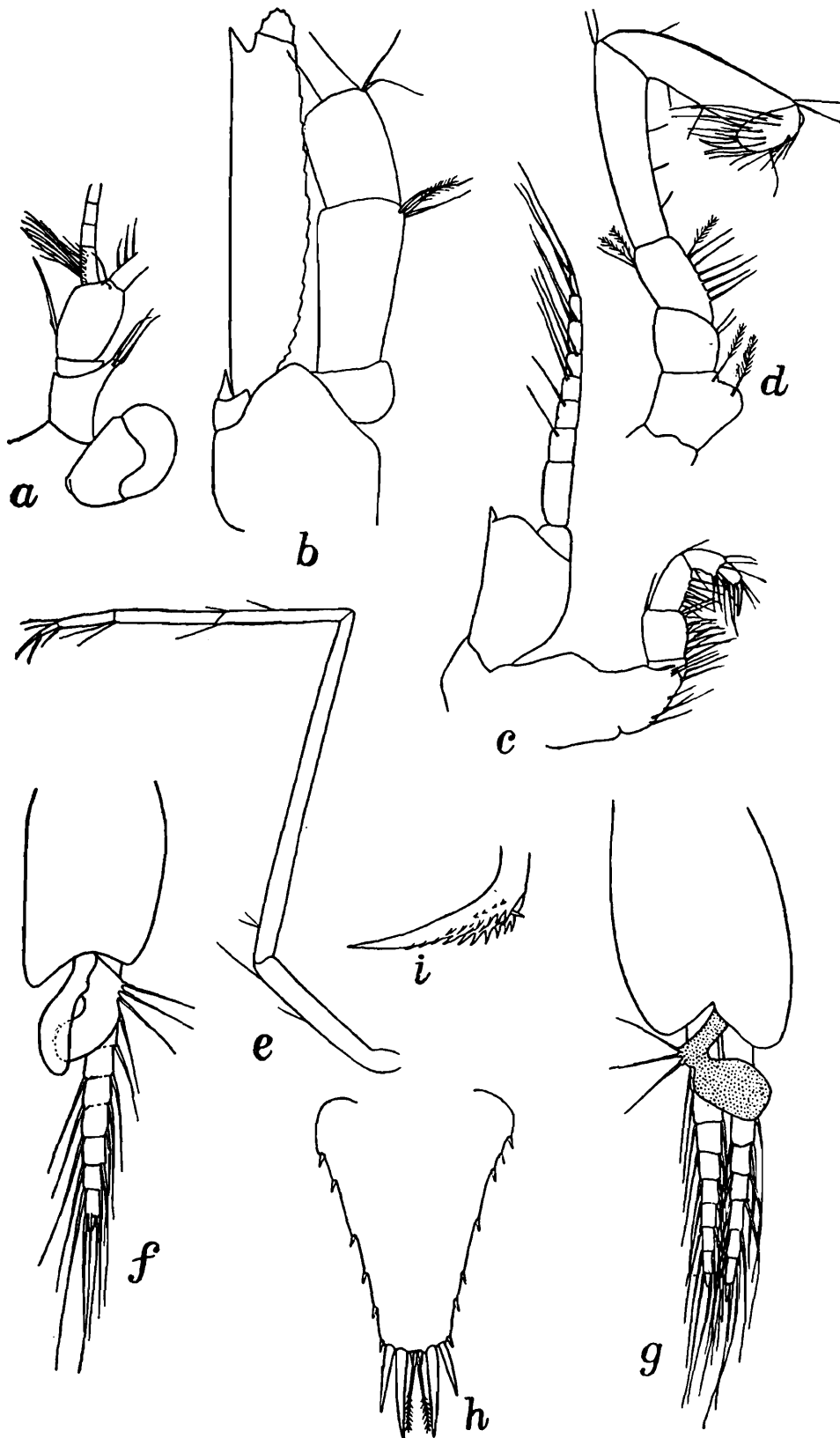
St. 19. Six males, eight females.

*Remarks*.—These specimens agree very closely with Hansen's description and figures of *Erythrops spinifera* except in one point, the number of spines on the lateral margins of the telson. Hansen gives the number as 10-13 and his figure shows them to be arranged at practically regular intervals along the whole margin. In these specimens I find the spines to be fewer and to be more distantly and more irregularly arranged. The figure (text-fig. I1h) shows a typical telson among the Port Blair specimens. But the spines on the telson appear to be very variable in number and seldom the same number on both sides of a single telson. The smallest number of spines on each margin is five and the largest number nine. In only four specimens was the number of spines on each side of the telson the same and frequently the two sides differed by two spines.

The apex of the telson in the Port Blair specimens bears two pairs of long stout spines, the inner pair of which is always longer than the outer pair but the proportion between the lengths of the outer and inner spines varies considerably, in some specimens approaching the condition as figured by Hansen in which the two pairs are nearly equal in size, in other specimens having the proportions shown in my figure in which the outer pair is considerably shorter than the inner pair. Between the latter are a pair of quite small spines and a pair of long plumose setae. Hansen found the setae only in one of his specimens and the spines only in the other.

In other respects these specimens agree so closely with Hansen's species that I feel that they cannot be considered as more than a variety, especially in view of the great variation which they show among themselves. I am content, therefore, to record them under Hansen's name, to point out the differences I have found and to figure the more essential parts for comparison.

Hansen had no mature males at his disposal. The Port Blair specimens include several males and an examination of them shows that the species must be referred to the genus *Hypererythrops* Holt and Tattersall (1905). This genus differs from *Erythrops* in having the telson much longer in shape with its lateral margins armed



TEXT-FIG. 11.—*Hypererythrops spinifera* (Hansen).

*a*, antennal peduncle and eye; *b*, antennal scale and peduncle; *c*, first thoracic limb; *d*, endopod of second thoracic limb; *e*, endopod of third thoracic limb; *f*, first pleopod of the male; *g*, second pleopod of the male; *h*, telson; *i*, one of the processes arming the sterna of the thorax of the male. *a* × 30, *b*—*h* × 60.

with spines instead of smooth, and in having the sterna of some of the thoracic and abdominal somites furnished with median processes. In the present species the sterna of the last six thoracic somites are furnished with long sharply pointed forwardly directed processes as shown in the accompanying figure (text-fig. 11*i*), the lower margin of which is furnished with numerous spinous processes. The sterna of the first four abdominal somites are furnished with simple papilliform processes.

The species, *H. spinifera*, therefore agrees absolutely with the characters of the genus *Hypererythropis* as distinguished from *Erythropis* and is closely allied to the type species, *H. serriventer* H. and T. It may, however, be distinguished from the latter by its smaller size, the different form of the antennal scale, which is narrower and has the terminal lobe much less developed than in the type, and by the different shape and spinulation of the telson.

One other feature of the genus *Hypererythropis* must be mentioned. In the pleopods of the male there is a broad flat branchial plate, devoid of setae, at the base of the endopod, which appears to arise from the short setiferous lobe characteristic of the endopod of the pleopods of Mysidae. The form of this branchial plate in *H. spinifera* is shown in (text-figs. 11*f*, *g*.) I have re-examined some specimens of *H. serriventer*, and find that a similar branchial plate, larger in size, is present on the male pleopods. I do not know of a similar development among the Erythropini and it is interesting to note that it is present in the European and the Indian species of this genus. Its presence forms an additional character separating the genus from *Erythropis*. These branchial plates recall the pseudo-branchial processes on the pleopods of the species of *Siriella* and, in point of fact, on the first pleopod of the male of *H. spinifera* the branchial lamella is bilobed as in so many of the species of *Siriella*. But in the remaining pleopods it is a simple broadly expanded plate without setae.

*Distribution*.—Hansen's specimens were found in the seas of the East Indian Archipelago. The occurrence of this genus, hitherto known only from European waters, in the waters of the Indian Ocean is a matter of great interest.

#### Tribe LEPTOMYSINI.

#### Genus *Mysidopsis* G. O. Sars.

#### *Mysidopsis indica*, sp. nov.

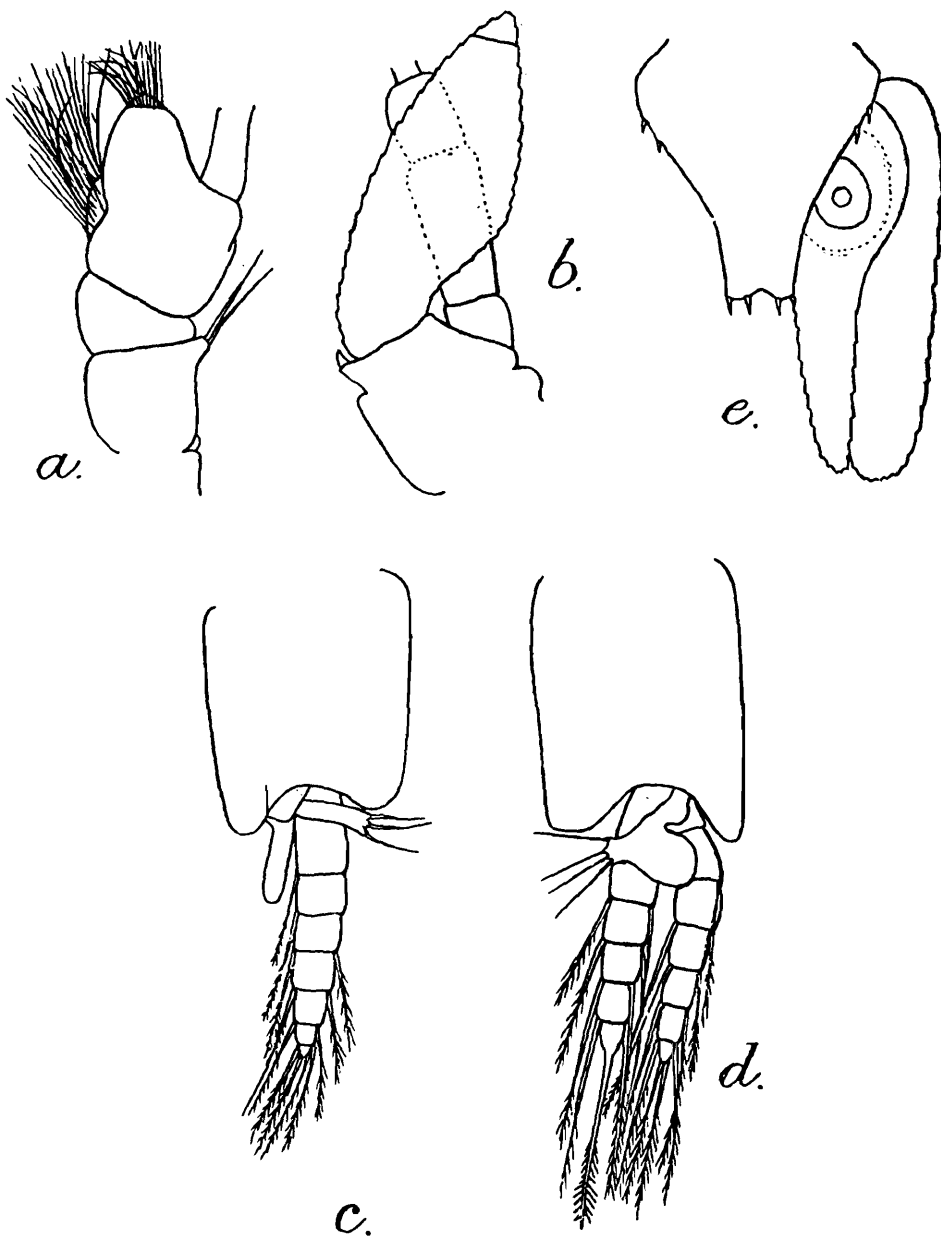
Text-figs. 12*a-e*.

*Locality*.—Port Blair, Andaman Islands, Station 5. Two males and two females, 4 mm. (Types.)

*Description*.—Very closely allied to *Mysidopsis gibbosa* G. O. Sars. It will be sufficient to refer to Sars' description of this species (1870-79) and to point out the following differences:—

(1) There are three nodules in the median dorsal line of the carapace, two in the same positions as in *M. gibbosa*, the third one in front of the cervical groove. These nodules are present in both sexes though less marked in the male than in the female.

(2) The frontal plate is more developed than in *M. gibbosa*,



TEXT-FIG. 12.—*Mysidopsis indica*, sp. nov.

*a*, antennular peduncle of male; *b*, antennal scale; *c*, first pleopod of the male; *d*, fourth pleopod of the male; *e*, telson and uropods. All  $\times 65$ .

more broadly triangular, longer and completely covering the basal joints of the eye-stalks.

(3) The antennal scale is two and a half times as long as broad, being thus broader than in *M. gibbosa*. It outreaches the antennular peduncle but not to the same extent as in *M. gibbosa*.

(4) Telson shorter than in *M. gibbosa*, not much more than half as long as the uropods, and hardly longer than wide at the base.

The distal part narrows very suddenly and considerably and the apex is only as long as one quarter of the basal width. The apex is very shallowly notched and bears a pair of small spines on each side of the notch. There are no plumose setae. The lateral margins bear two spines at the widest part of the telson but otherwise are naked.

(5) The uropods in the specimen figured have the endopod and exopod of approximately equal length, but there appears to be some variation in this respect since one of the female specimens has the endopod distinctly shorter than the exopod. There is a single spine on the lower inner margin of the endopod in the region of the otocyst. In *M gibbosa* there are five such spines.

(6) The pleopods of the male agree essentially with those of *M gibbosa*, except that there is a small branchial plate at the base of the endopod. This lamella-like expansion is broad and flat on the second to the fifth pleopods, but is narrower and more finger-like on the first pleopod. The exopod of the fourth pleopod terminates in a single stout plumose spine.

(7) *M. indica* is smaller than *M gibbosa*, adult specimens of both sexes measuring only 4 mm., as against 6-7 mm. in the latter species.

#### *Mysidopsis kemp*, sp. nov.

Text figs. 13a-g.

*Locality*.—Kilakarai, Gulf of Manaar, among weeds, 1-2 fathoms, February, 1913. Eleven females and four males, 5-6 mm. (Types.)

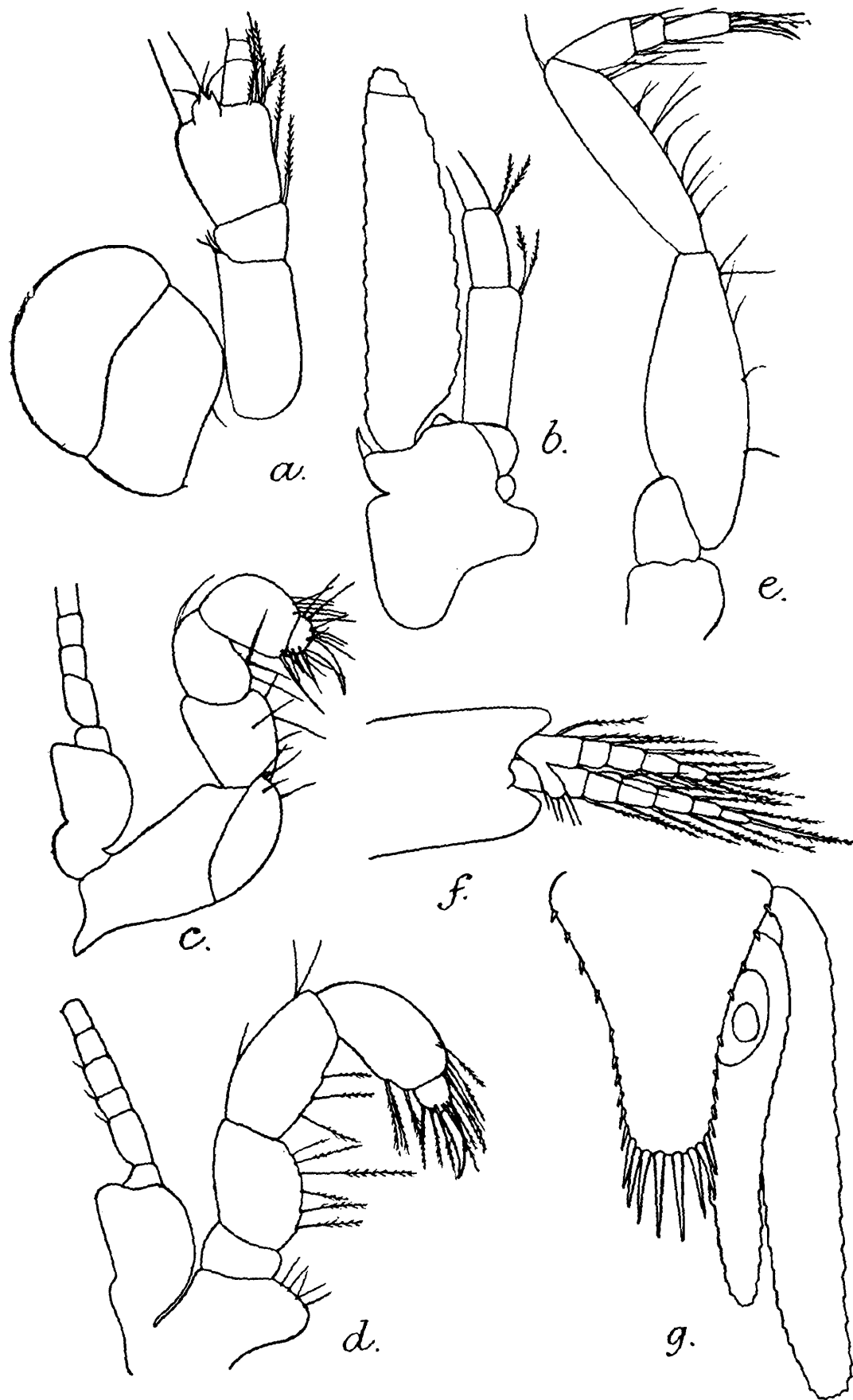
*Description*.—Carapace leaving the last two thoracic somites exposed dorsally, but laterally covering all but the last somite; produced in front into a short triangular plate with a bluntly pointed apex which does not project forward very much beyond the antero-lateral corners; no tubercles or nodules.

Eyes large, pigment black, cornea as wide as the rest of the eye and occupying half the eye in dorsal view.

Antennal scale narrowly oval in shape, four times as long as broad; setose all round, terminal joint distinct, extending for one-third of its length beyond the antennular peduncle.

Mouth parts and thoracic appendages not differing greatly from those of *M didelphys*; the inner lobe of the first maxilla has three terminal setae; in the posterior thoracic limbs the merus is about equal in length to the ischium but less expanded, the tarsus is three-jointed, the second joint the smallest; the basal joint of the exopodite has the outer corner rounded and the flagellum is composed of eight to ten joints.

Telson (without terminal spines) as long as the last abdominal somite, one and a quarter times as long as broad at its base, apex quadrate with rounded angles, with four pairs of long stout spines, the inner pair nearly one-third the length of the telson, outermost pair of the four about half as long as the inside pair, lateral mar-



TEXT-FIG. 13.—*Mysidopsis kempi*, sp. nov.

*a*, antennular peduncle and eye; *b*, antennal scale; *c*, first thoracic limb; *d*, second thoracic limb; *e*, endopod of third thoracic limb; *f*, fourth pleopod of the male; *g*, telson and uropods. All  $\times 64$ .

gins with about ten spines distributed throughout their length, more distantly placed proximally, nearer together distally, the most distal marginal spine less than half as long as the outer spines of the apex; no plumose setae at the centre of the apex.

Inner uropod half as long again as the telson, with a comb of ten spines on the lower surface in the region of the statocyst but not extending down the inner margin.

Outer uropod nearly twice as long as the telson.

Fourth pleopod of the male of the usual type found in *Mysidopsis*, both rami six-jointed, the outer ramus longer than the inner and terminating in a single, long, stout plumose spine.

*Remarks.*—This species is a very typical member of the genus *Mysidopsis* but is easily distinguished from all the other species by the shape and armature of the telson.

### Genus *Leptomysis* G. O. Sars.

#### *Leptomysis xenops*, sp. nov.

Text-figs. 14a-g.

*Leptomysis apiops*?, Zimmer, 1915 (3), p. 167, fig. 19.

*Locality.*—Port Blair, Andaman Islands.

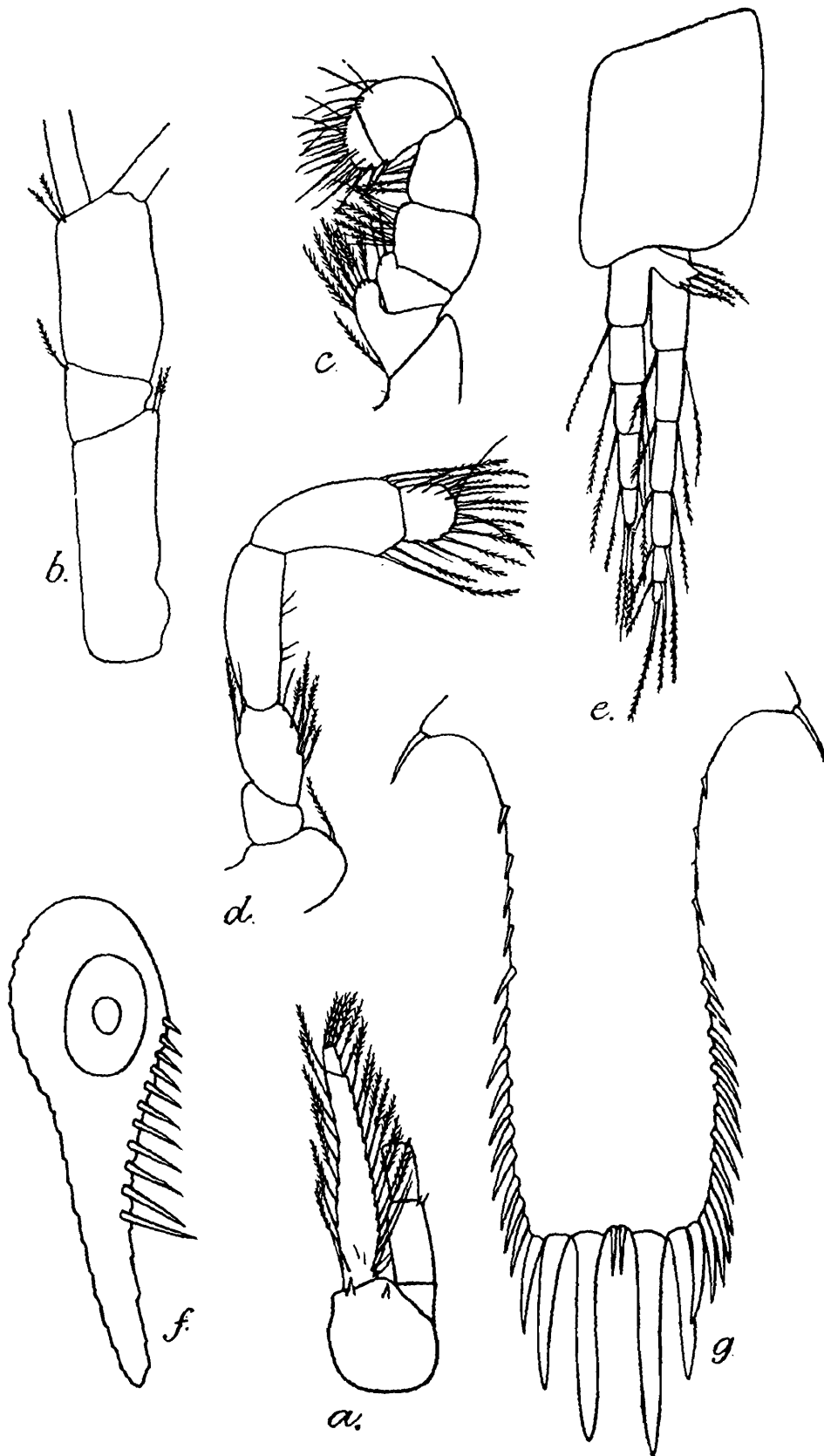
St. 5. Two.

St. 11. Abundant. (Types.)

*Description.*—Agreeing with *Leptomysis apiops* G. O. Sars, except in the form of the telson. The latter is linguiform in shape, one and a half times as long as broad at the base; apex more or less truncate, half as long as the width of the telson at the base, armed with three pairs of stout spines, the innermost pair the longest, equal in length to two-fifths of the length of the telson; between the inner pair of spines are two small spinules about one quarter of the length of the spines; the spines immediately outside the inner pair are about two-thirds of the length of the latter and the outer spines of the apex are slightly less than one half of the length of the inner pair; the lateral margins of the telson bear a single long spine at the point of the greatest width of the telson and from 14-17 spines on the rest of the margin, the proximal ones more distantly placed than the distal, the spines increasing in size in regular sequence towards the apex and not arranged in groups.

For the rest of the characters reference may be made to Sars' figures of *L. apiops* with which this species agrees in all its other characters. I have given figures of the principal appendages of *L. xenops* for comparison.

Zimmer (1915 (2)) has given a new figure of the eye of *L. apiops* to illustrate the elongation of certain facets which leads to the peculiar shape of the eye, from which the species takes its name. The present species has eyes of exactly the same form. In fact it is very closely allied to *L. apiops*, but the latter has about 35



TEXT-FIG. 14.—*Leptomysis xenops*, sp. nov.

*a*, antennal scale; *b*, antennular peduncle; *c*, endopod of the first thoracic limb; *d*, endopod of the second thoracic limb; *e*, fourth pleopod of the male; *f*, inner uropod; *g*, telson. *a* × 30, *b*—*g* × 60.

spines on each of the lateral margins of the telson and moreover these spines tend to arrange themselves in groups of three to five smaller spines separated by larger spines. There are also differences in the proportions of the spines at the apex of the telson. In *L. apiops* the inner pair of spines is twice as long as the next pair and the spinules between the inner spines are about half as long as the latter.

Zimmer (1915 (3)) has recorded *L. apiops* with a query from the Indian Ocean. It seems probable that the single specimen at his disposal really belonged to the present species. Zimmer does not give the number of spines arming the lateral margins of the telson but the spines at the apex, judging from his figure, agree in their proportions rather with *L. xenops* than with *L. apiops*. The only difference I can see is that the small spinules between the large pair of spines at the apex are about half as long as the spines in Zimmer's specimen and only one quarter as long as the spines in mine.

The species is an abundant one in the neighbourhood of the Andamans, to judge by the large number of the specimens in this collection.

#### Genus *Afromysis* Zimmer.

#### *Afromysis macropsis*, sp. nov.

Text-figs. 15a-g.

*Locality*.—Off Puri, Orissa, 4-4½ fathoms. One male, 9 mm. (Type.)

*Description*.—Body smooth, without spinules; carapace produced into a short triangular rostral plate with an obtusely rounded apex; eye long and narrow, recalling the eye of the genus *Mesopodopsis*, more than twice as long as broad, cornea occupying less than the distal half of each eye and not wider than the rest of the eye, pigment black.

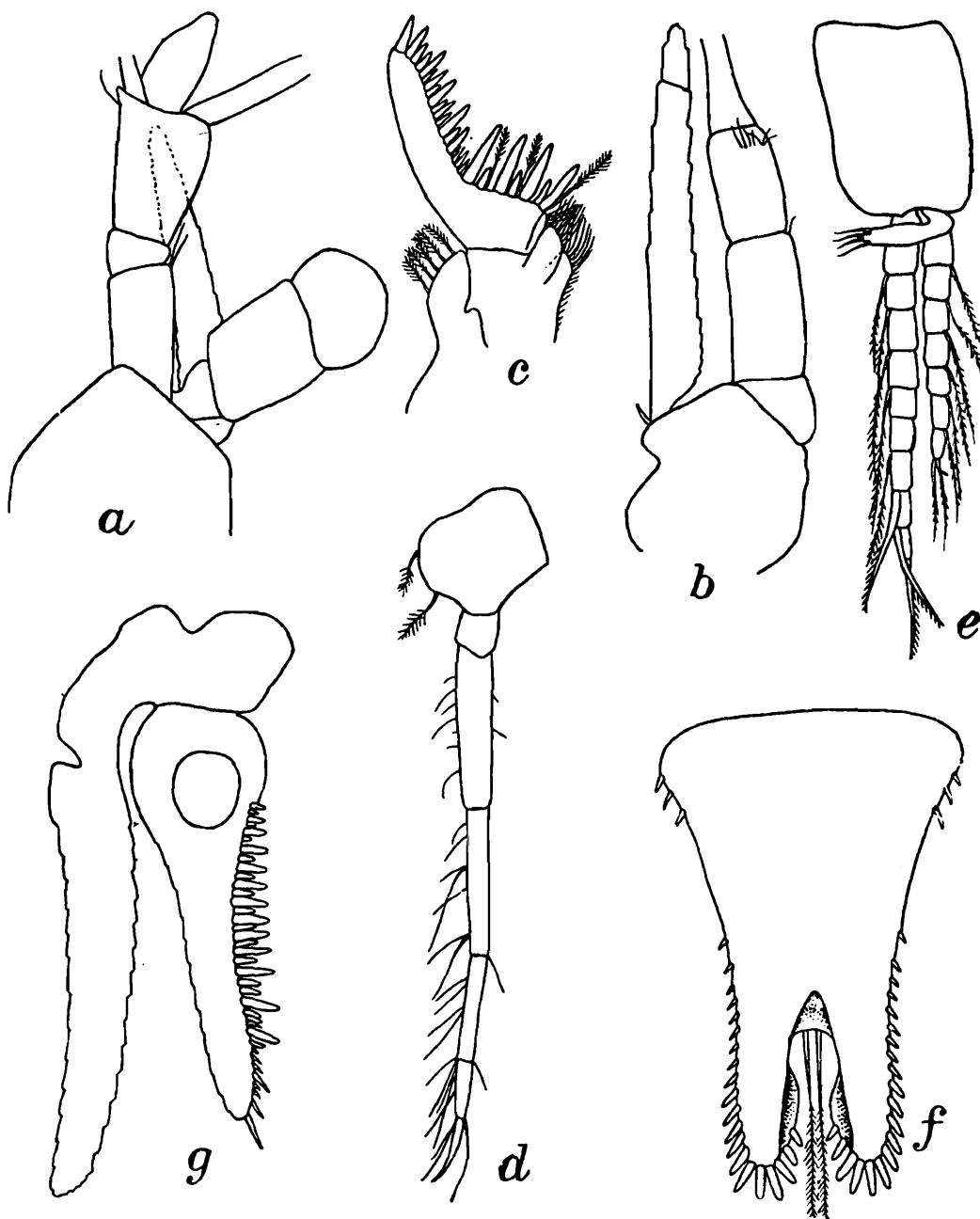
Antennal scale *shorter* than the antennular peduncle, about seven times as long as broad, setose all round, distal articulation well marked, a prominent spine on the outer distal corner of the basal joint.

Posterior thoracic legs rather short and slender, tarsal joint divided by a single transverse articulation.

Telson one and a half times as long as broad at the base, cleft for one-third of its length, cleft wider proximally than distally and unarmed except for two long plumose setae, the lateral margins armed with three spines proximally at the widest part; these are followed by a short unarmed portion of the margin and distally there are about twenty spines; the proximal eight or nine of these spines are normal sharply-pointed short spines; the remainder are blunt spines increasing in size to the apical lobes, the two or three on the inner side of the apical lobes somewhat smaller but of the same type.

Inner uropod one and a half times as long as the telson, its

inner margin armed with a dense row of about 35-40 spines, the proximal 30 of which are bluntly pointed, alternating larger and smaller sizes, nearly always one smaller one between two large ones, but distally there may be two or even three small ones



TEXT-FIG. 15.—*Afromysis macropsis*, sp. nov.

*a*, anterior end,  $\times 33$ ; *b*, antennal scale,  $\times 50$ ; *c*, second maxilla,  $\times 65$ ; *d*, endopod of fourth thoracic limb,  $\times 50$ ; *e*, fourth pleopod of male; *f*, telson,  $\times 50$ ; *g*, uropods,  $\times 50$ .

between the large ones; the distal spines are normal and sharply-pointed.

Outer uropod one and three quarter times as long as the telson.

The second maxilla conforms to the type found in *Afromysis hansonii*, with the outer distal corner of the second joint of the palp

very much produced. The fourth pleopod of the male differs from that of the type-species in having the penultimate joint of the exopod of normal size and not unduly elongated. But the only specimen has a look of immaturity about it, since the lobe on the antennule lacks the dense tuft of hairs characteristic of adult males. It is possible therefore that adult males may be found to agree more closely with the type in the form of the fourth pleopods of the male.

*Remarks.*—This interesting species is a true *Afromysis*, differing from the type-species in the different form of the eye, the more produced rostrum, the longer antennular peduncle and shorter antennal scale and in the different form and armature of the telson.

### Genus *Prionomysis*, nov.

Antennal scale long and narrow, setose on both margins, terminal joint distinct.

Terminal joint of the palp of the second maxilla longer than wide, without strong spines on its distal margin.

First thoracic limb with a masticatory lobe on the second joint of the endopod only, tarsal joint of the remaining thoracic limbs with two transverse articulations.

Telson linguiform in shape, cleft at the apex, cleft furnished with a pair of plumose setae but without spines, lateral margins armed throughout their length by spines which increase in length posteriorly and are arranged in a regular saw-like formation on each of the apical lobes.

Inner uropods with a dense row of spines on the inner margin, extending from the statocyst to the apex; outer uropods without a distal joint, and without spines.

Pleopods in the male as in the genus *Leptomysis*. Female with three pairs of incubatory lamellae.

Type:—*Prionomysis stenolepis*, sp. nov.

*Remarks.*—This genus is most nearly allied to the genus *Leptomysis*. It agrees with that genus in the form of the second maxilla, antennal scale and pleopods of the male, but is distinguished at once by the form of the telson.

At first I was disposed to refer the species to the genus *Afromysis* but the discovery of a second species of the latter, showing the same peculiar form of the palp of the second maxilla as in the type has led me to regard this character as of generic value.

*Prionomysis* shows considerable resemblances to the genera *Doxomysis* and *Bathymysis*, but again the form of the second maxilla separates it. In *Doxomysis* and *Bathymysis* the terminal joint of the palp of the second maxilla is broader than long, expanded distally and armed with stout spines. In both genera, too, the cleft of the telson is armed with spinules, whereas in *Prionomysis* the cleft is smooth. In *Doxomysis* the masticatory lobes on the endopod of the first thoracic limb are much more

developed than in *Prionomysis*, being present on the second, third and fourth joints and very much larger.

In addition to the form of the second maxilla, *Prionomysis* also differs from *Afromysis* in the less specialized form of the fourth pleopod of the male.

*Prionomysis stenolepis*, sp. nov.

Text-figs. 16a-j.

*Locality*.—Port Blair, Andaman Isles, Station 3. Eight females, two males, 8–9 mm. (Types.)

*Description*.—Carapace produced in front in the form of a triangular plate with acutely pointed somewhat depressed apex which reaches forward almost to the middle of the first joint of the antennular peduncle; antero-lateral corners rounded; last two thoracic somites exposed dorsally.

Eyes large, somewhat flattened, cornea wider than the remainder of the eye, occupying more than one half of the eye in dorsal view, the anterior margin of the eye stalk longer than the posterior; eye at least as long as the first joint of the antennular peduncle.

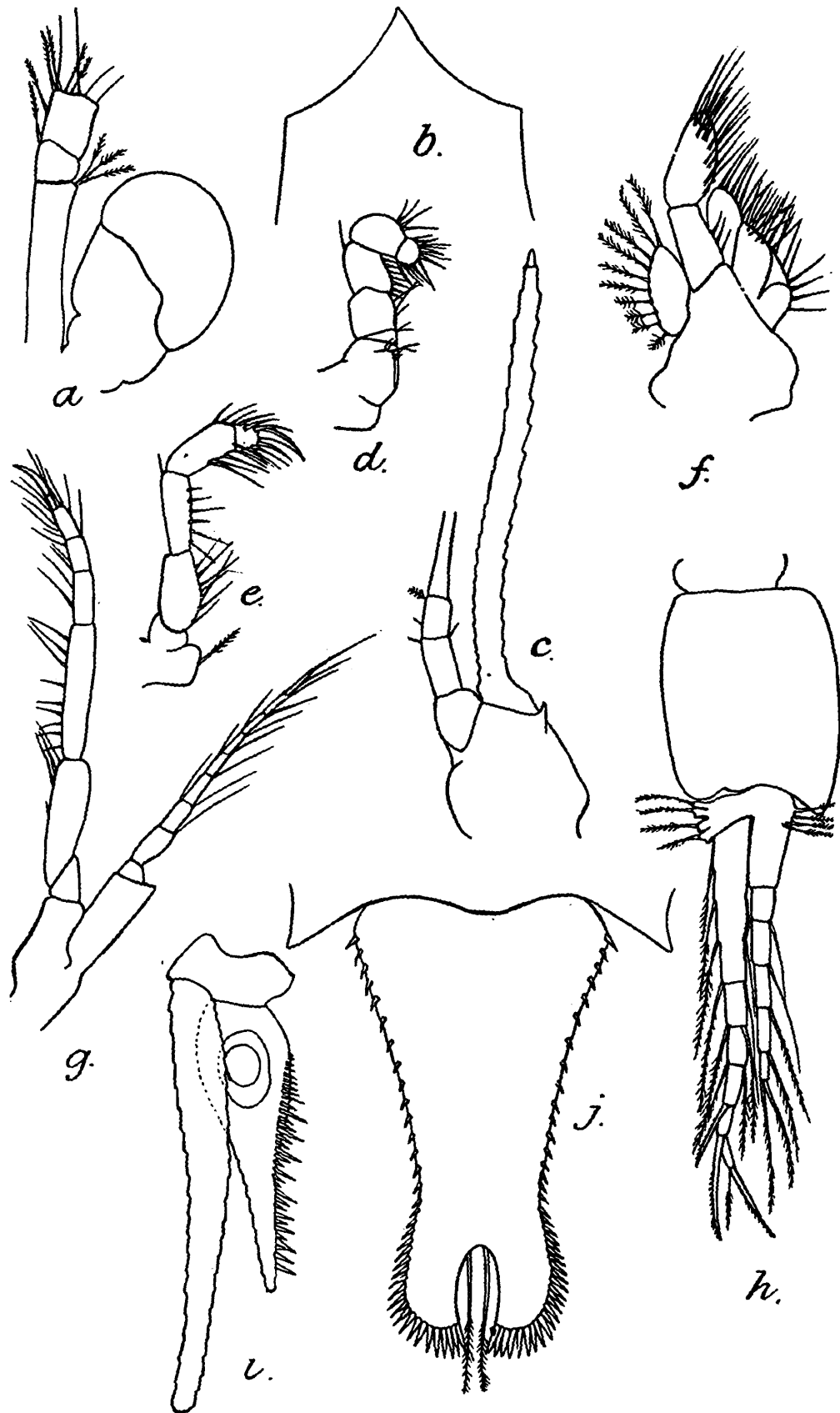
Antennular peduncle with the first joint longer than the remaining two combined, the last joint in the male with a well-developed hirsute lobe of normal form.

Antennal scale exceedingly long and narrow and curiously twisted, about thirteen times as long as broad, twice as long as the antennular peduncle and four times as long as the antennal peduncle, setose all round, terminal joint distinct though small. Antennal peduncle much shorter than the antennular, second joint longer than the third, mouth-parts agreeing on the whole with those of *Afromysis hansonii* Zimmer, except that the terminal joint of the palp of the second maxilla is not expanded and produced into a narrow process but is normal in shape.

First thoracic limbs robust, masticatory lobe present only on the second joint and not nearly so well developed as in *Afromysis* or *Doxomysis*, nail robust; second thoracic limbs having the nail long and stout; tarsus of the remaining thoracic limbs three-jointed and terminated by a long stout nail; all the posterior thoracic limbs appear to be similar in size and form.

Fourth pleopod of the male with both endopod and exopod six-jointed, but the exopod one quarter longer than the endopod; each of the last three joints bears a stout plumose spine; the fourth pleopod of the male is very like that in the genus *Leptomysis* and not nearly so specialized as in the genus *Afromysis*.

Telson slightly shorter than the last somite of the abdomen and not reaching very much beyond the statocyst of the uropod; lateral parts of the last abdominal somite produced rather acutely at each side of the base of the telson; telson much narrower than the last abdominal somite, not quite twice as long as broad at the base, narrowing gradually for almost three quarters of its length



TEXT-FIG. 16.—*Prionomysis stenolepis*, sp. nov.

*a*, antennular peduncle and eye,  $\times 30$ ; *b*, rostrum,  $\times 30$ ; *c*, antennal scale,  $\times 30$ ; *d*, endopod of first thoracic limb,  $\times 30$ ; *e*, endopod of second thoracic limb,  $\times 30$ ; *f*, second maxilla,  $\times 60$ ; *g*, third thoracic limb,  $\times 30$ ; *h*, fourth pleopod of the male,  $\times 60$ ; *i*, uropods,  $\times 30$ ; *j*, telson,  $\times 60$ .

and there widening and terminating in two broad lobes separated by a median wide cleft, about one-fifth of the length of the whole telson; margins of the cleft unarmed except for two long plumose setae at the anterior end; margins armed throughout their entire length with spines; about seventeen small spines on the proximal part of the margin from the base of the telson to the narrowest part; from the narrowest part to the apex of each lobe there are about twenty-five closely packed spines, longer than those on the proximal portion of the margin and increasing in size towards the apex.

Inner uropod about one and a half times as long as the telson with a very prominent spine on the dorsal surface of the statocyst, towards the outside; this spine is very prominent in lateral view; inner margin armed with a dense row of spines throughout its length from the statocyst to the apex, the spines arranged in series of larger and smaller ones, three to four in each series.

Outer uropod twice as long as the telson.

Female with three pairs of incubatory lamellae.

### Genus *Dioptrromysis* Zimmer.

#### *Dioptrromysis perspicillata* Zimmer.

*Dioptrromysis perspicillata*, Zimmer, 1915 (3), p. 168, text-figs. 20-22.

*Localities*.—Port Blair, Andaman Islands.

St. 3. Five females, one male.

St. 11. One male.

Pamban, Gulf of Manaar, from weeds, 0-2 fathoms, February, 1913. Nine females, one male.

Kilakarai, Gulf of Manaar, from weeds, 0-2 fathoms, February, 1913. Nine females, three males.

*Remarks*.—The largest female measured 5 mm., and the largest male, 3.5 mm. The discovery of male specimens allows of the proper classification of this species. It belongs to the tribe Leptomysini. The pleopods of the male agree generally with those of the genus *Leptomysis*. The exopod of the fourth pair is longer than the endopod, composed of six joints, the last one terminating in a single thick plumose spine, equal in length to the last four joints of the exopod, at the base of which is a small smooth spine. The endopod of the fourth pair and the exopods and endopods of the other pleopods are four jointed.

*Distribution*.—The only known record is of a female taken on a voyage from Ceylon to New Guinea.

### Genus *Doxomysis* Hansen.

This genus was established by Hansen (1912) for a species, *D. pelagica*, captured off the Galapagos Islands. Illig, however, in 1906, had described a species, "*Mysis*" *quadriscopiosa*, which is clearly referable to this genus, though as Illig had only a single female specimen at his disposal, he did not feel justified in

establishing a new genus for his species. Hansen's species was also represented by a single female and in consequence neither he nor Illig was able to place the genus in its proper place in the classification. Colosi (1920) had more abundant material and was able to establish the fact that the genus belongs to the tribe Lep-tomysini. He described four new species, *D. hanseni*, *D. zimmeri*, *D. tattersallii* and *D. microps*. These species do not seem to me to be founded on sufficient grounds. I regard *D. zimmeri* as a synonym of the earlier *D. quadrispinosa* (Illig) and I do not think *D. tattersallii* is separated from *D. pelagica* by any characters of specific value. This would leave four species in the genus. They all agree in having the spines arming the telson confined to the distal half of the lateral margins and thereby differ from the new species described below, in which the spines extend throughout the whole length of the lateral margins. All the hitherto described species are pelagic and were taken at the surface in the open sea, in contrast to the species in this collection which is littoral in habit.

The genus is very closely allied to *Bathymysis* Tattersall (1907 and 1911), and to *Afromysis* Zimmer (1916). It differs from the former in the possession of well-developed eyes and from the latter in the form of the second maxilla.

### *Doxomysis littoralis*, sp. nov.

Text-figs. 17a-e.

*Localities*.—Port Blair, Andaman Islands.

St. 3. Fifteen females, one male, 4 mm.

St. 11. Nine females, one male, 5 mm. (Types.)

St. 19. One male, 4 mm.

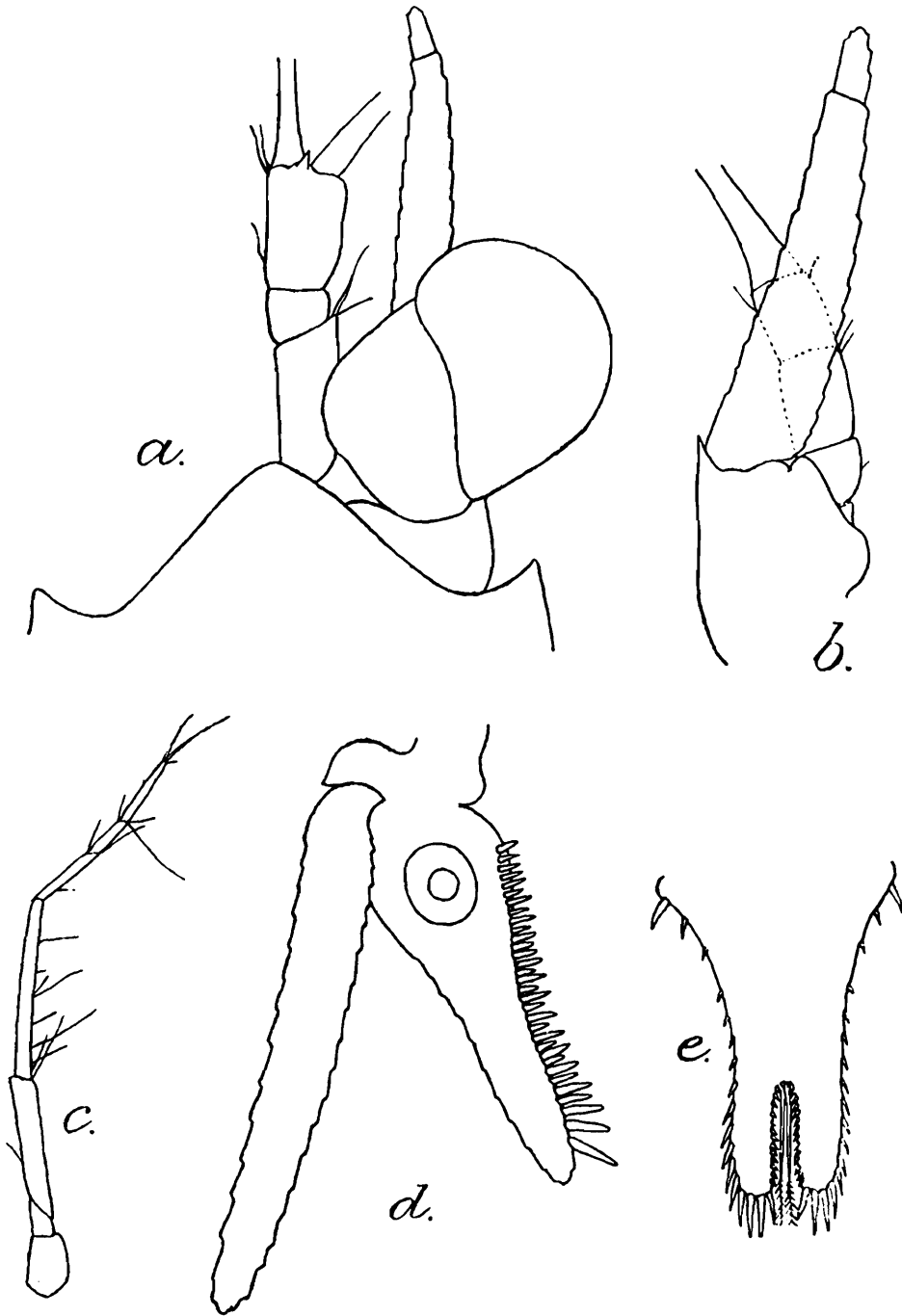
*Description*.—Body smooth, without spinules; carapace produced into a very short triangular rostral plate with the apex bluntly rounded, not covering the bases of the eyestalks. Eyes of moderate size, cornea more than half as large as the whole eye, slightly wider than the stalk, pigment black.

Antennal scale outreaching the antennular peduncle by one-third of its length, seven times as long as broad, setose all round, terminal joint one-seventh of the total length of the scale, a prominent spine on the outer distal corner of the basal joint.

Thoracic limbs with the endopods long and slender, increasing in length from the fourth to the eighth limbs, tarsus three-jointed, nail distinct.

Telson one and a half times as long as broad at the base, cleft for one-third of its length, cleft wide, rounded at the apex, armed with a pair of plumose setae and fifteen small spinules on each margin, terminal lobes of more or less equal width throughout, with the apex rounded, almost truncate, and armed with four spines, the centre pair of which are subequal in size and slightly longer than each of the lateral ones, the lateral margins armed

with about thirteen spines extending throughout their entire length, the proximal spines more distantly placed than the distal ones, the latter gradually increasing in size to the apical lobes and grading off into the spines which arm them.



TEXT-FIG. 17.—*Doxomysis littoralis*, sp. nov.

*a*, anterior end,  $\times 65$ ; *b*, antennal scale,  $\times 65$ ; *c*, endopod of eighth thoracic limb,  $\times 33$ ; *d*, uropods,  $\times 65$ ; *e*, telson,  $\times 65$ .

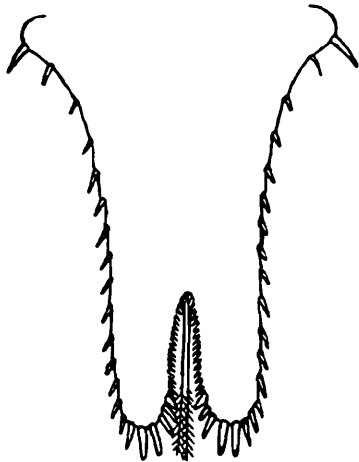
Inner uropods one and a quarter times as long as the telson, the inner margin armed with a row of about thirty-two blunt spines extending from the statocyst to the apex, alternately larger and smaller in size, sometimes distally there may be two or even three smaller spines between a pair of larger ones.

Outer uropod one and a half times as long as the telson.

Length of adults of both sexes, 5 mm. There is a considerable development of chromatophores on the antennular peduncle, antennal scale and its peduncle, mouth parts and first two pairs of thoracic limbs, brood lamellae, along the whole of the ventral surface of the abdomen, telson and uropods, and, as, at the time of death, these chromatophores were expanded, the preserved animals present a dusky appearance.

*Remarks.*—This species differs from all the other described species in having the margins of the telson armed throughout their entire length with spines and in the very large number of spines on the inner uropod. Only *D. hanseni*, among the described species, agrees with the present one in having a smooth body devoid of spinules.

Three specimens of a species of *Doxomysis* from Port Blair are held over to await further material.



TEXT-FIG. 18.—*Doxomysis* sp.

Telson,  $\times 65$ .

They differ from *D. littoralis* in having the whole of the carapace and abdomen covered with fine spinules which even extend to the eyestalks, in the shorter antennal scale which barely outreaches the antennular peduncle, in the slightly different arrangement of the spines on the telson (text-fig. 18) and in the longer uropods, the inner being one and a half and the outer twice as long as the telson. They agree with *D. littoralis* and differ from all the other described species in having the spines on the lateral margins of the telson extending throughout their whole length. The rostral plate is triangular in shape, with the apex bluntly pointed and quite short, while the eyes resemble the smaller eyes of *D. littoralis* rather than the larger eyes of the pelagic species. The specimens are rather damaged and though they appear to represent a new species, it does not seem advisable to give them a name at present.

### *Doxomysis anomala*, sp. nov.

Text-figs. 19a-f.

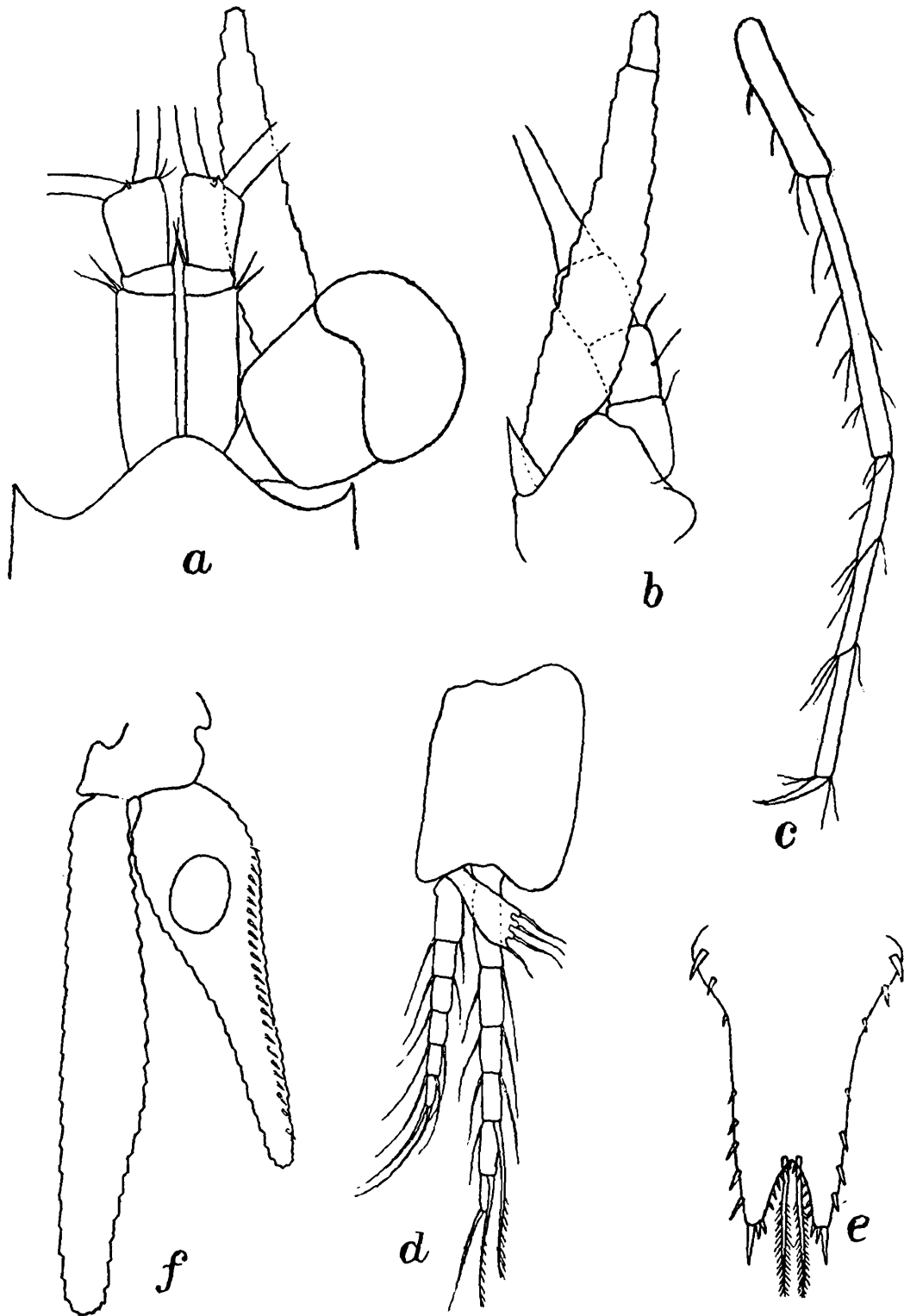
*Localities.*—Port Blair, Andaman Islands.

St. 3. One hundred and twenty specimens, up to 5.5 mm. (Types.)

St. 32. One female and two males.

*Description.*—Body smooth without spinules; carapace short, leaving the last three thoracic somites exposed dorsally, produced in front into a short triangular rostral plate with an obtuse apex, not covering the eyestalks.

Eyes of moderate size, cornea occupying one half of the whole eye and wider than the peduncle, pigment brown.



TEXT-FIG. 19.—*Doxomysis anomala*, sp. nov.

*a*, anterior end,  $\times 65$ ; *b*, antennal scale,  $\times 65$ ; *c*, endopod of fourth thoracic limb,  $\times 65$ ; *d*, fourth pleopod of male,  $\times 65$ ; *e*, telson,  $\times 65$ ; *f*, uropods,  $\times 65$ .

Antennal scale extending for about one-third of its length beyond the antennular peduncle, lanceolate in shape, six times a

long as broad, setose all round, terminal joint about one-seventh of the whole scale, a prominent spine on the outer distal corner of the basal joint.

Mouth-parts agreeing with those of the genus *Doxomysis* as described by Hansen except that the exopod of the second maxilla has more setae than Hansen figures though these setae are quite short and feeble; setose lobes well developed on the second, third and fourth joints of the first thoracic legs.

Endopods of the posterior thoracic limbs very slender, tarsus with three joints, the proximal articulation very *oblique*, the distal articulation slightly oblique, nail well developed.

Telson three quarters of the length of the last abdominal somite, one and a half times as long as broad at the base, cleft for one-fifth of its length, cleft armed on each side by six small articulated spines, a pair of plumose setae at the base of the cleft longer than the cleft, lobes at the apex truncate, each armed with three spines, the outer spine stouter and twice as long as the inner pair, lateral margins armed with 7-8 spines, three larger and stouter ones on the proximal portion at the widest part, 4-5 on the distal portion.

Inner uropod one and a half times as long as the telson with row of about 20-25 closely set spines on the inner margin extending from the statocyst almost to the apex.

Outer uropod twice as long as the telson.

Fourth pleopods of the male with the exopod longer than the endopod, the antepenultimate and penultimate joint each bearing a long stout seta feathered at the distal end, the terminal joint with a single short simple seta.

Female with two pairs of incubatory lamellae.

Length of adult specimens of both sexes, 5.5 mm.

*Remarks.*—Hansen in his monograph of the 'Siboga' Mysidae distinguished the tribe Erythropini from the tribe Leptomysini, among other characters, by the fact that the proximal articulation of the tarsus is oblique. The present species, which from the structure of the second maxilla, antennal scale and pleopods in the male is clearly a member of the Leptomysini, presents the anomalous character of two oblique articulations defining the joints of the tarsus of the thoracic limbs. The proximal articulation is very oblique, quite as oblique as in any of the Erythropini but the distal articulation is only slightly oblique.

#### Tribe MYSINI.

#### Genus *Mesopodopsis* Czerniavsky.

#### *Mesopodopsis orientalis* (Tattersall).

*Macropsis orientalis*, Tattersall, 1908, 1914, 1915.

*Locality.*—Balliaghatta Canal, near Calcutta, in brackish water. Abundant.

Bay N.-W of Nazareth Point, Mormugao Bay, Portuguese India, nine specimens. Chilcolna Bay and stream at its southern end, Mormugao Bay, Portuguese India, one specimen.

*Remarks.*—It is unfortunately necessary to alter the name of the genus. The name *Macropsis*, proposed by Sars in 1877, had already been applied by Lewis in 1836 to one of the Hemiptera and the genus must therefore be known by the name proposed as a subgenus by Czerniavsky in 1882.

### Genus *Neomysis* Czerniavsky.

Zimmer (1915(1)) has united with the genus *Neomysis* Czerniavsky, the genus *Acanthomysis* Czerniavsky (= *Dasymysis* Holt and Beaumont, *Metamysis* Nakazawa (not Sars), *Orientomysis* Derzhavin) on the grounds that the distinctions between these genera have broken down in the light of the species described by Nakazawa and Derzhavin. In the structure of the pleopods of the male both genera are identical and the differences lie mainly in the antennal scale and in the tarsus of the thoracic legs. In *Neomysis* the antennal scale is very long, with a sharply pointed apex, and the tarsus of the thoracic legs is many jointed. In *Acanthomysis* the antennal scale is short, the apex rounded or truncate, and the tarsus of the legs three-jointed. But *Metamysis mitsukurii* Nakazawa, has the antennal scale of *Acanthomysis* and the tarsus of the thoracic legs six-jointed, i.e. as found in *Neomysis*. Both the species of *Orientomysis* described by Derzhavin have many joints, 4-8, in the tarsus of the thoracic legs, but the antennal scale is short with a rounded apex. On the whole Zimmer appears to be right in uniting these genera. It is difficult to seize upon any constant character separating them. The type of the genus *Acanthomysis* is *A. longicornis* (M. Edw.) from the Mediterranean and the new species I describe below could without difficulty be referred to this genus. It agrees very closely with *A. longicornis* and is only distinguishable by characters which cannot be regarded as of more than specific value. But I have followed Zimmer in his arrangement and described the species under the genus *Neomysis*.

### *Neomysis indica*, sp. nov.

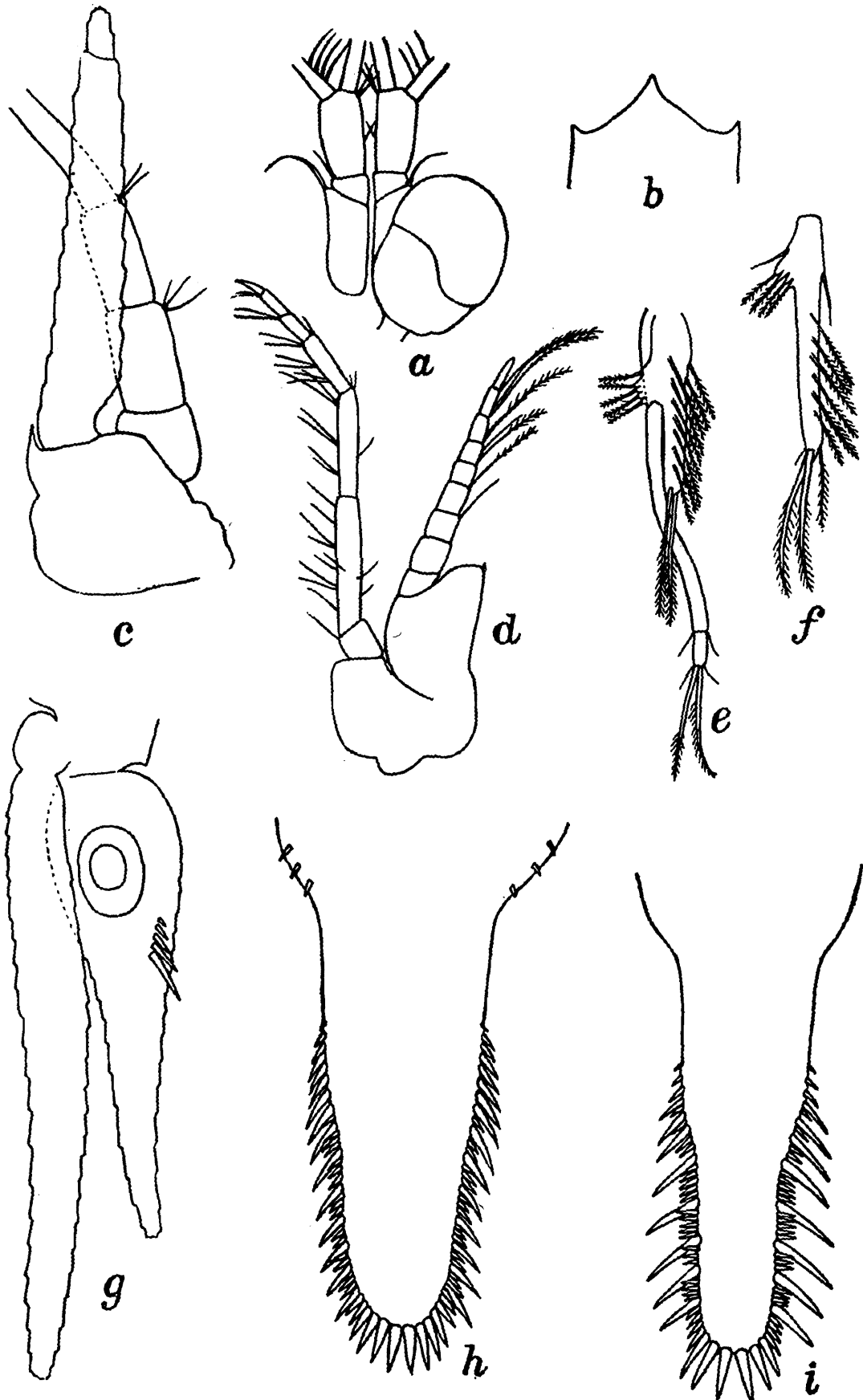
Text-figs. 20a-i.

*Localities.*—Port Blair, Andaman Islands. Stations 3, 5, 11 and 19. Ten females and 3 males, up to 6.5 mm.

Kilakarai, Gulf of Manaar, from weeds, 0-2 fathoms, February, 1913. Six females and 10 males up to 8 mm. (Types.)

Chilcolna Bay, and stream at its southern end, Mormugao Bay, Portuguese India. One specimen.

*Description.*—Very closely allied to *Neomysis longicornis* (M.-Edw.). Body, including the eyes, and last pair of brood

TEXT-FIG. 20.—*Neomysis indica*, sp. nov.

*a*, eye and antennular peduncle,  $\times 33$ ; *b*, rostrum,  $\times 33$ ; *c*, antennal scale,  $\times 65$ ; *d*, fifth thoracic limb,  $\times 50$ ; *e*, fourth pleopod of male,  $\times 65$ ; *f*, fifth pleopod of male,  $\times 65$ ; *g*, uropods,  $\times 65$ ; *h*, telson of adult,  $\times 65$ ; *i*, telson of young,  $\times 65$ .

lamellae in the female, hispid all over, the spinules thickest on the posterior segment of the abdomen and on the anterior part of the thorax. Fully grown males appear to be much smoother than young males and females.

Carapace produced in front into a short triangular rostral plate with pointed apex.

Eyes large, cornea wider than the rest of the eye, pigment black.

Antennal scale barely outreaching the antennular peduncle, seven times as long as broad, terminal joint about one-tenth of the total length of the scale.

Tarsus of the thoracic limbs three-jointed.

Telson one and a half times as long as the last abdominal somite lanceolate in shape, entire, about twice as long as broad at the base, suddenly narrowing a short distance from the base and gradually narrowing from that point to a bluntly rounded apex, the proximal part of the lateral margins smooth except for three small spines on each side of the widest part of the telson, apex armed with from 6–8 strong spines of equal length with no smaller spines between them, distal part of the lateral margins armed with numerous spines of varying sizes, about seven to nine of these spines much larger than the rest and placed more or less at regular intervals, between them groups of smaller spines, 3–5 in a group, grading in size, the smaller ones anterior and the larger ones posterior. In small specimens the large spines arming the telson are relatively more prominent than in larger specimens and the telsons of both sizes look strikingly different. But I think the difference is entirely due to differences in size and the development of the subsidiary spines.

Inner uropod slightly longer than the telson with a group of five graded spines on the lower inner margin, near the statocyst.

Outer uropod one-seventh longer than the inner. In young specimens the uropods are more equal in size.

Fourth pleopod of the male, with its terminal setae, not reaching as far as the telson, endopod well developed, of normal form, exopod two-jointed, the terminal joint about one-seventh of the length of the proximal joint and bearing two long stout plumose setae about three times as long as the joint itself.

Fifth pleopod of the male much longer than the first, second and third, but of the same form. It is nearly as long as the sixth abdominal somite and the apex bears two specially strong and long plumose setae.

*Remarks*.—This species is distinguished from *N. longicornis* at once by the armature of the telson. In *N. longicornis* the spines arming the telson are more equal in size and there are not any outstanding spines of much greater length than the rest. In *N. stelleri* Derzhavin (1913) the telson has special spines of outstanding length separating groups of spines, but the spines on the telson extend along the entire margin, whereas in *N. indica* the proximal

portion of the margins of the telson is unarmed. Moreover *N. stelleri* has the tarsus of the thoracic legs six-jointed.

*N. indica* is the Indian Ocean representative of *N. longicornis* and provides additional evidence of the close similarity of the Mysidacean fauna of the Mediterranean and Indian Ocean, so clearly exemplified by this collection.

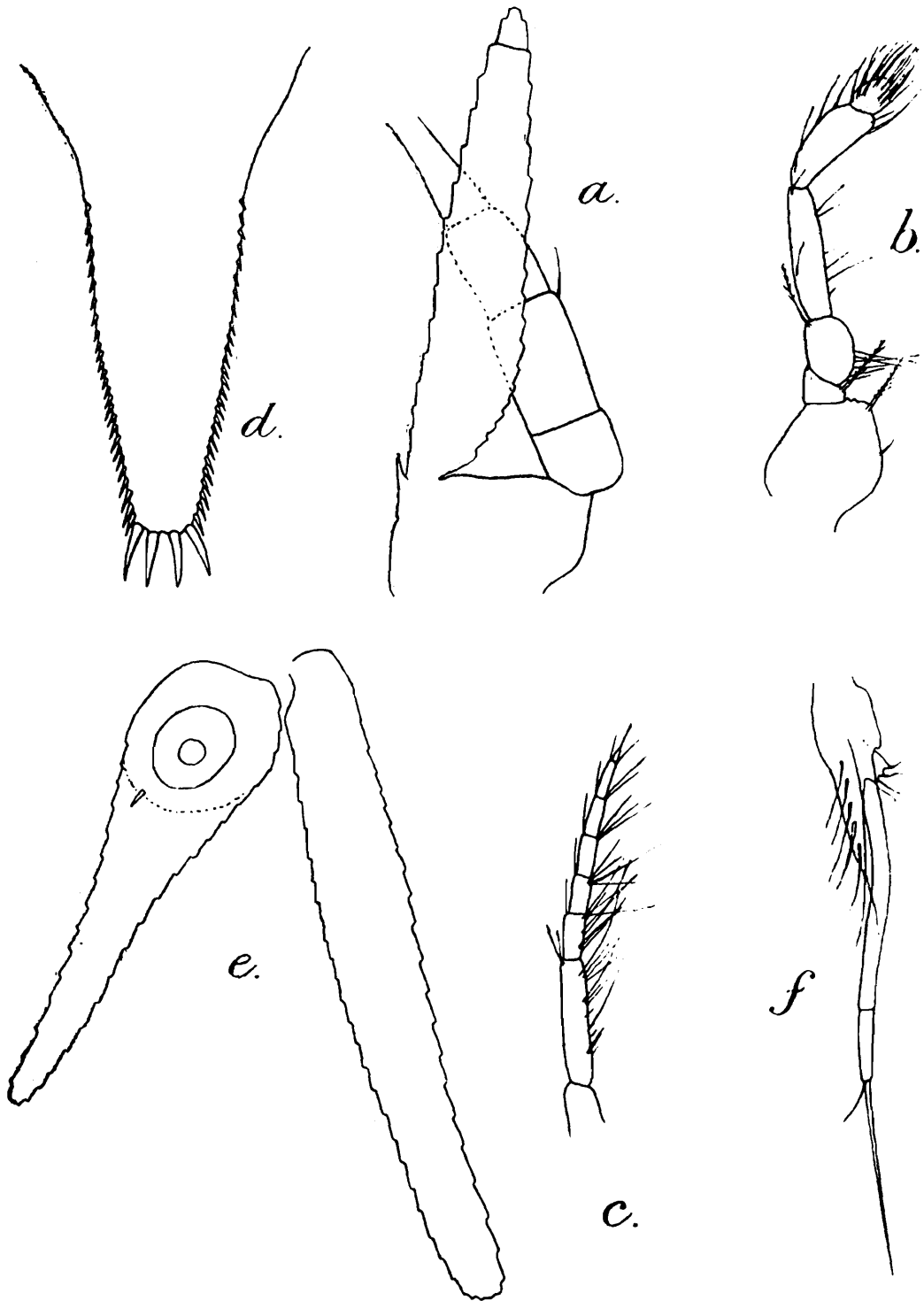
***Neomysis hodgarti*, sp. nov.**

Text-figs. 21a-f.

*Locality*.—Mouth of the Rajang River, Sarawak, Borneo, 1-vii-10. Four males and fifteen females, up to 7 mm. in length, collected by R. Hodgart. (Types.)

*Description*.—Body smooth, without spinules on either thorax or abdomen. Carapace produced into a short broadly triangular rostral plate with bluntly pointed apex, antero-lateral corners rounded. Eyes reaching to the end of the second joint of the antennular peduncle, normal in shape, pigment black. Antennal scale extending slightly beyond the distal end of the antennular peduncle in the female and level with the male process of the antennules in the male, narrowly oval in shape, setose all round, about five times as long as broad, terminal joint distinct, a strong spine on the outer distal corner of the joint from which the scale springs. Labrum with a very long sharp forwardly directed spine. Tarsus of the thoracic legs composed of five to six joints and terminated by a slender nail. Last segment of the abdomen slightly longer than the fifth. Telson one and a quarter times as long as the last abdominal somite, narrowly linguiform in shape, not quite twice as long as broad at the base, apex entire, without cleft, almost truncate, one-fifth of the width of the telson at the base, bearing four equal stout spines in length about one-eighth of the total length of the telson, distal two-thirds of the lateral margins armed with about 26–28 short, closely set and regularly arranged spines increasing in length towards the apex. Inner uropod about one-sixth longer than the telson plus the terminal spines, with a single spine on the lower surface near the statocyst. Outer uropod one-sixth longer than the inner. First, second, third and fifth pleopods of the male simple unjointed plates as in the female. Fourth pleopod reaching almost to the base of the telson, endopod with well developed side lobe, exopod composed of three joints, first joint very long, three and a half times as long as the second, latter bearing a very long straight simple seta three times as long as the joint, terminal joint very minute with a single short seta at the apex. Length of the largest specimens of both sexes, 7 mm.

*Remarks*.—This species belongs to the *N. longicornis* group of the genus and is distinguished by the form of the telson with its apical armature of four equal stout spines, the smooth dermis, and the number of joints in the tarsus of the thoracic limbs.



TEXT-FIG. 21.—*Neomysis hodgarti*, sp. nov.

*a*, antennal scale and peduncle; *b*, endopod of the second thoracic limb; *c*, distal end of the endopod of the third thoracic limb; *d*, telson; *e*, uropods; *f*, fourth pleopod of the male. All  $\times 57$ .

Genus *Potamomysis* Czerniavsky.

*Potamomysis assimilis* Tattersall.

Text-fig. 22.

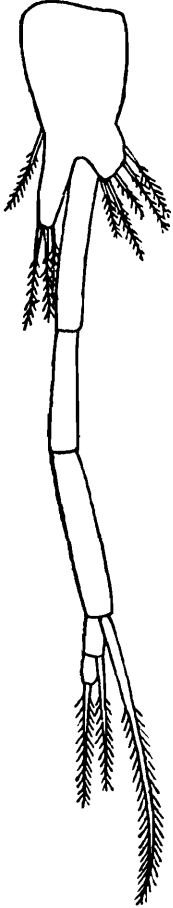
*Potamomysis assimilis*, Tattersall, 1908, 1914, 1915.

" " Zimmer, 1915 (1), p. 215, fig. 19.

*Locality*.—Ganges, near Buxar, Bihar, on surface. Several specimens (T. Southwell). " These specimens, captured over 600

miles from the sea, were taken at a point much further inland than any previously recorded." (N. A.).

*Remarks.*—Zimmer in his revision of the Mysini was unable to place this species and genus because he was of opinion that the male from which I figured the fourth pleopod was not mature. I find that this opinion is correct. Among the present specimens are two or three fully grown males, somewhat larger than I have examined before, and I find that the drawing I gave of the fourth pleopod of the male requires modification. The outer branch is five-jointed not three-jointed as I have described it, the third joint of my previous figure being subdivided into two extra small joints at the distal end. Each of these last three joints bears a single plumose seta at its outer distal end, those on the terminal and penultimate joints about equal in size, while that on the antepenultimate joint is much longer and stouter, and is plumose and not smooth as I had previously described it. Immature specimens have the fourth pleopod as I had previously described it, that is with the two small terminal joints of the outer branch not marked off and the large seta on the third joint smooth and not plumose.



TEXT-FIG. 22.—  
*Potamomysis*  
*assimilis*,  
Tattersall.

Fourth pleopod  
of the adult male,  
× 65.

The fourth pleopod in this species is remarkably like that of the genus *Stilomysis*, but the third pleopod of the latter is two branched whereas in *P. assimilis* it is rudimentary as in the female.

It is now possible to put this genus in its place in Zimmer's key. It should be placed in Group III B in which it will form a separate section, characterised by the large number of joints in the outer branch of the fourth pleopod of the male.

#### Genus *Idiomysis*, nov.

Body robust and gibbous, in the only specimen, flexed in the curious way shown in text-fig. 23a. Carapace produced in front into a large frontal plate with a broadly rounded apex. Eyes very large, stalks short, pigment golden brown. Antennular peduncle with the male lobe well developed and densely hirsute. Antennal scale very short and broad, the greater part of the outer margin smooth, without setae, no transverse suture distally. Second maxilla with the outer plate very reduced, with only four or five setae. First thoracic limbs with a masticatory lobe on the second joint only. Tarsus of the third fourth, sixth, seventh and eighth thoracic limbs unjointed. Fifth thoracic limbs markedly

longer than any of the others, tarsus two-jointed, nail prominent. Eighth thoracic limbs much reduced in size, shorter than the exopod and slender. Telson a very short broad triangular plate, not covering the statocyst, unarmed. Uropods short, robust, subequal, without spines, statocyst large. First, second, third and fifth pleopods of the male small unjointed plates, fourth pleopod of the male consisting of a basal joint from which the exopod and endopod are imperfectly separated, a small one-jointed endopod and a large exopod, apparently consisting of a single joint terminated by a single long stout seta, as long as the joint and imperfectly annulose at the tip, the whole appendage reaching to the tip of the uropods.

Type:—*Idomysis inermis*, sp. nov.

*Remarks*.—This curious genus is quite unlike any other Mysid known to me. Its robust gibbous body and the set of the telson and uropods remind one of *Mysidopsis gibbosa*, superficially, but it is widely removed from that species in structure. It belongs to the tribe Mysini and apparently to Zimmer's group III B. It is abundantly characterized by the very short and broad antennal scale and by the short unarmed telson.

#### *Idomysis inermis*, sp. nov.

Text-figs. 23a-f, 24a-g.

*Locality*.—Kilakarai, Gulf of Manaar, among weeds, 0-2 fathoms, February, 1913. One adult male, 4 mm. (Type.)

*Description*.—Body robust, gibbous, abdomen flexed between the third and fourth somites; carapace leaving the last thoracic somite exposed, produced in front into a prominent triangular frontal plate with a broadly rounded apex which reaches forward to the distal end of the first joint of the antennular peduncle.

Eyes very large, cornea much broader than the stalk, pigment golden brown.

Antennal scale barely outreaching the short antennular peduncle, very short and broad, one and a half times as long as broad, outer margin without setae and without a prominent distal spine, terminal lobe broader than long, without a suture, no spine on the outer distal corner of the joint from which the scale springs, peduncle of the antenna shorter than the scale and composed of three short broad subequal joints.

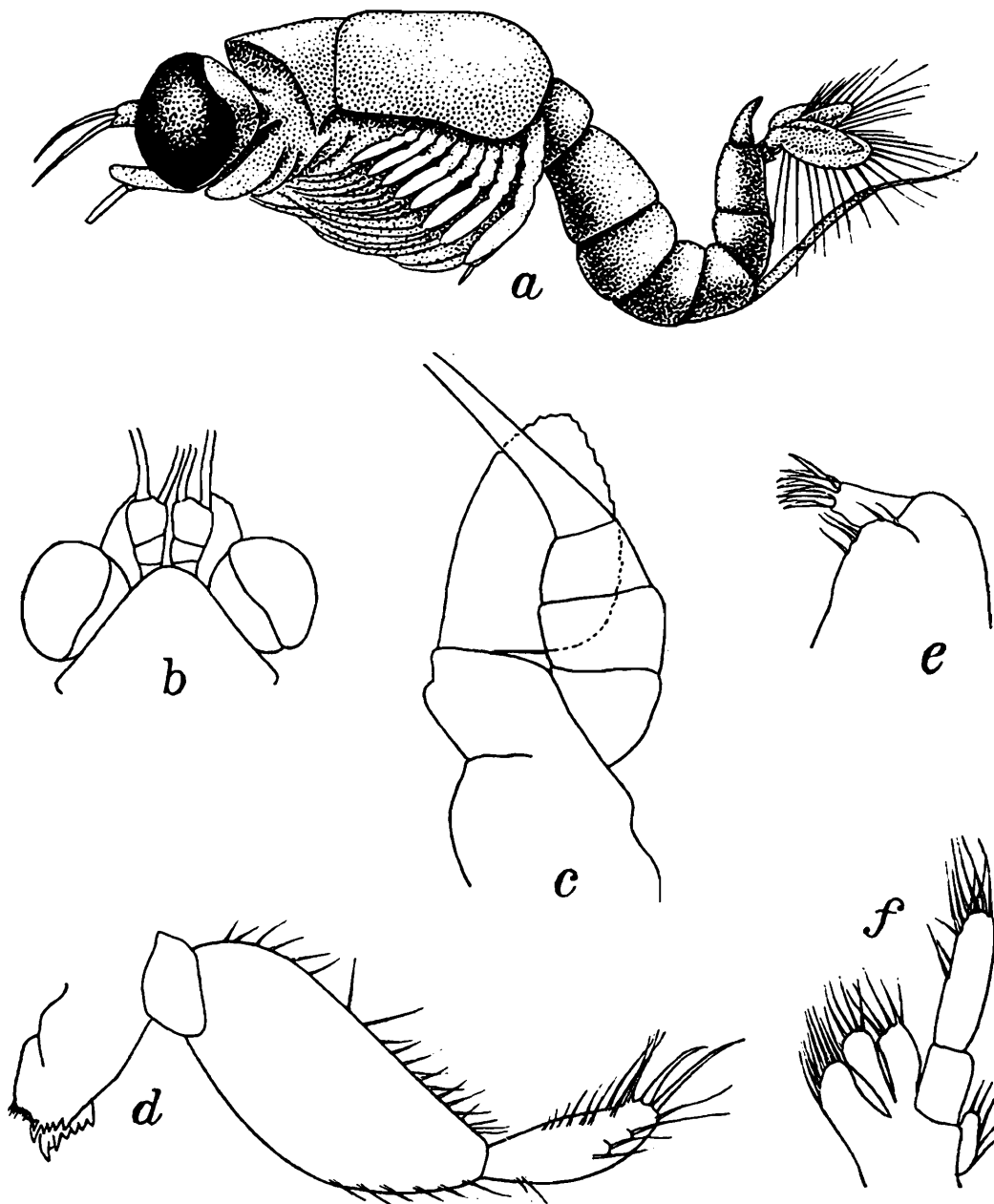
Mandible with a well-developed cutting edge and molar process, second joint of the palp broad. First maxilla with the inner plate reduced in size and tipped by four or five feeble setae.

Second maxilla with the outer plate very much reduced in size and feebly armed with five small setae, second joint of the palp linear, not expanded at the apex.

First thoracic limb (first gnathopod) with a masticatory lobe, tipped by two or three setae, on the second joint, no lobes on the third and fourth; nail not more prominent than the other setae arming the distal joint.

Third, fourth, sixth and seventh thoracic limbs of similar structure, tarsus unjointed, equal in length to the merus and to the ischium, nail only distinguishable from the other setae by its swollen base.

Fifth thoracic limb longer than any of the others, merus at



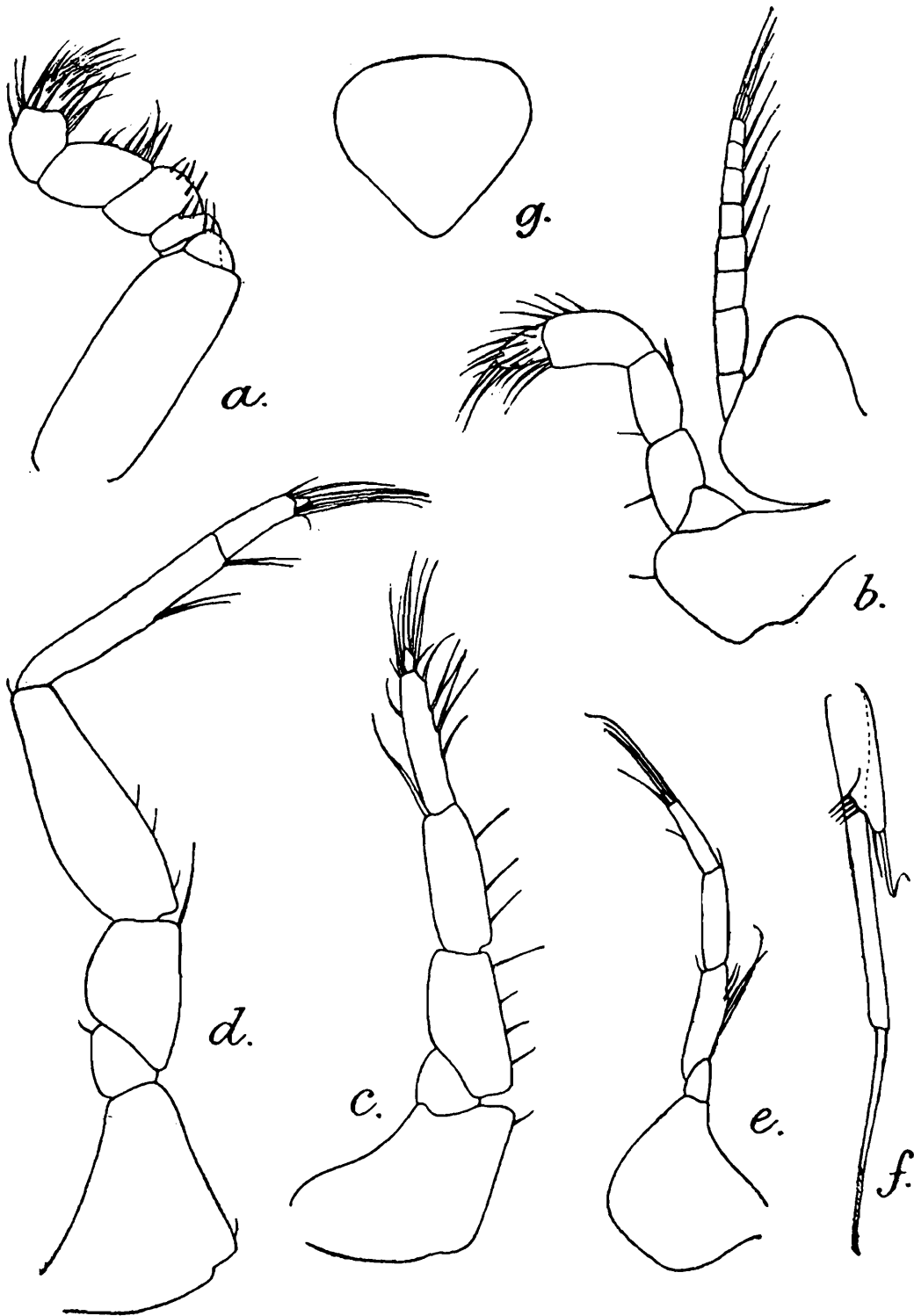
TEXT-FIG. 23.—*Idiomysis inermis*, gen. et sp. nov.

*a*, lateral view of adult male,  $\times 21$ ; *b*, dorsal view of anterior end,  $\times 22$ ; *c*, antennal scale,  $\times 65$ ; *d*, mandible,  $\times 100$ ; *e*, first maxilla,  $\times 100$ ; *f*, second maxilla,  $\times 100$ .

least twice as long as the preceding joint, tarsus about one-third longer than the merus but much narrower, two-jointed, the second joint one-third of the length of the first, nail with a swollen base.

Eighth thoracic limb much reduced in size, endopod possessing the full number of joints, shorter than the exopod, joints narrow and feebly armed. Exopods of all the thoracic limbs with

the outer distal corner of the basal joint rounded, flagellum with about ten joints.



TEXT-FIG. 24.—*Idiomysis inermis*, gen. et sp. nov.

*a*, endopod of first thoracic limb,  $\times 65$ ; *b*, second thoracic limb,  $\times 65$ ; *c*, endopod of third thoracic limb,  $\times 65$ ; *d*, endopod of fifth thoracic limb,  $\times 65$ ; *e*, endopod of eighth thoracic limb,  $\times 65$ ; *f*, fourth pleopod of male,  $\times 65$ ; *g*, telson,  $\times 65$ .

Telson very short, much shorter than the last abdominal somite and barely extending to and not covering the statocyst; a

broad triangular plate, rather broader than long, apex bluntly rounded and entire; telson quite unarmed.

Inner and outer uropods short broad plates, equal in size, furnished with long setae on both margins, inner uropod without spines on its lower margin, statocyst large.

First, second, third and fifth pleopods of the male simple small unjointed plates, fourth pair with the endopod of normal shape, consisting of a small unjointed plate with terminal setae and a well marked side lobe, imperfectly marked off from the basal joint, exopod consisting of a single long linear joint terminated by a single stout seta, annulose at its tip, the whole exopod extending to the tip of the uropods or slightly beyond. Length of the only specimen, an adult male, 4 mm.

*Remarks.*—This species shows no very great affinities with any described form. The form of the pleopods of the male clearly shows its place in the tribe Mysini, but the shape of the antennal scale and the very short unarmed telson are quite unlike any member of that tribe. I hope that female specimens will be forthcoming some day so that the sexual differences may be described. It is the most interesting and distinctive species in this collection.

### Genus *Lycomysis* Hansen.

#### *Lycomysis spinicauda* Hansen.

Text-figs. 25a-c.

*Lycomysis spinicauda*, Hansen, 1910, p. 77, pl. xi, figs. 3a-f, pl. xii, figs. 2a-h.

„ „ Colosi, 1916, p. 194, text-figs. 1a-d.

„ „ Colosi, 1918, p. 10.

„ „ Colosi, 1920, p. 251, pl. xx., figs. 10a-g.

„ *pusilla*, Zimmer, 1915, p. 175, figs. 30-37.

*Locality*—Port Blair, Andaman Isles.

St. 19. One male, 4.5 mm.

*Remarks.*—I have no doubt as to the identity of this specimen with the species described by Zimmer. The agreement is, in all points, complete. But I am somewhat puzzled as to the relation of *L. pusilla* to *L. spinicauda* and, after due consideration, I have reached the conclusion that the two species are identical, the supposed differences being due to a difference of interpretation of the structure of the male pleopods, the only character separating the two forms.

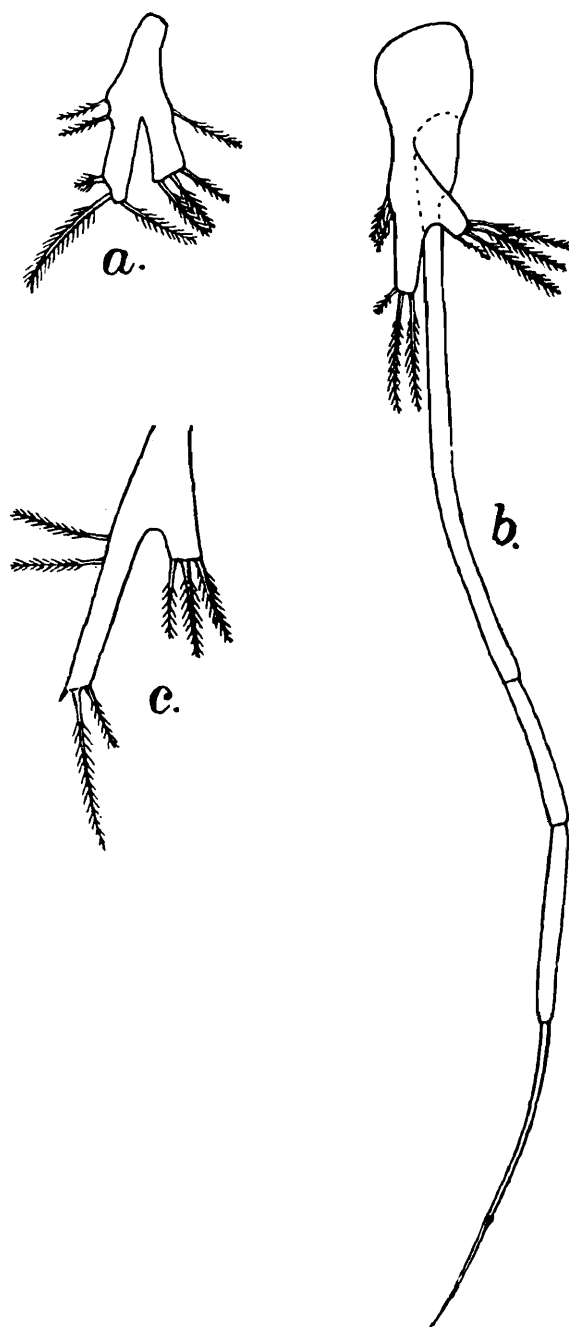
Hansen (1910) describing *L. spinicauda* from an immature male says (p. 76), "Pleopods in the male immature specimens small, biramous, with the exopod [endopod] increasing in length backwards, being on the anterior pairs shorter, on the fourth pair somewhat longer, than the exopod, on the fifth pair twice as long as the exopod, but very far from developed" and later (p. 77) "unfortunately the male pleopods are so imperfectly developed in my specimens, that they cannot afford any real help for deciding the systematic position of *Lycomysis*, yet it may be stated that they

show that it cannot be referred to the Mysini, and that the exopod [endopod] of the fifth pair being twice as long as the endopod [exopod] is somewhat anomalous." There is something inconsistent in both these statements and Hansen appears to have got his terms exopod and endopod mixed. I have given in square brackets the term which I think the author intended. At any rate, my interpretation is supported by Hansen himself earlier in the same paper (p. 13) where, when emphasising the supposed anomalous condition of the male pleopods, he states that *Lycomysis* differs from all hitherto known genera "in having the endopod of the posterior pairs of pleopods longer than the exopod and the endopod of the fifth pair longer than that of the fourth."

From these quotations it is clear, I think, that Hansen regarded the pleopods of the male of *Lycomysis* as biramous, and that, in consequence, it could not be referred to the tribe Mysini.

Colosi (1916) gives a new diagnosis of *L. spinicauda* based on a male specimen from the China Sea. He describes the pleopods of the male in the genus as follows "Primo, secondo, terzo e quinto pajo con endopodite ed esopodite rudimentali;

quarto pajo con peduncolo piu lungo che largo, endopodite rudimentale ed esopodite lunghissimo composto di tre articoli, di cui il primo piu lungo degli altri, e terminato da due filamenti (spiniformi?)." In the diagnosis of the species Colosi gives slightly fuller details especially of the fourth pair of pleopods, from an adult male, which have the exopod greatly elongated, three-jointed, the third joint bearing two terminal filaments. Colosi figures the fourth pair of



TEXT-FIG. 25.—*Lycomysis spinicauda*, Hansen.

*a*, third pleopod of male,  $\times 100$ ; *b*, fourth pleopod of male,  $\times 100$ ; *c*, fifth pleopod of male,  $\times 100$ .

pleopods but none of the others. His description, however, agrees with that of Hansen, in stating that the first, second, third and fifth pairs of pleopods in the male are *biramous* with exopodite and endopodite. In spite of this anomalous form of the pleopods, Colosi places *Lycomysis spinicauda* in the tribe Mysini of the subfamily Mysinae. But if the descriptions of Hansen and Colosi are correct this position for the species cannot be maintained, for in the Mysini at least the first and second and in most cases the fifth pair of pleopods of the male are simple unjointed plates as in the females of Mysidae generally, without any definite indication of a separate endopod and exopod.

In the meantime Zimmer (1915 (3)) described a second species of *Lycomysis*, *L. pusilla*. It is evident that Zimmer was puzzled by Hansen's description of the pleopods in his species for Zimmer's new species is founded entirely on the characters of the pleopods of the male, the author stating that in all other characters his species was identical with *L. spinicauda*. Zimmer (1915 (3), p. 175) describes the pleopods of the male in *L. pusilla* as follows:—"Die paare 1, 2, 3 und 5 rudimentär, während 4 einene eingliedrigeren Innen- und stark verlängerten Aussenast besitzt" and later (p. 177) he states that the pleopods 1, 2, 3 and 5 of the male are as in the female. He gives a figure of the first pleopod of the female which shows this appendage as a simple unjointed plate, somewhat bilobed at the apex, each of the lobes bearing setae. His description of the pleopods of the female states that in the first three pairs the two lobes are more or less equal in size, but in the last two pairs the inner lobe is much longer than the outer. The fourth pair of pleopods of the male have an endopodite which corresponds with the female pleopod in shape and a very elongate exopod of three joints terminated by a single long plumose seta.

Zimmer's species is clearly referable to the Tribe Mysini and the present specimen agrees absolutely with his description and figures in the matter of the pleopods of the male.

Colosi (1920) gives some further notes on *L. spinicauda*, Hansen, and compares it with *L. pusilla*, Zimmer. His description of the pleopods of the male of *L. spinicauda* is substantially as in his previous paper and he points out that the two species are distinguished not only by the pleopods but by the characters of the mandibular palp, the terminal joint of which is longer and narrower in *L. pusilla* than in *L. spinicauda* and the teeth on the margin of the second joint less well marked in the former than in the latter. I regard these latter differences between the two species as of no moment and due mainly to the fact that Zimmer's figure is taken from a somewhat more oblique point of view than Colosi's.

But the differences in the pleopods of the male are more puzzling. It is almost inconceivable that two species so essentially alike in all other details that female specimens could not be distinguished one from another, should differ so profoundly in the structure of the male pleopods that adult males should require to

be placed in separate subfamilies at least. I can only suppose that Hansen and Colosi are in error in describing the first, second, third and fifth pleopods in the males of *L. spinicauda* as biramous, with endopodite and exopodite defined. I give herewith a figure of the third, fourth and fifth pleopods of my specimen. The outer lobe (seitenlobus) is remarkably well developed in all the pleopods and in the first three is as long as the inner lobe (hauptteile). Zimmer makes the same observation. In the fourth and fifth pair the inner lobe is much the longer, in the fifth pair longer than in the fourth. At first sight the appendages look biramous and it is only when dissected and examined under the high power of the microscope that they are found to be simple unjointed plates of the type usual in the females of Mysidae except that the outer (side lobe) is unusually well developed. If we suppose the words endopod and exopod in Hansen's statements to be replaced by inner lobe and outer lobe, Hansen's description of *L. spinicauda* applies equally well to *L. pusilla*. In fact, if my suggestion is correct the two species should be united under the name *spinicauda* and it is in this light that I have regarded them here.

*Distribution*:— *L. pusilla* was recorded by Zimmer from a collection made during a voyage from Ceylon to New Guinea. *L. spinicauda* is known from the waters of the East Indian Archipelago (Hansen) and the China Sea (Colosi). The distribution of the two forms is therefore not inconsistent with their suggested specific identity.

#### Tribe HETEROMYSINI.

#### Genus *Heteromysis*, S. I. Smith.

Syn. *Chiromysis* G. O. Sars.

*Gnathomysis* Bonnier and Pérez.

Through the kindness of Professor C. Pérez, I have been permitted to see a series of unpublished drawings made by the late Dr. Jules Bonnier to illustrate the general form and the structure of the appendages of *Gnathomysis gerlachei* (Bonnier and Pérez, *C. R. Acad. Sci. Paris*, T. 134, p. 117-119, 1902), a preliminary description only of which, without figures, has so far appeared. I have not been able to examine the specimens from which the drawings were made but there is no doubt in my mind, after studying the drawings sent to me by Professor Pérez, that *Gnathomysis gerlachei* is identical with *Chiromysis harpax* Hilgendorf. The genus *Gnathomysis* is therefore a synonym of *Chiromysis* G. O. Sars, which in turn must give way to the earlier *Heteromysis* S. I. Smith.

*Heteromysis harpax* was described by Hilgendorf in 1879 in very summary fashion. Kossmann (1880) redescribed the species from examples collected in the Red Sea and figured the appendages in some detail. It is difficult to be sure that Kossmann des-

cribed and figured the same species as Hilgendorf, but the form of the third thoracic limb, more especially of its armature and the gap in the series of spines arming the inner margin of the carpus, which is indicated in Hilgendorf's figures and clearly shown by Kossmann, renders it at least probable that both authors were dealing with the same species. The unpublished drawings of Bonnier agree in the greatest detail with Kossmann's figures. The agreement is complete in the figures of the third thoracic limb, even to the peculiar form of the ischium and to the arrangement, number and forms of the spines arming the inner margin of the carpus. In only one respect do Bonnier's and Kossmann's figures differ, namely, in the armature of the telson. Kossmann gives no details in his description and his figure indicates that the lateral margins of the telson are armed distally with five spines, that each apical lobe of the telson bears one long spine and that each side of the cleft bears five spinules. Bonnier's figure shows that the lateral margins of the telson are armed distally with eleven spines, that each lobe of the telson bears two spines, the outer of which is stouter and twice as long as the inner, and that each margin of the cleft is armed with ten spinules.

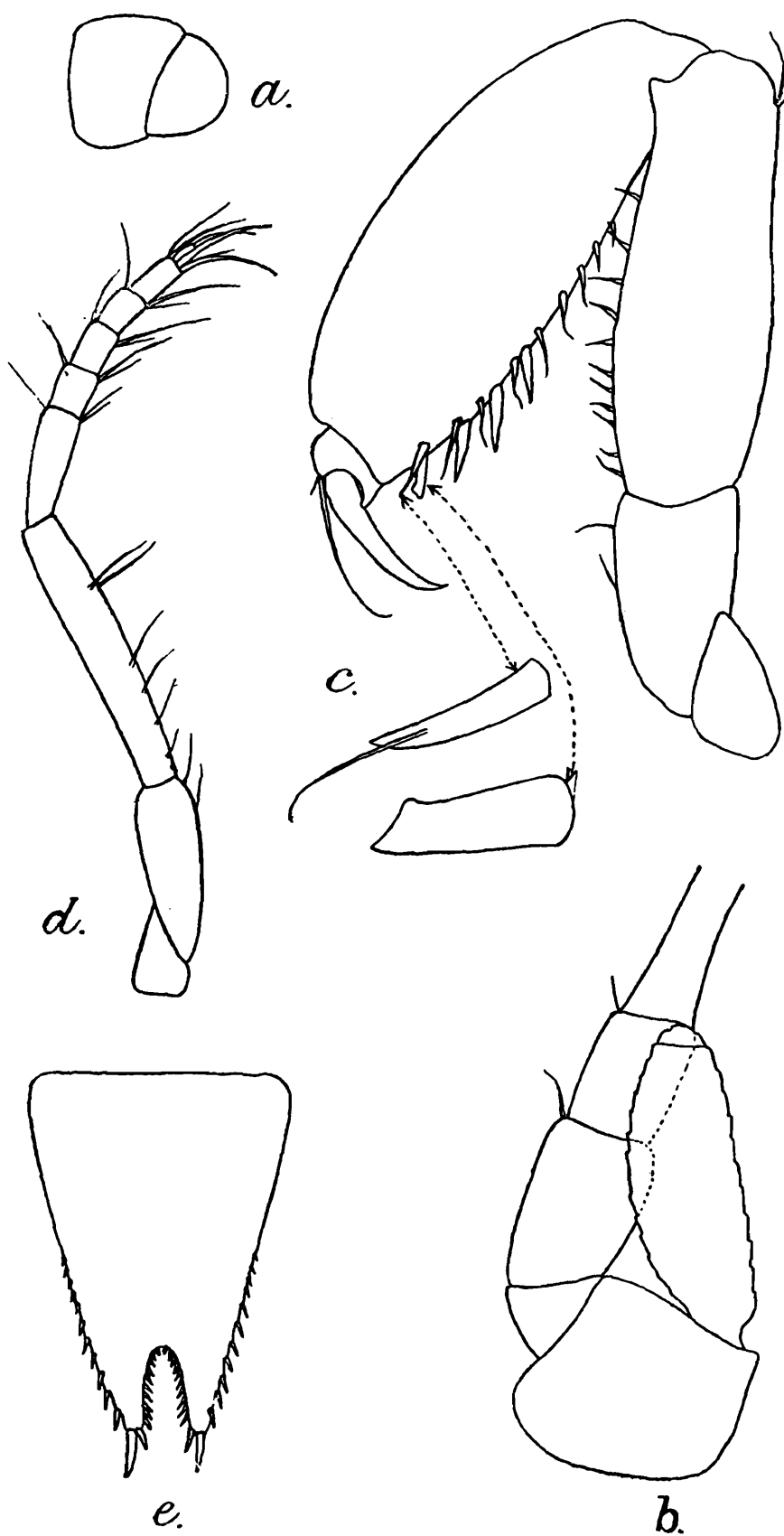
I conclude therefore, that *Gnathomysis gerlachei* Bonnier and Pérez must be considered undoubtedly as a synonym of *Heteromysis harpax* Kossmann, which is almost certainly the same as *H. harpax* Hilgendorf.

### *Heteromysis proxima*, sp. nov.

Text-figs. 26a-e.

*Locality*:—From pools on exposed reef at Pamban, Gulf of Manaar. One male and one female, 6-7 mm. (Types.)

*Description*:—Eye small, longer than wide, without finger-like process, cornea occupying less than half of the eye in dorsal view and narrower than the rest of the eye. Antennal scale equal in length to the antennal peduncle and shorter than the antennular peduncle, three times as long as broad, setose all round, terminal joint present. Third thoracic limb with the endopod massive and stoutly built, ischium with the inner distal corner not produced into an acute process, merus three times as long as broad with a prominent blunt process at the distal end of the inner margin, carpus stouter and longer than the merus, about two and a half times as long as broad, inner margin armed with spines of three kinds (1) stout simple spines, three or four in number on the distal part of the margin, (2) stout spines with a truncate apex, one or two in number at the distal end, and (3) slender spines bearing a single seta inserted some way from the tip, extending all along the margin in two double rows of eight or nine spines, between which the other spines are situated; penultimate joint small with an acute process at the distal end of the inner margin; nail long and strongly curved, one-third of

TEXT-FIG. 26.—*Heteromysis proxima*, sp. nov.

*a*, eye,  $\times 50$ ; *b*, antennal scale,  $\times 65$ ; *c*, endopod of third thoracic limb of male,  $\times 65$ ; *d*, endopod of fourth thoracic limb,  $\times 65$ ; *e*, telson,  $\times 65$ .

the length of the carpus. Tarsus of the remaining thoracic limbs five-jointed, at least equal to the merus which is one and a half times as long as the ischium; nail small and setiform. Telson slightly longer than the last abdominal somite, not quite one and a half times as long as broad at the base, cleft for one quarter of its length, the cleft armed on each side by ten coarse teeth, apex about one quarter of the breadth at the base, each lobe at the apex armed with an inner small spine and an outer larger and stouter spine which is twice as long as the small spine and about one-eighth of the length of the telson, lateral margins straight, distal half armed with 10-12 spines, proximal half of the margins smooth, without spines.

Inner uropod slightly longer than the telson plus the terminal spine at the apex, a single spine on the lower inner margin near the statocyst.

Outer uropod about one quarter as long again as the telson.

*Remarks*:—Of the three Indian species of *Heteromysis* here recorded, this species approaches most closely to *H. harpax* (Hilgendorf). I was inclined at first to regard my specimens as belonging to Hilgendorf's species, but after an examination of the unpublished drawings of Bonnier, illustrating the structure of *Gnathomysis gerlachei* which I regard as identical with *H. harpax*, I have decided that the Ceylon specimens represent a distinct species differing mainly in the form and armature of the third thoracic limbs.

In *H. harpax* as figured by Kossmann and also by Bonnier among his unpublished drawings, the ischium of the third thoracic limbs has the inner distal corner produced and acute and the distal margin minutely toothed or serrate. The carpus is armed on its inner margin with a group of four spines distally and two spines proximally, with a distinct gap, unarmed, between the two sets of spines. The distal spines are truncate at the apex and microscopically toothed. The proximal spines are bluntly pointed and bear two or three small blunt teeth. The inner distal angle of the propodus is bluntly produced.

In *H. proxima* the ischium of the third thoracic limbs is not produced at its inner distal angle and the distal margin is not serrate. The carpus has the inner margin armed with two rows of eight or nine peculiar spines with a seta inserted near the tip, extending in a continuous line, without gap, along the greater part of the margin. Between these two rows of peculiar spines, on the distal part of the margin, are three or four stouter, blunter spines and at the extreme distal angle one or two stout spines with a truncate apex. The inner angle of the propodus is more acutely produced than in *H. harpax*.

The close agreement between Kossmann's and Bonnier's drawings of the third thoracic limbs of the specimens they examined is strong evidence of the identity of these specimens and also of the probability that the Indian specimens represent a distinct species. The differences I have noted are not sexual,

since both Kossmann's and Bonnier's figures were drawn from an adult male and my own figure is likewise drawn from an appendage belonging to that sex.

In other respects *H. proxima* agrees closely with *H. harpax* and with *H. micros* from the Mediterranean. All three agree in having small eyes with processes, in having only one spine on the inner uropods, in having only the distal half of the margins of the telson armed with spines and in the number of joints in the tarsus of the thoracic limbs. The form and armature of the third thoracic limbs is, however, quite distinct in all three.

### *Heteromysis zeylanica*, sp. nov.

Text-figs. 27a-e.

*Locality*.—From pools on exposed reef at Pamban, Gulf of Manaar. One male, 5 mm.

Kilakarai, Gulf of Manaar, from weeds, 1-2 fathoms. One male, 5 mm., two immature. (Types.)

*Description*.—Eye small, longer than broad, a short pointed process on the upper distal border overhanging the cornea, latter occupying less than one half of the eye in dorsal view and narrower than the rest of the eyes.

Antennal scale slightly shorter than the antennal peduncle and considerably shorter than the antennular peduncle, three and a half times as long as broad, setose all round, terminal joint present.

Third thoracic limb with the endopod moderately stout, merus three times as long as broad without process at the distal end of the inner margin, carpus robust, shorter than the merus, twice as long as broad, inner margin armed with four or five spines each with an inserted seta, penultimate joint small without process, nail strongly curved about half as long as the carpus.

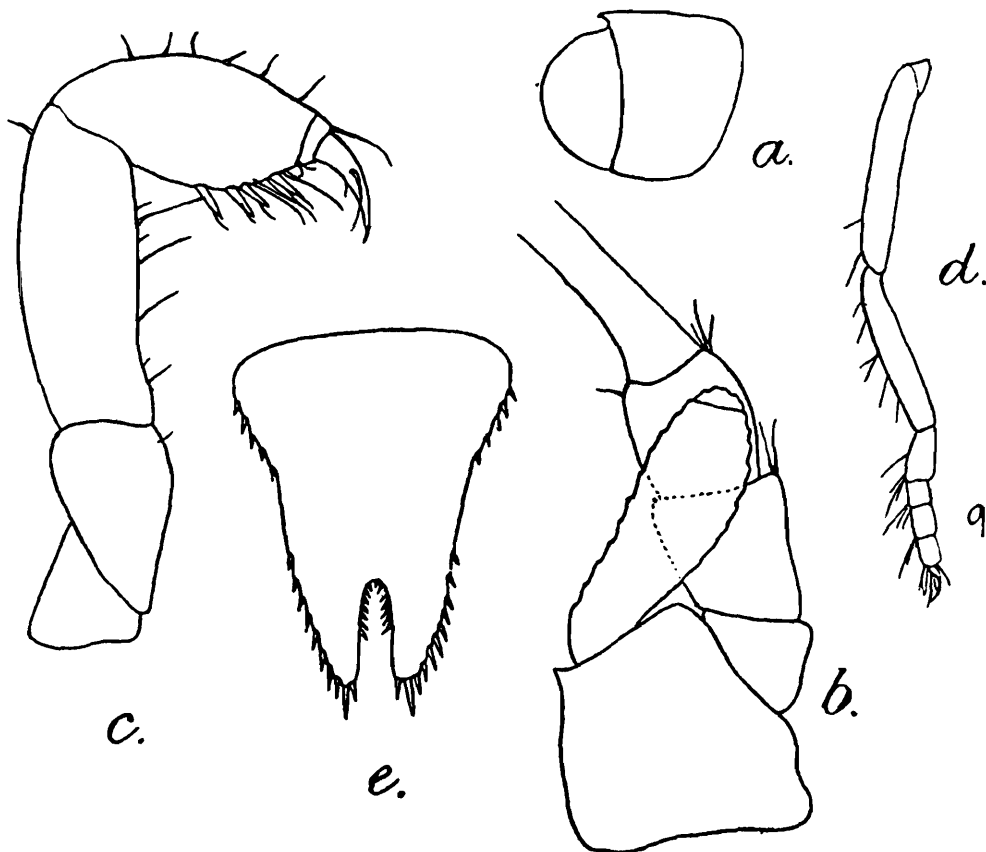
Remaining thoracic limbs having the endopods moderately stout with the tarsus four-jointed, merus equal to the ischium and longer than the tarsus, nail setiform and curved. Telson about as long as the last somite of the abdomen, one and a quarter times as long as broad at the base, cleft for rather more than one quarter of its length, the proximal half of each margin of the cleft armed with seven teeth, distal half of each margin of the cleft smooth, apex rather less than one quarter of the breadth of the telson at its base, each lobe of the apex furnished with two spines, the inner about half as long as the outer which is about one seventh of the length of the telson, lateral margins lightly concave the proximal portion with five spines at the widest part, the central portion smooth, the distal portion with about eight or nine spines arranged at more or less regular intervals, the interval between the last marginal spine and the large apical spine not greater than that between the other distal marginal spines.

Inner uropods about one quarter as long again as the telson

plus the terminal spines, inner lower margin armed with about eleven stout spines from the statocyst to just short of the apex, the spines increasing in size distally.

Outer uropod about half as long again as the telson.

*Remarks.*—This species belongs to that group of species characterised by the presence of a distinct process on the eye.



TEXT-FIG. 27.—*Heteromysis zeylanica*, sp. nov.

a, eye,  $\times 50$ ; b, antennal scale,  $\times 65$ ; c, endopod of third thoracic limb,  $\times 65$ ; d, endopod of fourth thoracic limb,  $\times 65$ ; e, telson,  $\times 65$ .

*H. odontops* Walker is the type of this group. It is distinguished from *H. harpax* by this character, by the telson having spines on the proximal wide part of its margins, by the details of the armature of the cleft and by the row of stout spines on the inner margin of the inner uropod, as well as by the less robust form of the third thoracic limb.

### *Heteromysis gymnura*, sp. nov.

Text-figs. 28a-e.

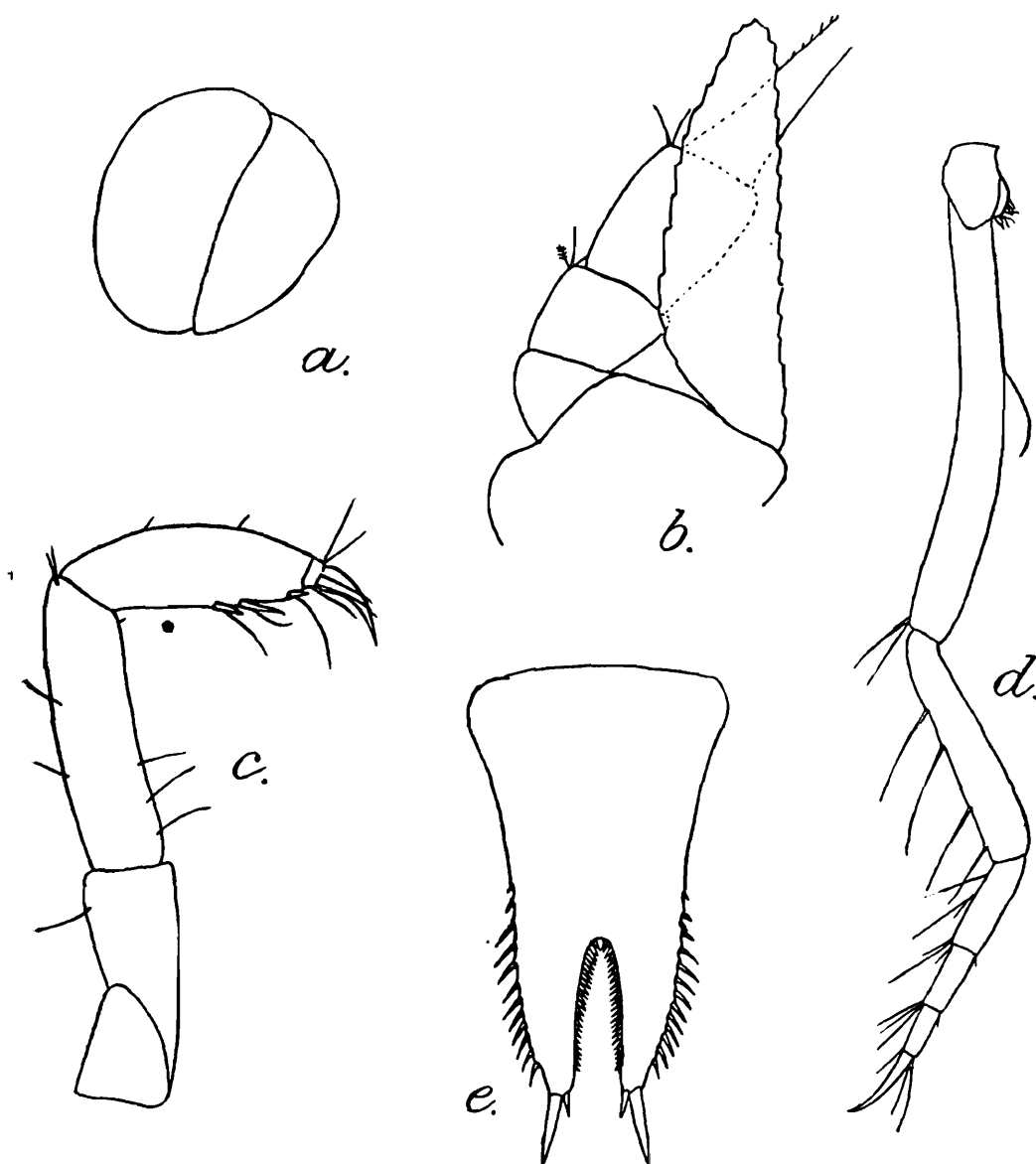
*Locality.*—Kilakarai, Gulf of Manaar, among weeds, 1-2 fathoms. Five males and two females, 4-6 mm. (Types.)

*Description.*—Eye large, at least as wide as long in dorsal view, no finger-like process, cornea occupying more than half the eye in dorsal view and wider than the rest of the eye.

Antennal scale longer than the antennal peduncle and equal in length to the antennular peduncle, three and a half times as long as broad, no terminal joint.

Third thoracic limb less robustly built than in the other two species, merus nearly four times as long as broad without distal process, carpus shorter than the merus, three times as long as broad, the inner margin armed distally with three rather stout simple spines, penultimate joint short without inner process, nail strongly curved, about one third of the length of the carpus.

Remaining thoracic limbs slender with the tarsus composed



TEXT-FIG. 28.—*Heteromysis gymnura*, sp. nov.

*a*, eye,  $\times 50$ ; *b*, antennal scale,  $\times 65$ ; *c*, endopod of third thoracic limb,  $\times 65$ ; *d*, endopod of fourth thoracic limb,  $\times 65$ ; *e*, telson,  $\times 65$ .

of three joints terminated by a distinct nail, merus almost equal to the tarsus and nail together, ischium one and a half times as long as the merus.

Telson slightly longer than the last abdominal somite, one and three quarter times as long as broad at the base, cleft for more than one third of its length, the margins of the cleft armed throughout with about 25 closely set teeth, apex one quarter of the base of

the telson in width, each lobe armed with two spines, the outer three times as long as the inner and equal to one sixth of the telson in length, lateral margins lightly concave, proximal portion smooth, distal portion armed with 12-15 spines increasing in length distally. the interval between the last marginal spine and the larger spine on the apical lobe greater than the interval between any other pair of marginal spines.

Inner uropod equal in length to the telson plus the long terminal spine, without any spines on its lower inner margin.

Outer uropod one-third as long again as the telson.

*Remarks.*—This species is much less specialized than the other two. The eyes are much larger, the antennal scale proportionately longer and the third thoracic limb much less robustly built. The posterior thoracic limbs are noteworthy for their slender build, for the great length of the ischium and for the distinct nail and few joints in the tarsus. The inner uropods are without spines, a character which marks this species as distinct from all other described species of the genus.

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## PARALLEL EVOLUTION IN THE FISH AND TADPOLES OF MOUNTAIN TORRENTS.

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The structural modifications of the fish and of the Batrachian larvae that inhabit the small mountain torrents of the Oriental Region afford a remarkable instance of parallel evolution on a comprehensive scale. The phenomena they exhibit may indeed, be called communal convergence. One of us<sup>1</sup> has quite recently discussed these modifications in the fish, while the other<sup>2</sup> has from time to time published observations on the external features of the tadpoles. We propose in the present paper to give a short general survey of the facts and to discuss a specific instance in anatomical detail.

Speaking generally, modifications in the tadpoles of mountain torrents chiefly consist either in the formation of floats for floating away lightly on the surface of the flood, as in some species of *Megalophrys*, or in that of "suckers" for clinging to fixed objects.

These structures in the tadpoles seem to have been evolved independently of any high degree of specialization in the adult frog or toad,<sup>3</sup> just as the larva of an insect may be highly modified in correlation with a peculiar mode of life, while the adult remains of an unspecialized type. Identical structural resemblances in the tadpoles mean that a true genetic affinity exists, but similar structures are frequently evolved independently for the same function but along different lines, for example the oral float on the mouth of the larvae of certain species of *Megalophrys*<sup>4</sup> and that on the mouth of *Microhyla achatina*,<sup>5</sup> or the powerful oral sucker of the tadpole of *Helophryne natalensis*<sup>6</sup> and that of *Bufo penangensis*.<sup>7</sup> In the floats of the two former tadpoles there is a general similarity in form and function, but in the *Megalophrys* the internal surface of the float bears rows of peculiar horny tooth-like processes and these are replaced

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<sup>1</sup> Hora, *Rec. Ind. Mus.* XXIV, pp. 31-36 (1922).

<sup>2</sup> Annandale, *Rec. Ind. Mus.* VIII, p. 29 (1912); *ibid.* XV p. 17 (1918); *Proc. As. Soc. Bengal* (n. s.) XIII, p. clxxxvi (1917).

<sup>3</sup> Boulenger, *Rec. Ind. Mus.* XV, p. 65 (1918).

<sup>4</sup> Hora, *Fourn. As. Soc. Bengal* (1922).

<sup>5</sup> Smith, *Fourn. Nat. Hist. Soc. Siam* II, p. 37, figs. A<sub>1</sub>-A<sub>4</sub> (1916).

<sup>6</sup> Hewitt, *Ann. Natal Mus.* II, p. 477, pl. xxxix, figs. 5, 6, 7 (1913).

<sup>7</sup> Flower, *Proc. Zool. Soc. London*, p. 908, pl. lx, figs. 3, 3a (1899).

in the *Microhyla* by soft ridges. Moreover, it is much more evident in the latter tadpole than in the former that the whole float is formed by a hypertrophy of the lower lip. Similarly in the *Helophryne* and the *Bufo* there is a structural difference, only to be observed on close examination. The sucker of the *Bufo* is formed (much in the same general way as the float of *M. achatina* but correlated with an entirely different function) by a hypertrophy of the lower lip, while in the *Helophryne* both lips are equally developed.

In this respect the *Helophryne* closely resembles an unidentified larva discussed by one<sup>1</sup> of us from the Malabar Zone of Peninsular India. Indeed the structural analogy is so close that it does not seem too much to claim that there is also a homology, in other words that a genetic affinity exists.<sup>2</sup> We can claim genetic affinity only between those tadpoles in which similar structures are present with a similar function and produced by the same modifications of structures or organs common to widely different forms, but when these conditions occur to such a degree as to produce morphological identity it is not extravagant to do so.

Suckers may be produced by the evolution of a new organ, as in the species of *Rana* described later, or by hypertrophy of the lips, as in the tadpoles of the *Helophryne* and the *Bufo* discussed above. In the latter instance many different stages in the evolution of the perfect structure are known.<sup>3</sup> But in species like *Rana afghana* the peculiar structure seems, so far as our present knowledge goes, to have arisen strictly *de novo*. That it has really done so is of course improbable, but the earlier stages have not been discovered and have perhaps been eliminated. There is no evidence for any homology between the adhesive apparatus and that found on the ventral surface of all very young Batrachian larvae.<sup>4</sup>

It has been observed by one of us both in the Khasi Hills and the Nilgiris that the tadpoles abundant in the large pools of hill-streams, at spots at which the current is not rapid, belong to quite a different type from any we have mentioned, being very large and stout, with powerful tails, comparatively small mouths, no marked structural peculiarities of an obviously adaptive nature and either a very conspicuous or a very dense pigmentation. Good examples of this type are the tadpoles of *Rana alticola*<sup>5</sup> in Assam and of *R. malabarica* in South India. The former has a conspicuous black ocellus on the tail and possesses parotid glands which produce an abundant secretion on irritation. The latter are of a

<sup>1</sup> Annandale, *Rec. Ind. Mus.* XV, p. 22, pl. 1, figs. 6, 6a (1918).

<sup>2</sup> No frog of the family Cystignathidae is known from the Oriental Region, but the Batrachia of the hills of the Malabar Zone are still imperfectly studied and the adult of this tadpole is a burrowing form and, therefore, liable to escape notice. The Ethiopian affinities of the fauna of the Malabar Zone are well recognised by Zoogeographers.

<sup>3</sup> Annandale, *Rec. Ind. Mus.* VIII, p. 19 (1912).

<sup>4</sup> Boulenger, *Rec. Ind. Mus.* XX, pp. 100, 168 (1920).

<sup>5</sup> Thiele, *Zeitsch. wiss. Zool.* XLVI, p. 75, pl. x, fig. 6 (1888).

dense and uniform black colour. Similar conditions are found as regards structure in the fishes of large pools of hill-streams, which are usually species with strong swimming-powers but not highly specialized, belonging to such genera as *Barbus* and *Barilius*.

The general analogy between the structure and form of these less specialized members of the fauna of hill-streams becomes in many instances particular as between fish and tadpoles when the more specialized members, living in more peculiar conditions, are critically examined. We know of no exact parallel between the oral floats of the larvae of *Megalophrys parva* and its allies and any similar structure in a mountain fish, but when we come to the production of adhesive organs many specific parallels occur. Between the enlarged lips and ventral mouth of several fish of the genera *Glyptothorax* and *Glyptosternum* and of tadpoles like those of *Bufo penangensis* there is a close analogy, and just as we find the oral suckers in different stages of evolution in different species of tadpoles, so also do we find them in different fish of the suborder Siluroidea. In the larvae, for example, of *Rana assamensis* and its close allies the lips, though ventral and enlarged, are not greatly enlarged and the organ produced is not conspicuous. Almost every stage between this condition and that of *Bufo penangensis* has been observed. Similarly in such species as *Glyptosternum andersoni* and *G. feae* the lips are comparatively small, while in other species of the same genus (e.g. *G. labiatum* and *G. blythi*) they are much more highly developed. In both groups the evolution can be correlated with life in waters of stronger and stronger current.

It is, however, in the ventral suckers of certain tadpoles of the section *Ranae Formosae*<sup>1</sup> of the subgenus *Hylorana* on the one hand and similar structures in fish of the genera *Garra* (or *Discognathus*) of the family Cyprinidae and *Glyptothorax* of the family Sisoridae on the other that the closest analogy is to be sought, especially, so far as the fish are concerned, in the former genus.

We have thought it worth while not only to give a brief general account of the convergence that occurs between these fish and tadpoles but also to consider the minute structure of the adhesive disc of such Ranid tadpoles as *Rana afghana* (Günther) [= *R. latopalmata*, Blgr.] and *R. livida* (Blyth) and to compare it in detail with that observed in the fishes of the genus *Garra*, in which the modifications are of a similar nature and occupy a similar position on the ventral surface just behind the mouth.

The disc of *Rana afghana*<sup>2</sup> is a well-marked structure; it is almost as broad as the body and a little more than half its length. The disc is provided with a free border except at the anterior end, where the border is replaced by the posterior lip. The comparatively thin central portion of the disc in preserved

<sup>1</sup> Boulenger, *Rec. Ind. Mus.* XX, pp. 123, 130 (1920).

<sup>2</sup> Annandale, *Rec. Ind. Mus.* VIII, pl. iv, fig. 3a.

specimens is as a rule depressed in the form of a saucer. Through the skin of this region are visible three large prominences, which on dissection are found to be the extremities of two muscles and a tendon. They represent (i) a strong tendon (*t*) attached internally to the middle of the disc: it proceeds upwards for a short distance and then divides into two portions, which are both attached to the vertebral column: and (ii) two pairs of muscles composed of striated fibres which have similar attachments at both ends but are quite distinct from the tendon. By keeping the free border closely in touch with a fixed object and then raising the central portion of the disc by contracting the muscles, the animal can convert the whole structure into an efficient organ of adhesion by creating a partial vacuum between it and the fixed object. The function of the elastic tendon is to counteract too strong contraction, which might tear the delicate surrounding tissues.

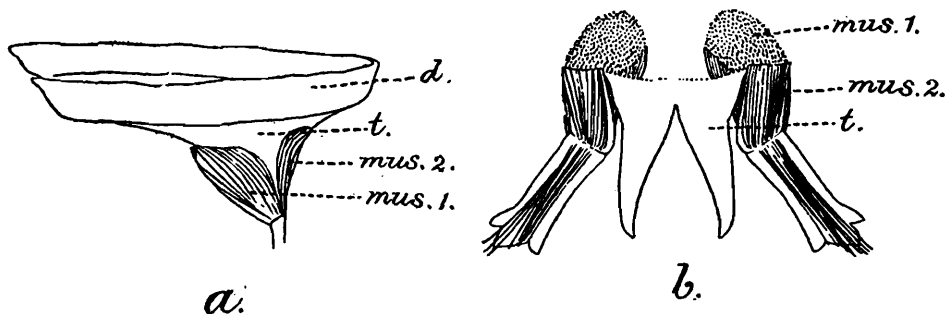


FIG. 1.—Disc and its musculature in *Rana afghana*.  
*a.* Slightly oblique lateral view of disc with its muscles and tendon.  
*b.* Anterior view of muscles and tendon after removal of disc.  
*d.* = disc; *t.* = tendon; *mus. 1.*, and *mus. 2.* = muscles of disc.  
 (cf. *Rec. Ind. Mus.* XXIV, p. 47, fig. 9b.)

The structure of the disc is precisely similar in the tadpole of *Rana livida* to that in *R. afghana*.

The mechanism of the disc is the same as that already described for the analogous structure in *Garra*<sup>1</sup>; except that in the fish the central portion of the disc is raised by the elevation of the urohyal, without direct muscular action in the disc itself, which is decidedly callous as a whole.

The free borders are quite smooth in the tadpoles, but in a section of the tissue under a high power (fig. 2) it is observed that the outer cells are produced into minute processes which are greatly flattened near the base and are somewhat pointed towards the end. These are covered by a chitinized cuticle. Each of the spine-like outgrowths (*s*) is provided with a nucleus at the base. The rest of the epidermis (*ep. d.*) consists of a large number of nuclei irregularly scattered in a homogenous mass of cytoplasm. Below the epidermis is a loose connective tissue in which nuclei are present at irregular intervals. This tissue (*c. t.*) is formed of a series of minute fibres, which in the outer region run parallel to the epidermis, while internally they

<sup>1</sup> Hora, *Rec. Ind. Mus.* XXIV, p. 47 (1922.)

run at right angles to it. In all essentials the structure described above is similar to that of the free borders of the disc of *Garra*. The spine-like outgrowths help to make the surface rough in such a way that better grip must be obtained.

The minute structure of the disc is thus much less complicated than that of the adult *Garra* or *Glyptothorax*.<sup>1</sup> The spine-like outgrowths on the organs of adhesion are strictly analogous in the fish and the tadpoles, but they occupy a different position and the structure of the underlying parts is completely different.

One of the most interesting features of these instances of parallel evolution lies in the fact that whereas in the larvae of the *Ranae Formosae* we only know, so to speak, the finished product of evolution in the highly perfected organ of adhesion, in the

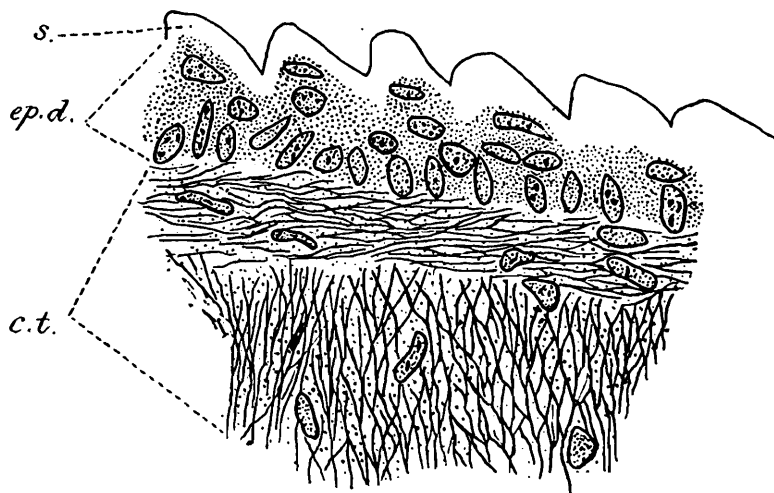


FIG. 2.—Transverse section through free border of disc of *Rana afghana*.  
(Highly magnified and slightly diagrammatic).

s.=spine; ep. d.=epidermis; c. t.=connective tissue.  
(cf. *Rec. Ind. Mus.* XXIV, p. 50, fig. 13.)

genus *Garra* we have before us almost every possible stage alike in postembryonic development, in individual variability and in specific differentiation. One<sup>2</sup> of us has so recently given the facts that it is unnecessary even to recapitulate them here. The evolution of the mental disc of *Garra* is in this respect parallel to that of oral suckers in various tadpoles of the Himalayan streams. We have thus evidence that these particular structures have come into existence, not through mutation and not by any Mendelian segregation of characters, but through a gradual accumulation of small changes. The close correlation, especially in *Garra*, between these changes and differences in the flow of water in which species and even individuals live is at any rate suggestive. Whether we are witnessing the survival of the fittest in the Darwinian sense or must accept a frankly Lamarckian explanation only experiment can prove.

<sup>1</sup> Cf. Hora, *op. cit.*, figs. 12, 13, p. 50; also figs. 15, 17, 18, 19 on pages 53, 55, 57.

<sup>2</sup> *Id.*, *ibid.*, XXII, pp. 639-643, text-fig. 1 (1921).



## SOME ORIENTAL ASCALAPHIDAE IN THE INDIAN MUSEUM.

By F. C. FRASER, *Major, I.M.S.*

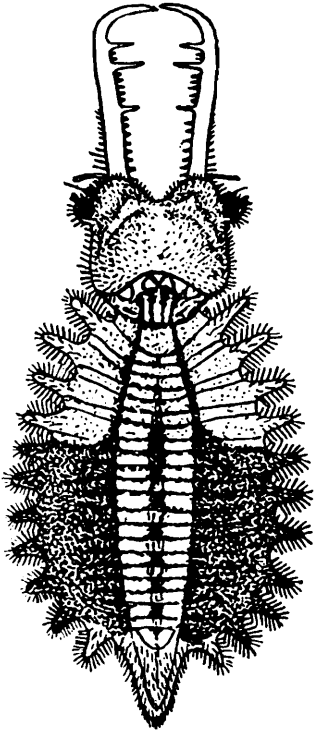
With one exception, the whole of the specimens dealt with in this paper are from within the limits of the Indian Empire. Four new species are dealt with, of which one is from Siam and the other three from purely Indian localities. The types of these will be preserved in the Indian Museum.

Individual species are difficult to determine from the wide variations met with in colouring both of body and wings. They pass through a teneral stage analogous to that met with in dragonflies and markings may be obscure, well-defined or entirely obliterated according to the age of individual specimens.

Very little is known of the life-histories of this family of insects so that the descriptions and illustrations of three new larvae will be of interest even though it is impossible to say with certainty to which species they belong. Dr. Tillyard writing to me three or four years ago described a method of obtaining the larvae which is best given in his own words: "There is a very simple trick not known to many, for the finding of these sorts of larvae and that is to go out into the dry bush (as we call it here), and study the large isolated trees, if you have them. I select a tree that is old and worn, with a good lean on it, and with loose rubbly soil around it (termite earth is very good). I then go down on my hands and knees, scoop the soil up in both hands, and let it run slowly through again, forming a mound slowly. Any larvae of Myrmeleontidae or Ascalaphidae hiding in the soil fall out, and can be seen at once, as they give a kick and begin to burrow again very quickly. I also examine bits of bark, etc., for the Ascalaphidae, which are usually more sluggish and like to hide under bark, debris, etc." Dr. Tillyard states that he has secured larvae of nearly every known local genus in this manner around Sydney. I have adopted his methods from time to time but have not met with any success. Situations such as he describes are very common in parts of the Deccan and Punjab, but I have not found them to yield fruit although I have copied his instructions to the letter. Dry seasons, he further states, promote the increase of these Neuropterous groups, whilst wet weather nearly wipes them out. This does not appear to be the case in India as I have found Ascalaphids more common in the wet than the dry seasons, although their occurrence is scattered pretty well throughout the whole of the year. The termination of the monsoon is probably the best time to take most species, so that the latter part of the rainy season is at least spent in the senior larval state.

## LARVAE.

1. A single specimen from Talewadi, near Castle Rock, N. Kanara District, Bombay Pres. (coll. S. W Kemp), almost certainly the larva of *Glyptobasis dentifera* which species was common in the same neighbourhood (Fig. 1.)



TEXT-FIG. 1.—Ascalaphid larva from Talewadi, Castle Rock, N. Kanara Dist.

Head quadrate, deeply fissured in front, coated with very short fine bristles and pigmented darkly save for a pale fascia which begins at the mid-line on a level with the eyes and runs out and backwards. Eyes deeply pigmented and furnished with a small chitinous horn-like process antero-laterally. Maxillae long and curved inward at a right angle near the tips. They are furnished with short spines of which three are much longer than the rest; of these latter, the two anterior are close together and the middle one longer than the two others.

Prothorax very short and rather hidden, with no definite tubercles on the outer side.

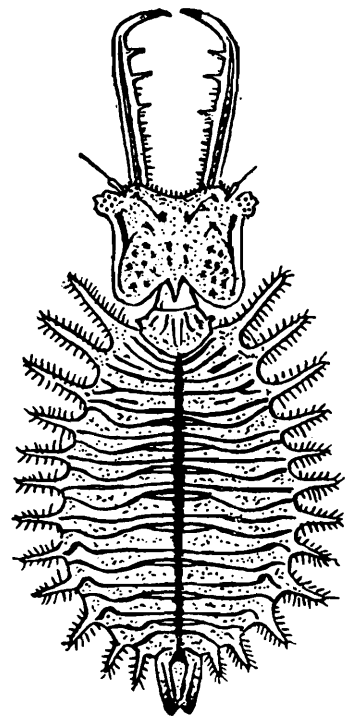
The remainder of the body-segment furnished laterally with twelve stout spines all of which are beset with short, stiff setae. This armature forms an impassable rampart around the insect which serves to protect it from the attacks of ants, and is closely analagous to that found in various larvae of *Euthalia*. The presence of these spines serves readily to distinguish the larvae from those of Myrmeleonidae which otherwise are closely similar in form and sometimes size.

Legs short and slim and entirely hidden beneath the body.

With the exception of the last segment, the final seven are deeply pigmented as far inward as the sub-dorsum, including the stout spines.

2. A single specimen from Janakhmukh, Abor country, 600 ft., 29 xii 1911 (coll. S. W Kemp). Species? (Fig. 2.)

Generally similar to the last in shape but differing as follows:—The maxillae are rather shorter and more robust and deeply pigmented. The



TEXT-FIG. 2.—Ascalaphid larva from Janakhmukh, Abor country.

three spines on their inner side are equal in size and separated by approximately equal intervals. The head is not coated densely with short bristles; it is spotted above with dark brown and bears a fine, lateral streak of the same colour. The frontal notch is very shallow and wide. Eyes without the small, horn-like process.

The prothorax is longer and more evident and has on each side a short, stout, blunt tubercle.

The lateral spines on the remainder of the body-segment are longer and more slim. The mid-dorsum is marked with a dark pigmented line and each segment bears a couple of fine transverse lines of which the anterior is very sinuous and the posterior more or less straight. The whole body is paler and of a pale brown colour.

3. A single specimen from Rotung, Abor country, alt. 1300 ft., 7·iii·1912 (coll. *S. W. Kemp*). Found under stones. (Fig. 3.)

Somewhat similar to the last but the head differing markedly in shape, much more rounded, the sides concave immediately posterior to the eyes. The frontal border somewhat crenate and the median notch narrow and shallow. Eyes without the horn-like process. Upper surface of head moderately deeply pigmented save for a pale band which passes between the eyes and is convex posteriorly. Maxillae long, not so sharply curved at the ends, one with its tip bifid, the three inner spines of equal length, the posterior one wider-spaced than the two anterior. Between them and posterior to the hinder, a short and a long series of smaller spines.

Prothorax narrow and well defined, with similar lateral tubercles to the last.

Lateral spines of the remainder of the body similar to those of the first described. Similar, but thicker and darker pigmented transverse lines traversing the dorsum.

No imagines were collected on the Abor Expedition so that one cannot give any opinion as to which species the two latter larvae belong to. All the larvae are juveniles, so no measurements have been given.

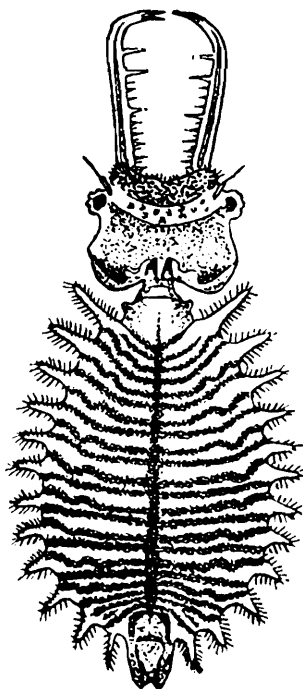
#### ADULTS.

Tribe SUHPALACSINI Ris.

Genus *Suhpalomitus* Ris.

*Suhpalomitus serratus* sp. nov.

1 male, Meetaw Forest, W Rahang, Siam, alt. ca. 1000 ft. 4·iv·1913 (*C. S. Barton*).



TEXT-FIG. 3.—Ascalaphid larva from Rotung, Abor country.

Antennae yellowish, club broad, black and spatulate. Head thickly coated with light brown hair, face rather paler, also coated with brownish hair. Eyes reddish brown, about evenly divided.

Thorax moderately broad and short, striped longitudinally and alternately with dark brown and pale ochreous, the mid-dorsum dark brown followed outwardly by a narrow ochreous band and then by a broader, dark brown, humeral band on a level with the wing insertions. Laterally pale ochreous, chest pale brown.

Legs short and moderately slim, femora yellowish red, tibiae reddish brown, tarsi black, claws reddish. Posterior tibial spurs about as long as the basal joint of tarsus.

Abdomen long and slim, uniform dark reddish brown, the sides of the three basal segments coated with very short, very stiff hairs which stand out perpendicular to the surface.

Anal appendages very short, directed down and outwards, with a few long bristles projecting from the ends; genital flaps very short, conjoined, spatulate.

Wings hyaline, faintly tinted with brown, reticulation moderately close, reddish brown, subcostal field brown; this colour prolonged along all the nervures radiating from the subcosta and radius so as to form a narrow, serrated fascia extending from the base of the wing to the stigma. Pterostigma brown, traversed by 4 to 5 nervures, broad and rather long, its outer border rather oblique. The brown of the stigma is also prolonged along the costal margin as far as the apex of the wing. Apical field moderately broad, with 3 rows of cells. Axillary angle obtuse and very blunt.

Antennae 25 mm.; forewing 39 mm.; hindwing 32 mm.; abdomen 31 mm.

### Suphalomitus verbosus Walk.

*Ascalaphus verbosus*, Walk., *Cat. B.M. Nerr.*, no. 36, p. 426 (1853).

*Ascalaphus profunus*, Walk., *l.c.*, no. 39, p. 428 (1853).

*Helicomitus verbosus*, MacLach., *Fourn. Linn. Soc., Zool.*, XI, p. 262, no. 4 (1871).

*Helicomitus profunus*, MacLach., *l.c.*, no. 5, p. 262 (1871).

*Suphalomitus verbosus*, Ris, *Cat. Coll. Selys, Ascalaphidae*, p. 183 (1908).

Type in Brit. Mus. from North India.

2 females, Coorg, 2000 ft., 1913, coll. *Hannington*, and *Annarchardi*, S. India, 1909.

2 females, Pashok, Darjiling Dist., alt. 2500 ft., vi. 1916, (coll. *L. C. Hartless*).

A widely distributed species reported from Northern India, Mysore, Rangoon and Ceylon. The present examples do not differ markedly from type, the markings varying according to the age of individuals.

### Genus *Helicomitus* MacLach.

#### *Helicomitus dicax* Walk.

*Ascalaphus dicax*, Walk., *l.c.*, no. 31, p. 423 (1853).

*Ascalaphus sinister*, Walk., *l.c.*, no. 32, p. 424 (1853).

- Ascalaphus immotus*, Walk., *l.c.*, no. 33, p. 425 (1853).  
*Ascalaphus procox*, Walk., *l.c.*, no. 34, p. 425 (1853).  
*Ascalaphus odiosus*, Walk., *l.c.*, no. 35, p. 426 (1853).  
*Ascalaphus insimulans*, Walk., *l.c.*, no. 36, p. 429 (1853).  
*Helicomitus insimulans*, Walk. and MacLach., *Journ. Linn. Soc., Zool.*  
 XI, p. 262 (1871); Weele, *Notes Leyden Mus.* XXVI, p. 200 (1905);  
 XXVIII, p. 153 (1907)  
*Ascalaphus cervinus*, Hagen, MacLach., *l.c.*, p. 267 (1871).  
*Suphalasca cervinus*, Hagen, Gerstaecker, *Mitt. natur. Ver. Neu.-*  
*Vorpomm. und Rugen*, 16, p. 88 (1885).  
*Suphalasca placida*, Gerst., *l.c.*, p. 105 (1893); Weele, *Notes Leyden*  
*Mus.* XXVI, p. 228 (1906); *l.c.*, XXVIII, p. 156 (1907).  
*Helicomitus dicax*, Ris, *Cat. Coll. Selys, Ascalaphidae*, p. 172 (1908).

Type in Brit. Mus.

1 ♀, Amarah, Mesopotamia (taken in a tent), x·1916 (coll. F. P. Connor); 3 ♂ ♂, Eden Gardens (at light) and Museum Compound, Calcutta; 2 ♀ ♀, Chowringhee, Calcutta, 27·iv·1914, 27·v·1921, 17·vi·1911, and 28·v·1911 (coll. N. Annandale and F. H. Gravely); 1 ♀, Khargpur, Bengal, 17-30·vi·1911 (coll. R. Hodgart).

The specimens exhibit in a small way the extreme variability of this insect, especially in the markings. The species is widely distributed. I have taken it on several occasions in Mesopotamia above Kerna, that is above flooding areas, and it becomes increasingly common towards Amarah and Kut. Extends from Asia Minor to the Philippines and has been reported from Arabia, India, Ceylon, Java, China and Celebes.

### Genus *Suhalasca* Lefebvre.

#### *Suhalasca obscura*, sp. nov.

1 ♂ (rather teneral), Khemsa, 2650 ft., 5·v·1913.

Head: Antennae pale yellowish brown, the club long and pyriform, finely ringed with blackish brown; about half the length of the forewing. Jaws and face pale yellow; vertex and occiput brown, coated thickly with long brown hair, eyes dark purplish, iridescent brown.

Thorax dark brown, unicolorous, coated thickly with long dark brown hair, the sides paler.

Legs moderately short and robust, palest brown with a sub-basal spot of black on the tibiae, coated with long whitish hairs.

Abdomen long and cylindrical, tapering at the end segments, shorter than the hindwing, purplish brown, with obscure apical black annules on each segment.

Anal appendages tumid, elliptical, moderately long; genital flaps foliate, notched in the middle.

Wings hyaline, reticulation moderately close, white spotted with black, the subcosta especially, which bears at its junction with each transverse nervure, a longitudinal black spot, so that it appears alternately black and white; stigma short, very pale brown, traversed by 4 nervures; apical field broad, 3 rows of cells

in forewing, 2 to 3 in the hind; 7 rows of cells at outlet of the discoidal field.

Forewing 37 mm.; hindwing 31 mm.; abdomen 23 mm.; antennae 19 mm.

I place this species with some doubt in genus *Suhpalacsa*, which so far has not been shown to contribute any species within Indian limits.

It is at least very closely allied to the genus. It bears a superficial resemblance to *Idricerus decrepitus* from which, however, it is of course easily separated by its bipartite eyes.

### Tribe HYBRISINI Ris.

#### Genus Acheron Lefebv.

##### *Acheron trux* Walk.

*Ascalaphus trux*, Walk., *Cat. B.M.*, p. 432, no. 45 (1853).

*Ascalaphus loquax*, Walk., *l.c.*, no. 48, p. 434, (1853).

*Ascalaphus antiquus*, Walk., *l.c.*, no. 49, p. 434 (1853).

*Ascalaphus longus*, Walk., *l.c.*, no. 50, p. 435 (1853).

*Helicomitus ctenocerus*, Gerstaeck., *Mitt. natur. Ver. Neu-Vorpom. und Rugen XXV*, p. 101 (1893); Weele, *Notes Leyden Mus. XXVI*, pp. 200, 228 (1900).

*Acheron trux*, Ris, *Cat. Coll. Selys, Ascalaphidae*, p. 228 (1908).

1 ♂ and 2 ♀♀, Tura, Garo Hills, Assam, 1200-1500 ft., vi-viii, 1917 (coll. S. Kemp); 1 ♂, Pashok, alt. 3500 ft., Darjiling Dist., E. Himalayas, 26.v.1914 (coll. F. H. Gravely).

Type in Brit. Mus. from Bengal, but without precise locality. This species is very constant and has a fairly wide distribution. Localities from which this insect has been recorded are Burma, Sylhet, Darjiling, Bhutan, Bengal, Assam, Sikkim, Malacca, China and Formosa.

#### Genus Glyptobasis MacLach.

##### *Glyptobasis dentifera* Westwood.

*Ascalaphus dentifer*, West., *Cab. Ori. Ent.*, pl. xxxiv (1848).

*Ogcogaster dentifer*, West., *l.c.*

*Ascalaphus dentifer*, Walk., *Cat. B.M.*, p. 421, no. 26 (1853).

*Glyptobasis dentifera*, MacLach., *l.c.*, p. 268 (1871); Ris, *Cat. Coll. Selys, Ascalaphidae*, p. 241, fig. 197, 198, 199 (1908).

2 ♂♂ and 1 ♀, Talewadi, near Castle Rock, N. Kanara, Dist., Bombay Pres., 3-10.x.1916 (coll. S. Kemp); 3 ♂♂, Mormugao, Portuguese Ind., ix.1916 (coll. S. Kemp); 1 ♀, Balugaon, Puri Dist., Orissa, 21-31.viii.1913 (coll. N. Annandale); 1 pair, Parambikalam, Cochin State, 1700-3200 ft., 16-24.ix.1914 (coll. F. H. Gravely), 2 ♂♂ and 2 ♀♀, Trichur, Cochin State, 0-300 ft., 1-4.x.1914; ♂, Kavalai, Cochin State, 300-3000 ft., 24-27.ix.1914 (coll. F. H. Gravely).

This species is the type of the genus. Type in Brit. Mus. (East India). MacLachlan's specimen is from Bombay and specimens have also been obtained from Goregaon, which is near Bombay. Bangalore is another locality mentioned for the species.

The Deccan and Western Ghats appear to be the districts to which this species is mainly restricted.

### ***Glyptobasis nugax* Walk.**

*Ascalaphus nugax*, Walk., *Cat. B.M.*, p. 433, no. 47 (1853); Hagen, *Verh. zool.-bot. Ges. Wien*, VIII, p. 481, no. 66 (1858).

*Ascalaphus incusans*, Walk., *l.c.*, p. 442, no. 63 (1853); Hagen, *l.c.*, p. 481, No. 67 (1858).

*Glyptobasis incusans*, Walk., *l.c.*, p. 442, no. 2, p. 268 (1871).

*Glyptobasis nugax*, Ris, *Cat. Coll. Selys, Ascalaphidae*, p. 243, figs. 200 and 201 (1908).

Type, a ♀ from Ceylon, Mus. Griefwald.

One pair from Castle Rock, ix·1916; 2 ♀♀, Talewadi, near Castle Rock, Kanara Dist., Bombay Pres. (coll. S. Kemp); 1 ♂ and 2 ♀♀, Barkul, 0-1000 ft., Orissa, 1-3·viii·1914, "flying in thick jungle, in rain" (coll. F. H. Gravely).

This species appears to be restricted to Southern India and Ceylon. With regard to the two females from Orissa I am not altogether sure of the determination and think that they may be varieties of the species. Females are, however, difficult to determine satisfactorily.

### ***Glyptobasis brunnea*, sp. nov.**

1 ♀, foot-hills, Pegu Yomas, Thayetmyo Dist., Burma, Oct. 1911 (coll. C. J. Rogers).

Antennae dark reddish brown, extending nearly to the level of the stigma, about  $\frac{4}{5}$ ths the wing-length; club long and pyriform, very dark brown.

Labium bright yellow, rest of head and face dark blackish brown, coated thickly with coarse dark brown hair except the occiput which is pale yellow and nearly bald. Eyes brown with a metallic reflex, the upper hemisphere decidedly the larger.

Thorax sparsely hairy, dark brown with a broad mid-dorsal stripe of yellow which is encroached upon by an angular process of the ground colour. Laterally a moderately broad, bright yellow, oblique stripe. Legs dark brown, almost black, robust but short, the anterior tibiae with a cushion of short, thickly-set, yellow hairs on the flexor surfaces. Tibial spine of posterior tibia as long as the basal joint of the tarsus.

Abdomen blackish brown. Each of the four basal segments bearing a bright ochreous spot shaped like a leaf with a crenate border, the stalk connected to an apical ring of the same colour. On the other segments this spot is more quadrate or like a leaf without its stalk.

Wings long and broad, slightly enfumed throughout, but the apices for about the outer fourth of the wings dark reddish brown. There is also a streak of the same colour immediately posterior to the radius in the forewing. Stigma dark brown, with five nervures, very obliquely pointed outwardly; reticulation close, black; the appendix very acute and rather long; apical field moderately

broad, with 3 rows of cells; 10 cells at the outlet of the discoidal field.

Anal appendages short, tumid, elliptical; genital valves, two rounded, convex, vertical flaps furnished with stiff black hairs.

Abdomen 23 mm.; forewing 38 mm.; hindwing 36 mm.; antennae 38 mm.

### Genus *Siphlocerus* MacLach.

#### *Siphlocerus* *Minus*, Walk.

*Ascalaphus minus*, Walk., *l.c.*, p. 429, no. 40 (1853).

*Ascalaphus luctifer*, Walk., *l.c.*, p. 432, no. 46 (1853).

*Siphlocerus minus*, Walk., and MacLach., *Journ. Linn. Soc., Zool.* XI, p. 261, no. 1 (1871); Ris, *l.c.*, p. 246, figs. 202, 203, 204, (1908).

1 ♂, Dharampur, Patiala State, 12.vii.1911 (Mus. coll.); 1 ♂ and 2 ♀♀, Shahzadpur, Allahabad Dist., 29.viii.1910 (Mus. coll.).

Not differing from type, which is in Dr. Ris' collection. Only so far reported from North India and North Bengal.

### Genus *Ogcogaster* Westwood.

#### *Ogcogaster* *tessalata* West.

*Ascalaphus tessalatus*, West., *Cat. Orient. Ent.* 34, fig. 1 (1848); Walk., *l.c.*, p. 420, no. 24 (1853).

*Ogcogaster tessalatus*, West., MacLach., *Journ. Linn. Soc., Zool.* XI, p. 265, no. 1 (1871).

*Ogcogaster tessalata*, Ris, *l.c.*, p. 253 (1908).

1 ♀, Kumaon, 6075 ft., W Himalayas, vii.1914 (coll. Tytler.) Type in Brit. Mus., a female. No localities have hitherto been recorded for this insect except the broad term "India."

The single specimen is a very large one, its measurements being: abdomen 15 mm.; forewing 38 mm.; hindwing 32.5 mm.; antennae 25 mm.

The discoidal spots of brown are missing but the brown marking in conjunction to the stigma is well defined and forms with the stigma a very conspicuous arrowhead-shaped marking.

#### *Ogcogaster* *kempii*, sp. nov.

Two pairs from Talewadi, near Castle Rock, N. Kanara Dist., Bombay Pres., 10.x.1916 (coll. S. Kemp).

Male.

Antennae bright yellow, a little longer than half the length of the wing; club broad, dark brown.

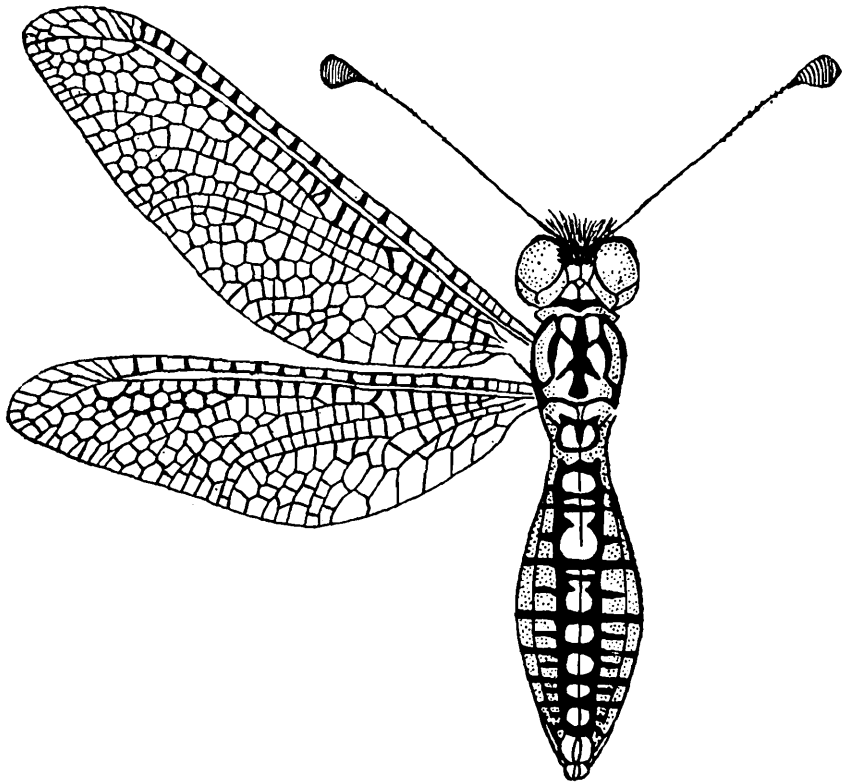
Head bright yellow except the vertex which is black and coated thickly with long dark brown hair; a tuft of bright yellow hair in front of and between the antennae; eyes dark reddish brown with an iridescent sheen.

Thorax bright yellow marked with black as follows:—a narrow, dorsal, transverse, black mark on middle of prothorax, on middorsum of thorax from before back, a broad, "T" shaped mark, followed by a marking shaped like an inverted anchor. The arms

of the "T" prolonged out and back as far as the root of the forewing and on each side of its stem with a parallel stripe which runs back and joins the arms of the anchor-mark. Posterior to the latter, a transverse black line and then another, smaller "T" shaped mark.

Laterally pale yellow marked with two fine, black and rather sinuous lines which pass down from the root of each wing to run between the first and second, and second and third pairs of legs respectively. A third line borders the metepimeron below and runs forward behind the last pair of legs.

Legs golden yellow, the femora with a ferruginous tinge on the extensor surface; tarsi and extreme distal ends of tibiae black; a longitudinal broad stripe of brown on the distal two-thirds of



TEXT-FIG. 4.—*Ogcogaster kempfi*, sp. nov. ♀ : × 2.

the extensor surface of femora. Tibial spines as long as the first joint of tarsus.

Abdomen yellow marked with black. On the dorsum, each segment is outlined in black enclosing a bright yellow spot, and from the lateral black line, on each segment runs an apical and a medial fine, black line, the former passing right under the ventrum to join up with its fellow from the other side and the latter or medial stopping short at the level of the spiracles.

Wings similar to those of *segmentator*, rather rounded at the apex, membrane hyaline, reticulation black except the main nervures which are bright yellow, especially the subcosta and radius. The transverse nervures along the costa of both wings, at the base and over a small area of the wing posterior to the

stigma in the hindwing and a similar area of the same wing along the posterior border opposite the stigma suffused with dark brown; stigma bright citron yellow, traversed by 5 yellow nervures which bear minute, black spines.

Appendages very short, genital flaps projecting horizontally out and forwards.

Female very similar to the male, differing as follows:—

The eyes are puce coloured; legs black except the knee-joints and extensor surface of tibiae which are yellow, this colour being more extensive on the anterior tibiae than the middle pair and on the middle than the posterior pair.

Genital flaps very broad, bluntly triangular, not differing markedly from those of *segmentator*.

Abdomen ♂ 16 mm., forewing ♂ 40 mm.; hindwing ♂ 35 mm., antennae ♂ 27 mm. Abdomen ♀ 16 mm.; forewing ♀ 37 mm.; hindwing ♀ 32 mm.; antennae ♀ 25 mm.

This species is readily distinguished from *tessalata* and *kirbyi* by the bright yellow stigma (black in the latter two species), and from *segmentator* by the absence of the broad, black, midventral line, by the antennae being yellow, the face quite unmarked and by the very short anal appendages of the male.

## HIRUDINEA FROM THE INLÉ LAKE, S. SHAN STATES.

By ASAJIRO OKA, *Tokyo*.

(Text-figs. 1-7.)

The collection of leeches from the Inlé Lake, S. Shan States, kindly placed in my hands for study by Dr. N. Annandale, is a small one, comprising only three genera and five species. It is nevertheless of an exceptional interest on account of certain structural peculiarities exhibited by some of the new forms, which seem to throw considerable light upon the question concerning the external morphology of the Hirudinea in general.

One of the new forms, *Glossiphonia inleana*, sp. nov., is unique among the Glossiphonidae in having the three annuli constituting a somite easily recognizable at a glance. As is well known, the external annuli of the Hirudinea have, as a rule, an exactly similar appearance, making the determination of somite limits a matter of great difficulty. Until so late as 1900, when Castle (5) and Moore (11) almost simultaneously pointed out its inadequacy, an entirely erroneous method of plotting out the somite limits by assuming the sensillae-bearing annulus to be the first annulus of the somite, was in use among students of leeches. Now, in our species, there is no danger of being mistaken in the determination, as the furrows separating the somites are decidedly deeper and more conspicuous than those separating the annuli of the same somite. This is particularly apparent at the margins of the body, where the rings form groups of three each, two fused together and one separate, projecting toward the side in the form of broad and narrow teeth placed alternately.

Another new species, *Glossiphonia annandalei*, is also very interesting because of its having four of the six eyes arranged transversely upon one and the same annulus. This character, though not uncommon among the Herpobdellidae, has, so far as I know, never been observed in any of the remaining families.

The five species dealt with in the present paper are here systematically arranged :—

### Family GLOSSIPHONIDAE.

*Glossiphonia heteroclita* (Linné).

*Gl. inleana*, sp. nov.

*Gl. annandalei*, sp. nov.

*Piacobdella parasitica*, juv. (?)

## Family HERPOBDELLIDAE.

*Trocheta quadrioculata*, sp. nov.***Glossiphonia heteroclita* (Linné).**Syn.: *Hirudo heteroclita*, Linné, 1761.*H. hyalina*, O. F. Müller, 1774.*H. trioculata*, Carena, 1823.*Clepsine hyalina*, Moquin-Tandon, 1826.*Glossiphonia heteroclita*, Moquin-Tandon, 1846.

Localities:—Loitan Tank, Yawnghwe Valley. One specimen.

Marginal zone, Inlé Lake. Three specimens, from *Pachylabra maura* (Reeve, Mollusca Gastropoda, family Ampullariidae).

These are all small specimens, measuring only 6 mm. in length and 3–4 mm. in width. Preserved in alcohol, the specimen from Loitan Tank is almost white; those from the other station are somewhat darker. In both cases there is no indication that the animal was striped or spotted during life.

The identification of these specimens is chiefly based upon the disposition of the six eyes, so characteristic of the species. They are arranged, namely, in three groups of two eyes each, one anterior median and two posterior lateral, in such a way that the animal, when examined superficially, appears to possess only three eyes. So far as I could ascertain, the constitution of the abbreviated somites at the anterior and posterior extremities of the body agrees fairly well with the minute description of American specimens of *Glossiphonia heteroclita* given by Castle (6).

From *Glossiphonia ceylanica* Harding (9), some examples of which, according to Kaburaki (10), appear to be identical with this species, the specimens examined by me could be easily distinguished by comparing the position of the eyes. In *Gl. ceylanica* the second and third pairs of eyes are not so close together as in *Gl. heteroclita*, but are separated by at least one ring.

***Glossiphonia inleana*, sp. nov.**

Locality:—Fort Stedman, Inlé Lake. Numerous (about 60) specimens, from a tortoise (*Cyclemys dhor shanensis* Annandale).

*Shape and dimensions.* As shown in fig. 1 the form is rather slender for a *Glossiphonia*, being from 3 to 4 times as long as wide in moderately contracted specimens. The broadest part lies posterior to the middle, from where the body tapers very gradually toward both ends. Both the dorsal and ventral surfaces are convex, so that the body is somewhat lens-shaped in cross sections. The lateral margins are sharp and serrate. The posterior sucker is of moderate size, circular in outline. Except the shape of the head, which does not project toward the side, this species closely resembles *Hemiclepsis marginata*, with which it also shares the habit of living as an ectoparasite on tortoises.

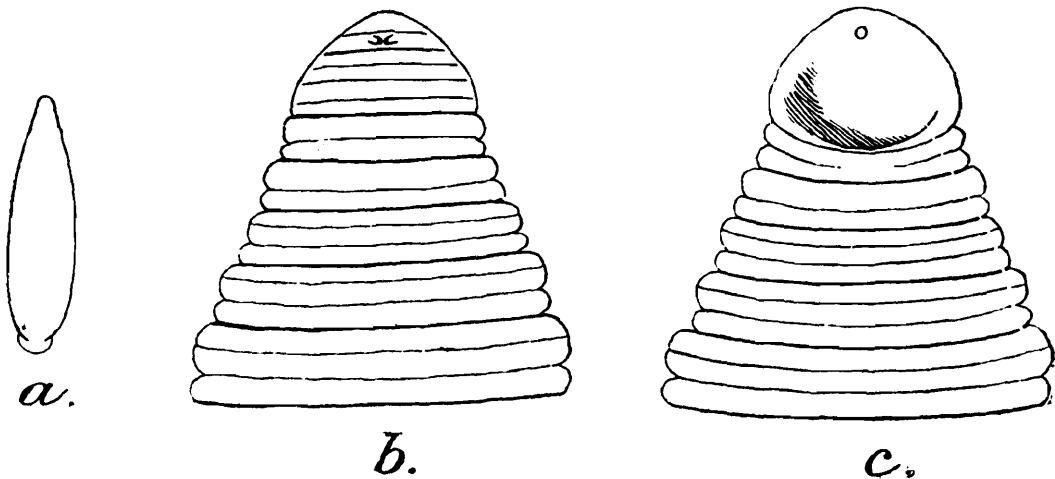
The largest individuals measure about 9 mm. in length and

nearly 3 mm. in width, the posterior sucker is about 1.5 mm. across.

*External features.* There is a single pair of eyes on the second annulus. They are pretty large and distinct, and are placed close together, almost touching with the base at the median plane of the animal. The opening of the pigment-cup is directed obliquely forward and toward the side.

The oral sucker occupies the ventral surface of the first six annuli, the ventral portion of annulus 6, which is very narrow on that side, forming the posterior boundary of the sucker. The mouth-opening is situated in the anterior half of the sucker just below the eyes, corresponding in position with annulus 2.

The genital apertures are separated by two rings; the male opening lies between annuli 26 and 27, the female opening between 28 and 29, counting each of those annuli at the anterior end,



TEXT-FIG. 1.—*Glossiphonia inleana*, sp. nov.

- a. Outline of entire animal:  $\times 3$ .
- b. Somites i-ix, dorsal view:  $\times 30$ .
- c. Somites i-ix, ventral view:  $\times 30$ .

which are double in larger specimens, as two. Both pores are small and inconspicuous. In most of the specimens the clitellum was not distinguishable from the rest of the body.

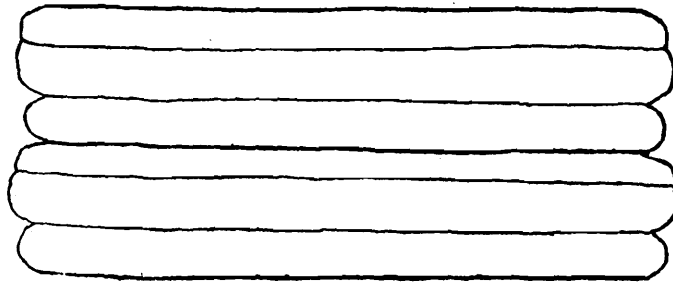
The anus is a small transverse slit placed behind the last annulus. There is, however, a small ring-like portion of the body on the dorsal surface of the sucker just behind the anus.

The hinder sucker is directed ventrally and is attached to the body by the ventral surface of the last three or four annuli.

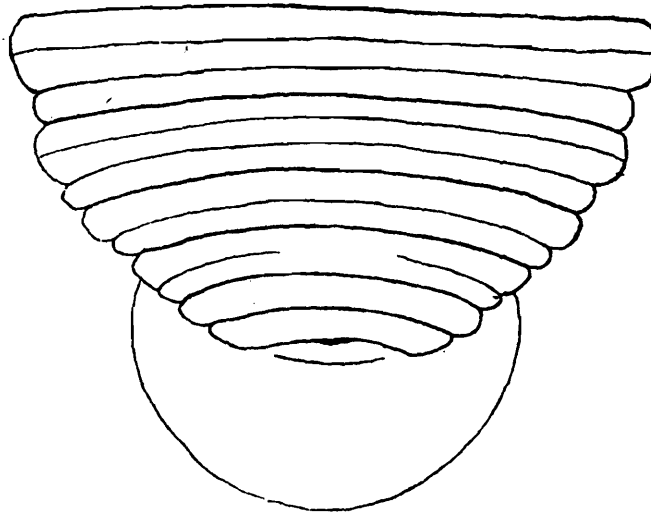
The specimens preserved in alcohol are of a uniform pale grey colour, but there are indications that the animal was ornamented during life with roundish spots regularly arranged on the dorsal surface, much in the same way as those of *Hemiclebsis marginata* (2). In many individuals the crop with its paired diverticula is recognizable externally on account of the dark brown mass (coagulated blood of the host) it contains.

*Internal anatomy.* The small mouth-opening leads into the

usual pharyngeal sac, in which is found the long muscular proboscis. This organ is rather slender throughout, being only about twice as thick at the base as at the tip. A pair of groups of unicellular salivary glands open into the posterior end of the proboscis. The oesophagus is quite short and leads into the crop, produced laterally into seven pairs of diverticula, of which the last is much larger than the rest and elongated posteriorly. The diverticula show a slight bifurcation laterally, except those of the



*a.*



*b.*

TEXT-FIG. 2.—*Glossiphonia inleana*, sp. nov.

*a.* Somites xvi and xvii:  $\times 30$ .

*b.* Somites xxii-xxvii, with sucker:  $\times 30$ .

last pair which have three metamericly arranged dilatations directed toward the side. The stomach is provided, as in all other species, with four pairs of simple finger-like caeca.

There are six pairs of testes placed alternately with the crop diverticula, the first pair occupying the space between the first and second pairs of the latter and partly covered by the second pair dorsally. The vas deferens forms a mass of convoluted tubes on either side of the male opening. The ovaries occupy the usual

position and present nothing particular compared with those of other well-known species.

Of the nephridia I counted sixteen pairs, which are situated in the same position as those of *Hemiclepsis marginata* (12). The openings could not be detected in surface views, so that their position had to be determined by a study of sections. They lie, as in many other species of the genus, in the furrow separating the first and second annuli of the respective somites.

The nervous system is composed of 34 ganglia connected by longitudinal nerve trunks. The first six are fused together to form the circum-oesophageal ring. The last seven are likewise coalesced in a single mass at the base of the hinder sucker. The remaining ganglia are separate, arranged regularly one in each somite, except near the anterior and posterior extremities where they are more crowded.

*Annulation.* As stated before, the somite limits are recognizable at a glance in this species, as the furrows separating the successive somites are more conspicuous than the interannular furrows. Examined under a low power of the microscope a little out of focus, the former alone are visible, while the latter disappear completely, in such a way that the worm has now the appearance of being uniannulate throughout. I have never seen a leech, except perhaps *Myxobdella annandalei* Oka (14) from Hongkong, which presented a somewhat similar appearance. Moreover, the interannular furrows are not all of the same depth, that separating the first and second annuli of each somite being always less deep than that separating the second and third annuli, so that in many somites the first two annuli appear as a single broad ring, especially at the margins. In most cases the three annuli composing a somite have different widths; as shown in the accompanying figure (fig. 2a) the second ring is the widest, then comes the third which is a little narrower, while the first ring is always the narrowest.

There is apparently a certain amount of variation in the constitution of somites at either end of the body according to the age of the individual. This will be clear from the following table which shows the annulation of two individuals, 9 mm. and 5 mm. in length respectively.

Somites.	Number of rings in each somite.	
	A.	B.
i, ii	1	1
iii, iv	2	1
v, vi	2	2
vii, viii	3	2
ix-xxii	3	3
xxiii	3	2
xxiv	2	2
xxv	2	1
xxvi, xxvii	. . . 1	1

Thus, the larger individual (A) has 67 rings, while the smaller one (B) has only 61. As the somites at the extremities are more abbreviated in younger individuals than in older ones, it is evident that the elaboration of the somites has progressed centrifugally from the middle region toward both extremities. This is exactly the opposite of what we should expect, if the triannulate somite represented the primitive condition, from which both biannulate and uniannulate somites were derived by subsequent abbreviation. An examination of the individual somites seems to confirm this view.

Somite i has only one ring. It bears a faint transverse groove which, however, does not reach to the lateral margins. Somite ii is clearly uniannulate, the pigment cup of the eye occupies almost the entire breadth of this ring. Somites iii and iv are biannulate in large individuals, but uniannulate in smaller ones. In the former case somite iii is composed of two rings of practically equal breadth, somite iv, on the contrary, of an anterior broader and a posterior narrower, the ratio of the breadths being about 2 to 1. Somites v and vi are always biannulate, being composed of a broad and a narrow ring. Somites vii and viii are triannulate or biannulate according to the size of the individuals, the furrow separating the first and second rings being confined to the median area in smaller individuals. Somites ix to xxii are triannulate. Somite xxiii is triannulate in large individuals but biannulate in small ones; in some cases it is difficult to decide whether the somite should be considered as triannulate or as biannulate. Somite xxiv is biannulate; somite xxv either bi- or uniannulate; somites xxvi and xxvii uniannulate. The biannulate somites at the posterior end of the body are invariably composed of an anterior broader and a posterior much narrower ring. At the margins all the triannulate somites appear as biannulate, as the rings 1 and 2 form a single broad tooth separated by a notch from the narrow tooth formed by the ring 3.

The chief peculiarity in the external morphology of this leech is, as already stated, that the somite boundaries are recognizable at a glance and the three annuli forming a somite are not of the same size. By tracing the somites from the extremities toward the median region, we can observe the various stages through which the primitive uniannulate somite of the ancestral leech gradually became the typical triannulate somite of the Glossiphonidae. First the somite became broader, then a narrow ring was separated off from the posterior margin. The biannulate somite thus formed next became triannulate by the separation of a still narrower ring from the anterior margin. Afterwards the three rings became equivalent in size, making it extremely difficult to find out where the somite boundaries really are.

This species presents a certain resemblance to the diagrammatic figure of *Placobdella emydae* Harding (9), with which it agrees in the number of crop diverticula, the testes, and the position of the genital openings. Both forms were also found attached

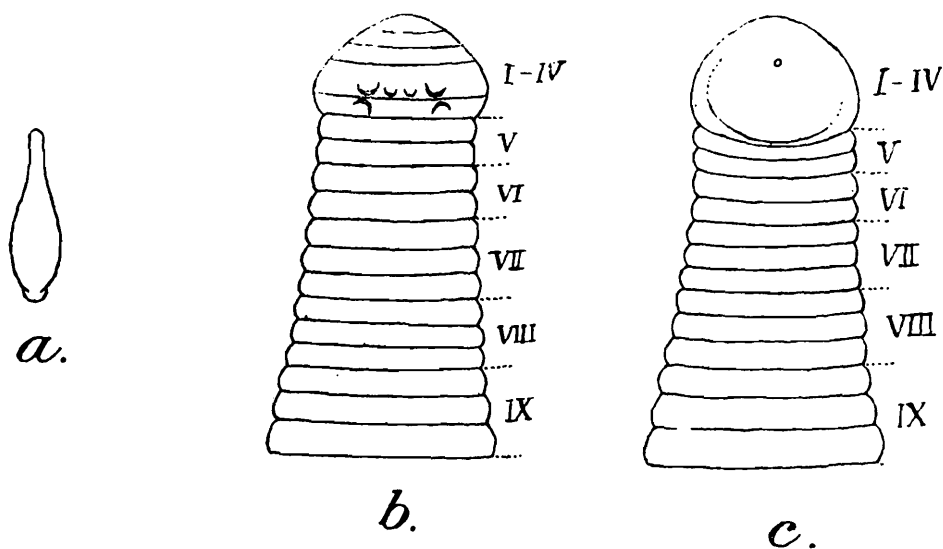
to chelonians. In reality, however, the difference is very great, as *Pl. emydae* is a broad and flat species, measuring 13.5 mm. in length by 9 mm. across.

### *Glossiphonia annandalei*, sp. nov.

Localities :—Central region of Inlé Lake. Eight specimens.

Central region of Inlé Lake. Two specimens, on *Taia intha* Annandale (Mollusca Gastropoda, family Viviparidae).

*Shape and dimensions.* Body rather long and slender, not unlike *Gl. stagnalis*, anterior portion having the appearance of a neck. The greatest width, which is about one-third of the length, lies at about one-third of the length from behind. The head is slightly broader than the neck. The body is not much flattened, being convex on both sides, though more so on the dorsal than on



TEXT-FIG. 3.—*Glossiphonia annandalei*, sp. nov.

- a. Outline of entire animal :  $\times 3$ .
- b. Somites i-ix, dorsal view :  $\times 30$ .
- c. Somites i-ix, ventral view :  $\times 30$ .

the ventral surface. The margins are sharp and serrate, but not thinned out. The hinder sucker is small and directed ventrally and backward.

The largest example, somewhat contracted, measures 6 mm. in length and 2.8 mm. in width.

*External features.* The surface of the body is on the whole smooth, all the papillae being low and insignificant. Neither transverse nor longitudinal rows of particularly large papillae could be observed.

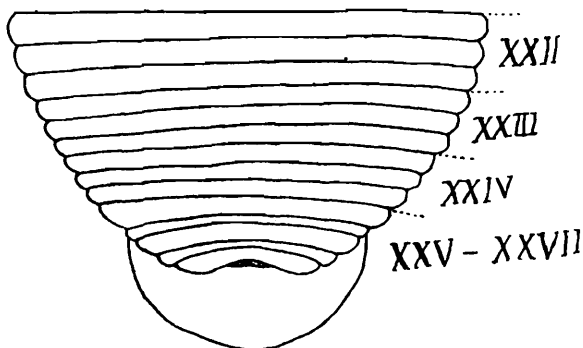
The oral sucker occupies the ventral surface of the first five rings, ring 5, which is very narrow on the ventral side, forming its posterior border. The small mouth-opening lies a little in front of the middle of the sucker.

There are three pairs of eyes, whose position is quite unique among the *Glossiphoniidae*. Two pairs are situated in the pos-

terior half of annulus 4, a pair of small eyes on either side of the median line and a pair of much larger eyes placed about midway between the median eye and the lateral margin. The opening of the pigment-cup of the median eyes is directed forward, that of the lateral eyes forward and slightly toward the side. The remaining pair is found on annulus 5 just behind the lateral eyes of the preceding annulus. The pigment-cup of this pair is directed backward and a little laterally. The two lateral eyes of either side are placed so closely together, that their pigment cups touch each other with their bottom, presenting the form of **X** in surface views. Very possibly the eyes which appear to be placed in annulus 5 belong in reality to annulus 6, the pigment cup having been displaced forward. So far as I am aware, there is no Glossiphonid hitherto known which presents a similar arrangement of eyes.

The genital openings are separated by two rings. The male pore lies between annuli 24 and 25, the female pore between 26 and 27. Both openings are small and inconspicuous. The clitellum could not be distinguished in any of the specimens.

The nephridial pores were invisible in surface views. By a careful study of longitudinal sections I was enabled to locate them



TEXT-FIG. 4.—*Glossiphonia annandalei*, sp. nov.  
Somites xxii-xxvii with sucker :  $\times 30$ .

at the usual position, namely, in the furrow separating the first and second annuli of the respective somites. In all sixteen pairs of nephridia were observed.

The anus is situated behind the last annulus on the dorsal surface of the sucker.

The colour of the specimens preserved in

alcohol is a uniform pale gray. There is no indication of the animal having been spotted or mottled during life.

*Internal anatomy.* The proboscis is very long and slender. A short oesophagus connects the base of the proboscis with the crop, which extends over six somites and is provided with as many pairs of diverticula. The latter are all simple except those of the last pair which extend backward and are provided with three short branches directed toward the side. The stomach bears four pairs of simple tubular diverticula, of which the first two pairs are directed forward, the last pair backward, while the third pair lies about at right angles to the long axis of the body.

There are six pairs of testes placed alternately with the crop diverticula, the first pair being in front of the most anterior of the latter. The ovaries are, as usual, a pair of simple sacs extending back along the sides of the ventral nerve chain.

The nervous system agrees most closely with that of *Glossiphonia stagnalis*.

*Annulation.* Somites i, ii, and iii are uniannulate. Somite iv is biannulate, consisting of an anterior broad and a posterior narrow ring; it is in the hinder half of the broad ring, i.e. ring 4, that the four anterior eyes are transversely arranged, while the remaining two eyes are imbedded in the interior of the next ring. Somites v and vi are biannulate, with the rings of practically equal breadth. Somites vii-xxiv are triannulate; here the rings are of the same breadth throughout, so that there is no distinction between the inter-somital and interannular furrows. Somites xxv and xxvi are biannulate with the anterior ring about twice as broad as the posterior. Somite xxvii has but one ring, behind which is placed the anus. At the posterior extremity, where the somites are abbreviated, the somite boundaries can be determined without difficulty, as it is always the first and second annuli that are fused.

This species can be easily distinguished from all other species of the genus by the peculiar arrangement of the eyes mentioned above.

#### *Placobdella parasitica*, juv. (?).

Syn.: *Hirudo parasitica*, Say, 1824.

*Clepsine parasitica*, Diesing, 1850.

*Cl. plana*, Whitman, 1891.

Locality:—Canal on W side of Inlé Lake. One specimen, on *Taia shanensis* (Kobelt).

It is with much doubt that I assign this specimen to the above species. Judging from the size as well as from the condition of the genital pores, it is certainly immature, and it is difficult to ascertain whether the slight but obvious discrepancies existing between this specimen and typical *P. parasitica* are due to difference in age or to specific distinctness.

The specimen is a good deal contracted. The form is oval, much arched dorsally, concave ventrally. The head is curved downward, so that the eyes cannot be seen when the animal is viewed from above. The lateral margins are similarly inflexed. The total length measured along the curved dorsum is 5.5 mm., the transverse diameter 3 mm., the widest part being a little behind the middle of the body. The posterior sucker is circular and measures about 1 mm. across; its margins are inflexed.

There is a single pair of eyes in the anterior half of the third annulus. They are not so close together as in the normal specimens of *Placobdella parasitica*. As I could not study the unique specimen in sections, it was impossible to determine whether the eyes were really simple, as they appeared to be in surface view, and not composed of three eyes crowded together as is the case in that species.

The genital pores are separated by two rings. The male opening is situated in the furrow between rings 27 and 28, the

female opening between 29 and 30. They are both very small and hidden in the furrow, so that the specimen had to be strongly bent dorsally to make them discernible.

The nephridial pores could not be observed.

The annulation is practically the same as that given by Castle (6) for *Glossiphonia parasitica*. Somites i and ii are uniannulate, somites iii and iv biannulate, somites v-xxiv triannulate, somites xxv and xxvi biannulate, and somite xxvii uniannulate, giving the total of 71 rings. Castle regards somites xxv and xxvi as uniannulate each, which reduces the number of rings to 69, but as these somites were divided, in his specimens too, into a broad anterior and a narrow posterior portion at the margins, the difference is more apparent than real. The oral sucker occupies the ventral surface of somites i-iv. The anus lies just behind the last (71st) ring.

The surface is on the whole rather smooth; in this respect the specimen comes nearer to var. *plana* than to var. *rugosa*. The dorsal surface is covered with numerous papillae, but they are all exceedingly low, and there seems to be no regularity as to their arrangement. The colour is a uniform pale gray.

One striking peculiarity in this specimen is that, on the ventral surface, the furrow separating the first and second annuli of each somite is markedly less deep than the others, in consequence of which the body appears, when viewed from this side, to be composed of double and single annuli arranged alternately. This is one of the rare instances among the Hirudinae where the somite limits are externally recognizable at a glance. On the dorsal surface, however, all the furrows appear quite alike, rendering it impossible to distinguish the inter-somital from interannular furrows. A similar condition was also noticed by Castle in some of his specimens of *Placobdella parasitica*, in which the anterior two-thirds of a somite appeared at places like a single broad annulus, but this character seems to have been present in his case on the dorsal as well as on the ventral surface of the body and not confined to the latter as in the case of our specimen.

#### *Trocheta quadrioculata*, sp. nov.

Localities :—Central region of Inlé Lake. "Colour blood-red."  
One specimen.

Central region of Inlé Lake on muddy bottom, 9-12 ft. One specimen.

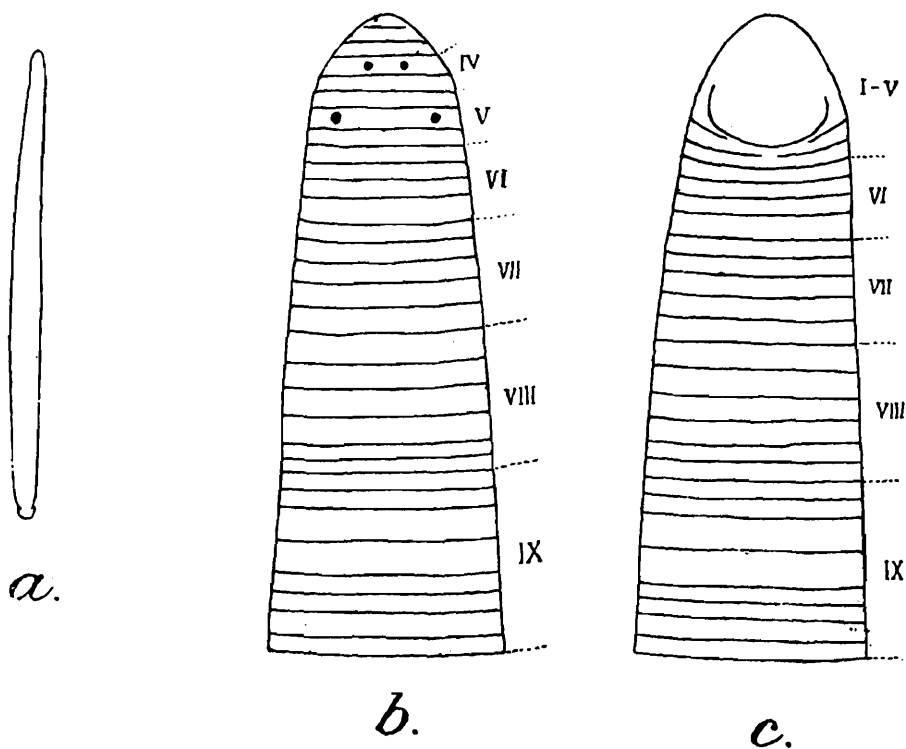
*Shape and dimensions.* Both specimens are small and seem to be immature. The body is long and slender, almost cylindrical, being only slightly wider in the middle than near the extremities. The head is rounded in front, forming the anterior lip of the spacious mouth. The hinder sucker is almost circular, a little broader than long, and is directed ventrally and backward.

The specimen from 9-12 ft. measures 24 mm. in length and

1.5 mm. in width; that from the first-named locality is 19 mm. in length and 1.3 mm. in width. The hinder sucker is about as wide as the body in both cases.

*External features.* The mouth is very wide and occupies the ventral surface of the first six rings. It is a spoon-shaped hollow directly continuous with the oesophagus. No jaws nor so-called pseudognaths are visible externally.

The eyes, in two pairs, are situated on the fourth and seventh rings, rather wide apart. In the individual from the first-named locality the posterior pair presents an anomaly in the fact that the right eye is placed one ring in front of the left eye, i.e.



TEXT-FIG. 5.—*Trocheta quadrioculata*, sp. nov.

- a. Outline of entire animal :  $\times 3$ .  
 b. Somites i-ix, dorsal view :  $\times 25$ .  
 c. Somites i-ix, ventral view :  $\times 25$ .

on ring 6. There is no marked difference in size between the anterior and posterior pairs.

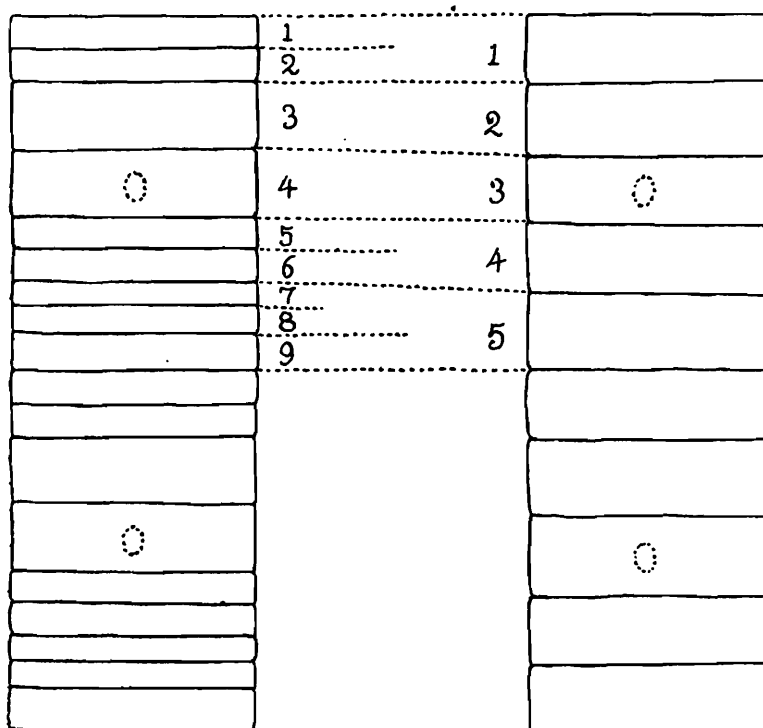
The genital apertures are very small, almost invisible, except the male opening of the smaller specimen which is rather prominent. The male pore is situated close to the posterior boundary of somite xi, the female pore just in front of the furrow separating ring 6 and ring 7 of somite xii; they are separated, thus, by a space equivalent to four rings of a five-ringed somite. The clitellum is not developed in either specimen.

The colour is pale grayish, a little yellowish anteriorly. There is no indication that the animal possessed any pattern during life. The surface is perfectly smooth all over.

As I have not studied the anatomy of the specimens, no

comparison can be made with allied forms in regard to the structure of internal organs. However, a minute study of the annulation of various similar-looking leeches from other sources has led me to the conclusion that the specimens under consideration can belong to no other genus than *Trocheta* Dutton.

*Annulation.* The study of the annulation of this leech presented a very great difficulty. Observed in alcohol, the furrows were almost invisible, the integument appearing entirely smooth throughout the whole extent of the body. It was necessary, therefore, to examine the specimens placed on a piece of blotting paper and illuminated from the side, when the furrows became visible as faint lines on the half-dried surface.



*a.*

*b.*

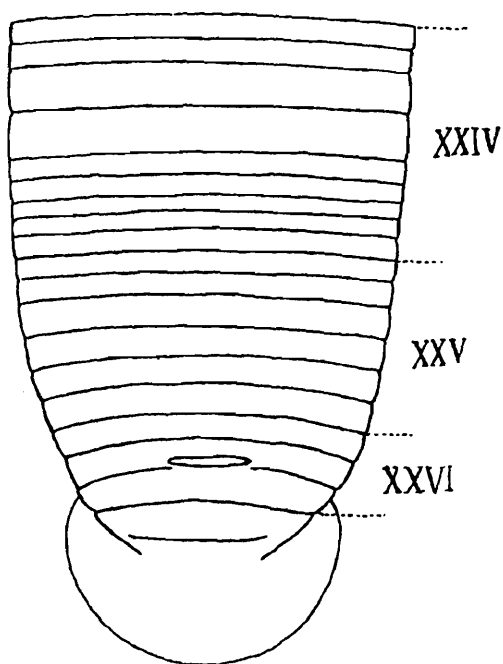
TEXT-FIG. 6.—Somites xvi and xvii of

*a. Trocheta quadrioculata*, sp. nov.

*b. Herpobdella atomaria*.

The annuli are very numerous and of different widths. Except at the extremities they fall into groups repeated metamERICALLY, each consisting of a definite number of broad and narrow rings. In the middle region of the body, we find two broad and seven narrow rings forming such a group, but where the somite limits exactly lie, it is impossible to tell for want of proper landmarks. A thorough investigation of those Herpobdellid genera, whose somites exhibit annuli of unequal widths, such as *Trocheta*, *Mimobdella*, and *Odontobdella* (as yet unpublished) enables me to state with certainty, that the somite limit falls between the fifth and sixth narrow rings. In other words, a somite in this species typically consists of nine annuli arranged in the following order: two narrow, two broad, and five narrow. Compared with the

five-ringed somite of *Hirudo* or *Herpobdella* (*Nephelis*) the first two rings of *Trocheta* correspond with the first ring of these leeches, the two broad rings with the second and third, the two narrow rings that come next with the fourth, and the last three narrow rings with the fifth. As shown in the accompanying figure, the narrow rings are not all of the same width, the seventh and eighth of each somite being always somewhat narrower than their neighbours either in front or behind. These rings have, in all probability, been derived by subsequent division from the anterior half of the last ring of a five-ringed somite and are, consequently, each equivalent to one-fourth of the original ring, while all the other narrow rings are each equivalent to one half of the original ring. In larger specimens of *Trocheta* from Japan these relations can be demonstrated so perfectly as to leave no doubt about the matter. The subject will be discussed more fully in my paper on the Herpobdellidae of Japan to be published shortly.



TEXT-FIG. 7.—*Trocheta quadrioculata*, sp. nov.  
Somites xxiv-xxvii, with sucker :  $\times 25$ .

I refrain from giving the exact number of rings in these specimens, as it was impossible to count them in some places. On the whole, the annulation appears to be very similar to that of Japanese species of the same genus.

#### Remarks upon the genus *Scaptobdella* Blanchard.

In my Synopsis of Japanese Leeches (13) I recognized the genus *Scaptobdella* Blanchard and described a new species under the name of *Scaptobdella blanchardi*. Subsequent studies, however, led me to cast doubts upon the validity of this genus, which I now regard as synonymous with the European genus *Trocheta*. The reasons for this change will be given in my future paper referred to above. M. P. Gedroyé, in his paper on European leeches (7) expressed his doubts as to the systematic value of the genus *Scaptobdella*, and in his Synopsis of Polish Leeches (8) published some years afterwards, he abolished that genus and placed *Scaptobdella horsti*, the type of the genus, in the genus *Trocheta* naming it *Trocheta horsti*. In this regard I am of exactly the same opinion as the Polish author.

It may also be mentioned here that I possess a specimen of a small leech from Formosa, which agrees well with the specimens here described, in size, shape, annulation, and above all in the number and arrangement of the eyes. I regard it, therefore, as belonging to the same species. It is interesting to note that a new species of leech with characters different from those of any known form, has been discovered almost simultaneously from two localities so widely separated from each other as Burma and Formosa.

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DESCRIPTIONS OF SOME INDO-MALAYAN SPECIES  
OF *CAPRITERMES* (TERMITIDAE).

By F. SILVESTRI.

Among a collection of Termites kindly submitted to me for determination by Dr. N. Annandale, Director of the Zoological Survey of India, I have found four species of *Capritermes* which I am describing in this note and I have added, with Dr. Annandale's kind permission, the description of two more species of the same genus which are in my collection from Sumatra.

*Capritermes gravelyi*, sp. nov.

(Fig. I.)

*Miles*. Corpus ochroleucum capite ochraceo-ferrugineo, mandibulis nigris.

Caput aliquantum minus quam duplo longius quam latius, lateribus antice paullum convergentibus, fontanella parva glandula sat magna, ab occipite ad parvum tractum supra fontanellam gradatim parum altius et supra fontanellam ipsam convexiusculum, superficie setis nonnullis instructa, labro longo, a media basi ad medium marginem anticum menso, subaeque longo atque lato, lateribus mediis parum convexis, margine antico profundiore sinuato, angulis anticis elongatis subtilibus corniformibus, margine externo ad cornuum basi parum producto, breviter et irregulariter inciso, mandibula laeva capitis longitudinem aequante et quam mandibula dextera aliquantum longiore, forma vide fig. I, 1-2, antennis 14-articulatis, articulo tertio quam secundus parum brevior et quartum longitudine aequante.

Pronotum quam caput magis quam  $1/3$  minus latum, lobi antici margine supero paullum sinuato, setis nonnullis sat longis et aliis brevibus et brevioribus instructo, meso- et metanoti margine postico medio subrecto vel vix sinuato, angulis rotundatis.

Pedes primi paris coxis antice ad marginem externum setis 6-7 brevibus robustis instructis, tibiae margine interno serie setis robustis 9-10, calcare externo quam interna parum minore.

Abdomen setis sat longis, setis brevibus et brevioribus numerosis instructum. Cerci breviores, parte distali subcylindracea.

Long. corp. mm. 5, long. capitis 2.10, ejusdem lat. 1.30, long. mandibulae laevae 2.10, antennarum 2.50, tibiae III, 1.30.

*Operarius*. Corpus stramineum capite ochroleuco.

Caput parum latius quam longius, supra setis parum numerosis brevibus instructum, fontanella circulari magna albicante,

clypeo bene inflato, ejusdem dimidia parte aequae longa atque lata, antennis 14-articulatis, articulo tertio quam secundus parum brevior et quartum longitudine subaequante.

Pronotum lobi anteriori margine superiori rotundato, meso- et

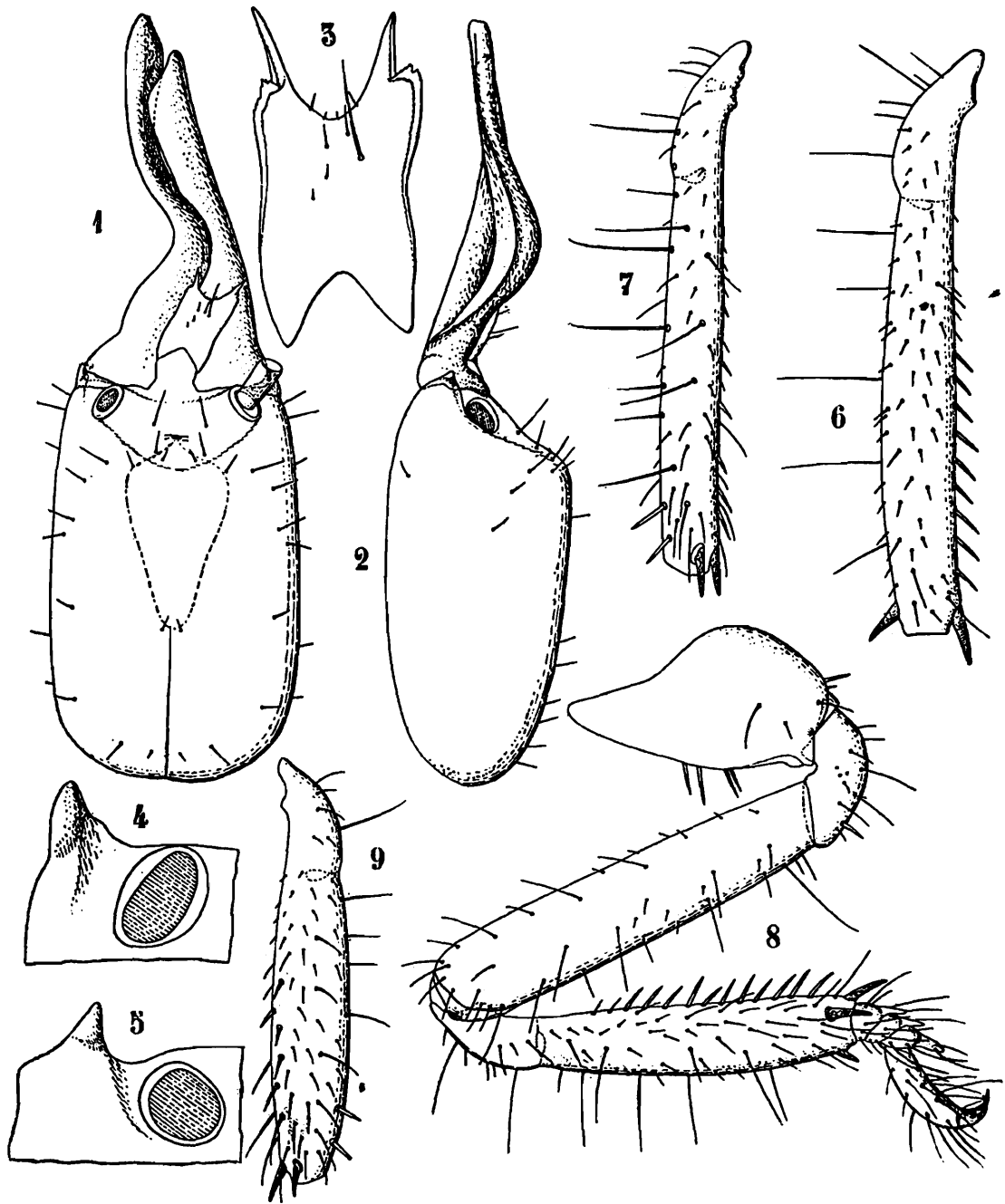


FIG. 1.—*Capritermes graveleyi*: 1. militis caput pronum; 2. idem lateraliter inspectum; 3. labrum; 4. epicranii pars antica lateralis laeva prona; 5. eadem lateraliter inspecta; 6. tibia primi paris; 7. tibia secundi paris; 8. operarii pes primi paris; 9. operarii tibia secundi paris.

metanoti margine postico et pedibus eisdem militis similibus sed pedum primi paris coxis tantum setis externis 3-4.

Abdomen setis numerosis quam eadem militis parum brevioribus.

Long. corp. mm. 4.2, long. capitis 1.10, ejusdem lat. 1.18, long. antennarum 1.60, tibiae III, 1.04.

*Habitat.* Exempla typica ad Kas, Satara Distr., 3700 ft., clar. F. H. Gravely legit, alia (paratypi!) idem Gravely ad Helvak et Vela, Koyna Valley, Satara Distr. ca. 2000-2100 ft. et E. side of Koyna Valley legit.

*Observatio.* Species haec ad *C. longirostris* Wasm. valde affinis est, sed militis capite ab occipite ad frontis partem anticam gradatim parum altiore (in *C. longirostris* linea supera fere subrecta), labro parum magis elongato, operarii tibiis primi paris setis internis robustis magis numerosis armata, bene distincta est.

### **Capritermes longirostris** Wasm.

var. **cornutella**, nov.

(Fig. II.)

*Miles.* Corpus cremeum capite ochraceo-ferrugineo, mandibulis nigris.

Caput ca.  $\frac{1}{3}$  longius quam latius, lateribus antice paullum convergentibus, supra ab occipite ad parvum tractum ante fontanellam gradatim parum altius et supra fontanellam ipsam discendens superficie setis parum numerosis instructa, fontanella parva, epicrani margini antico sublaterali ad mandibularum basim in processum brevem conicum producto, labro longo a media basi ad medium marginem anticum meso subaeque longum atque latum, lateribus antice parum latioribus angulis anticis elongatis corniformibus, margine externo ad cornuum basim breviter et irregulariter inciso, mandibula laeva capitis longitudinem aequante et quam dextera parum longiore, forma vide fig. II, 1-2, antennis 14-articulatis, articulo tertio secundum longitudine aequante et quam quartus parum longiore.

Pronotum quam caput fere dimidio minus latum, lobi antici margine antico sat profunde et anguste sinuato, setis nonnullis sat longis et aliis brevioribus instructum, meso- et metanotum margine postico medio subrecto, angulis rotundatis.

Pedes primi paris coxis setis robustis 6-7 externis, tibia setis brevibus robustis 9-10 internis, calcare externo quam interna fere  $\frac{2}{3}$  brevior, setis ceteris vide fig. II, 5-6, secundi paris tibiae spinis duabus externis sat longis et sat robustis.

Abdomen setis sat longis parum numerosis et setis brevibus et brevioribus magis numerosis instructum. Cerci breviores, parte distali subcylindracea.

Long. corp. mm. 4.6, long. capitis 1.84, ejusdem lat. 1.20, long. mand. laevae 1.84, antennarum 2, tibiae III, 1.10.

*Operarius.* Corpus cremeum capite ochroleuco.

Caput parum latius quam longius supra setis brevibus et brevioribus parum numerosis instructum, clypeo bene inflato, ejusdem dimidia parte subaeque longa atque lata, antennis 14-articulatis, articulo tertio quam secundus ca.  $\frac{1}{3}$  brevior et quam quartus parum longiore.

Pronotum lobi antici margine medio vix inciso.

Pedes primi paris tibia calcare externo perparvo, cetero eisdem militis subsimiles ut fig. II, 7-8, demonstrant.

Long. corp. mm 4, long. capitis 0.90, ejusdem lat. 1.10, long. antennarum 1.30, tibiae III, 0.90.

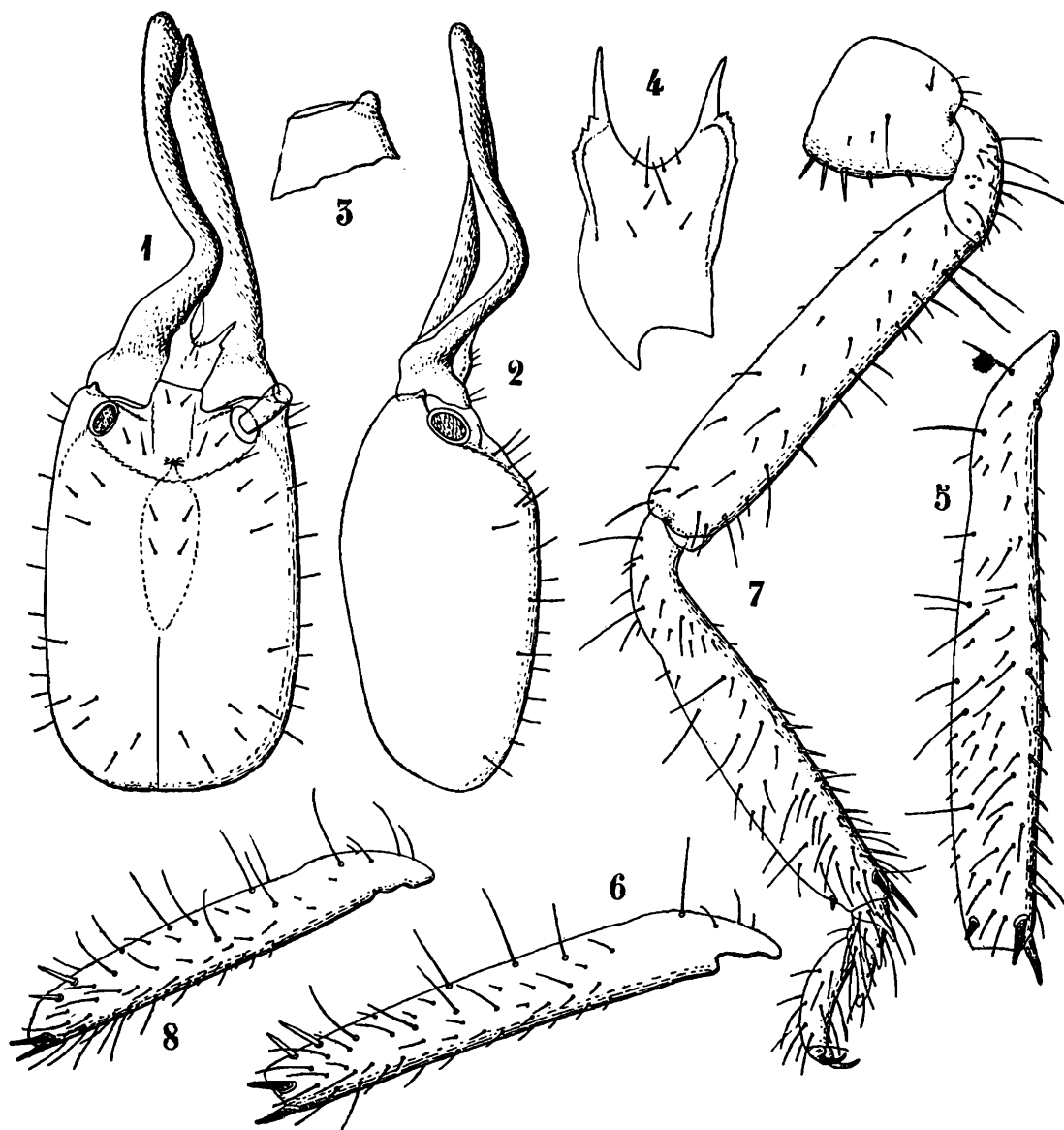


FIG. II.—*Capritermes longirostris* var. *cornutella*: 1. militis caput pronum; 2. idem lateraliter inspectum; 3. epicranii pars antica lateralis dextera parum oblique inspecta; 4. labrum; 5. tibia primi paris; 6. tibia secundi paris; 7. operarii pes primi paris; 8. operarii tibia secundi paris.

*Habitat.* Milites duos et operarios paucos ad Akalpa, Randal Valley, Ratnagiri distr. collectos vidi.

*Observatio.* Subspecies haec statura minore a forma typica *C. longirostris* Wasm. distinctissima est.

### *Capritermes santschii*, sp. nov.

(Fig. III-IV.)

*Femina alata.* Corpus castaneum, sternorum parte mediana, sterniti sexti parte postica excepta, ochroleuca, alis fumosis.

Caput parum longius quam inter oculos latius, supra setis

sat numerosis brevibus et setis brevissimis magis numerosis instructum, fenestra sat magna, ovali, fusca, clypeo parum inflato, ejusdem dimidia parte parum latiore quam longiore, oculis sat magnis et sat prominentibus, ocellis ab oculis quam ocelli diametros transversalis parum minus distantibus, antennis 14-articulatis, articulo tertio quam secundus  $\frac{1}{4}$  et quam quartus fere duplo longiore.

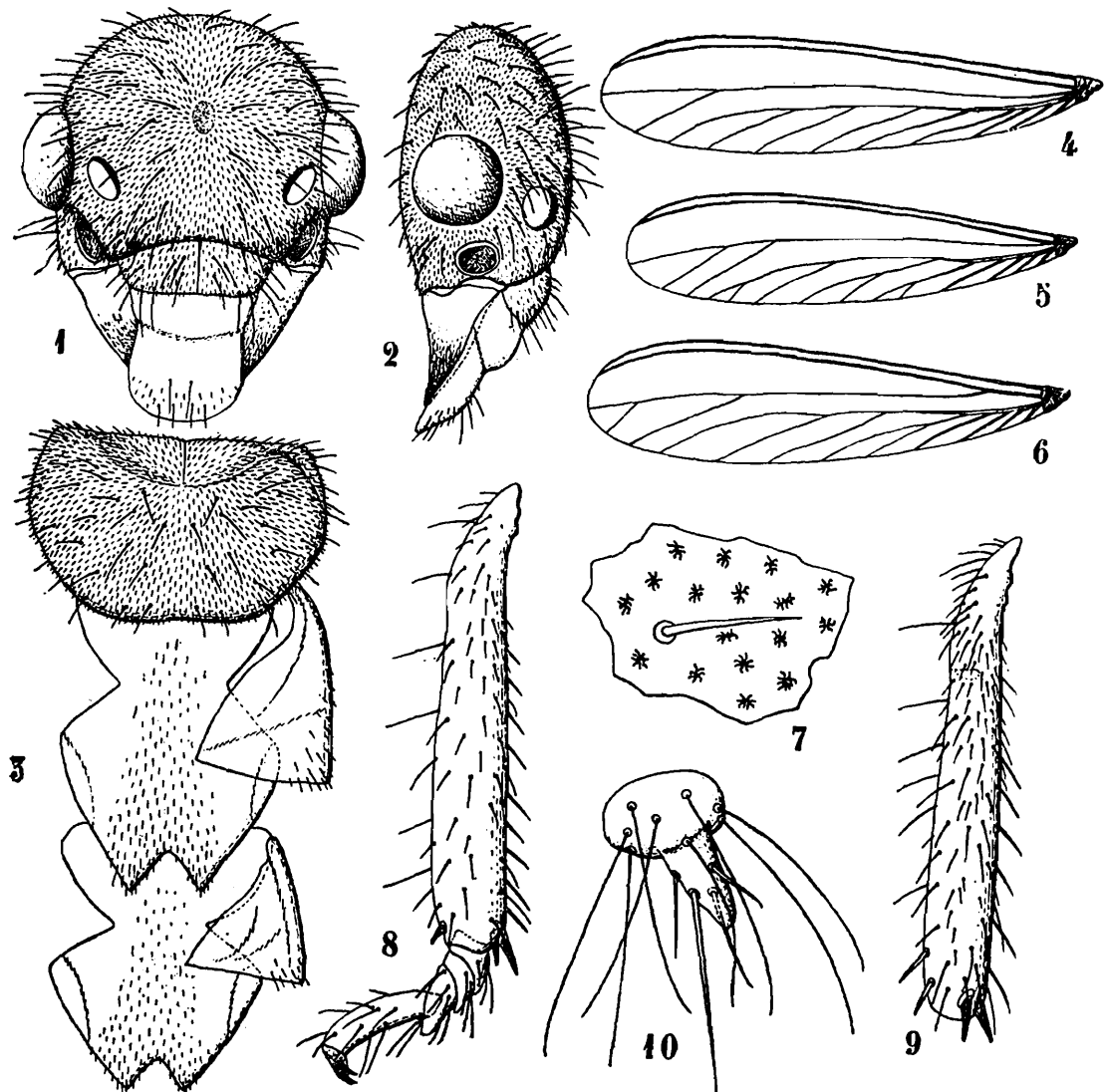


FIG. III.—*Capritermes santschii*, alatus: 1. feminae caput pronum; 2. idem lateraliter inspectum; 3. thorax pronum; 4-5. ala interior et ala posterior; 6. ala anterior anomala; 7. alae particula multo ampliata; 8. pes primi paris a tibia; 9. tibia secundi paris; 10. cercus.

Pronotum quam caput cum oculis ca.  $\frac{1}{8}$  minus latum, antice brevi tractu sursum vergens, lateribus postice convergentibus angulis rotundatis, margine postico medio vix sinuato; meso- et metanotum lateribus convergentibus, margine postico angulatim profunde inciso, angulis posticis acutis.

Alae superficie tuberculis minimis, 6-7 radiatis obsessis et setis sparsis brevibus instructa, venis vide fig. III, 4-5.

Pedes primi paris tibia interne setis sat numerosis instructa,

calcare externo quam interna multo brevior, secundi paris tibia spinis apicalibus duabus externis sat robustis.

Abdominis tergita setis brevioribus sat numerosis et setis brevissimis numerosis sternita setis brevibus, brevioribus et brevissimis instructa, pleuris setis brevioribus numerosis vestitis.

Long. corp. cum alis mm 11, sine alis 6, long. capitis 0.91, ejusdem lat. inter oculos 0.82, diametros longitudinalis oculi 0.32,

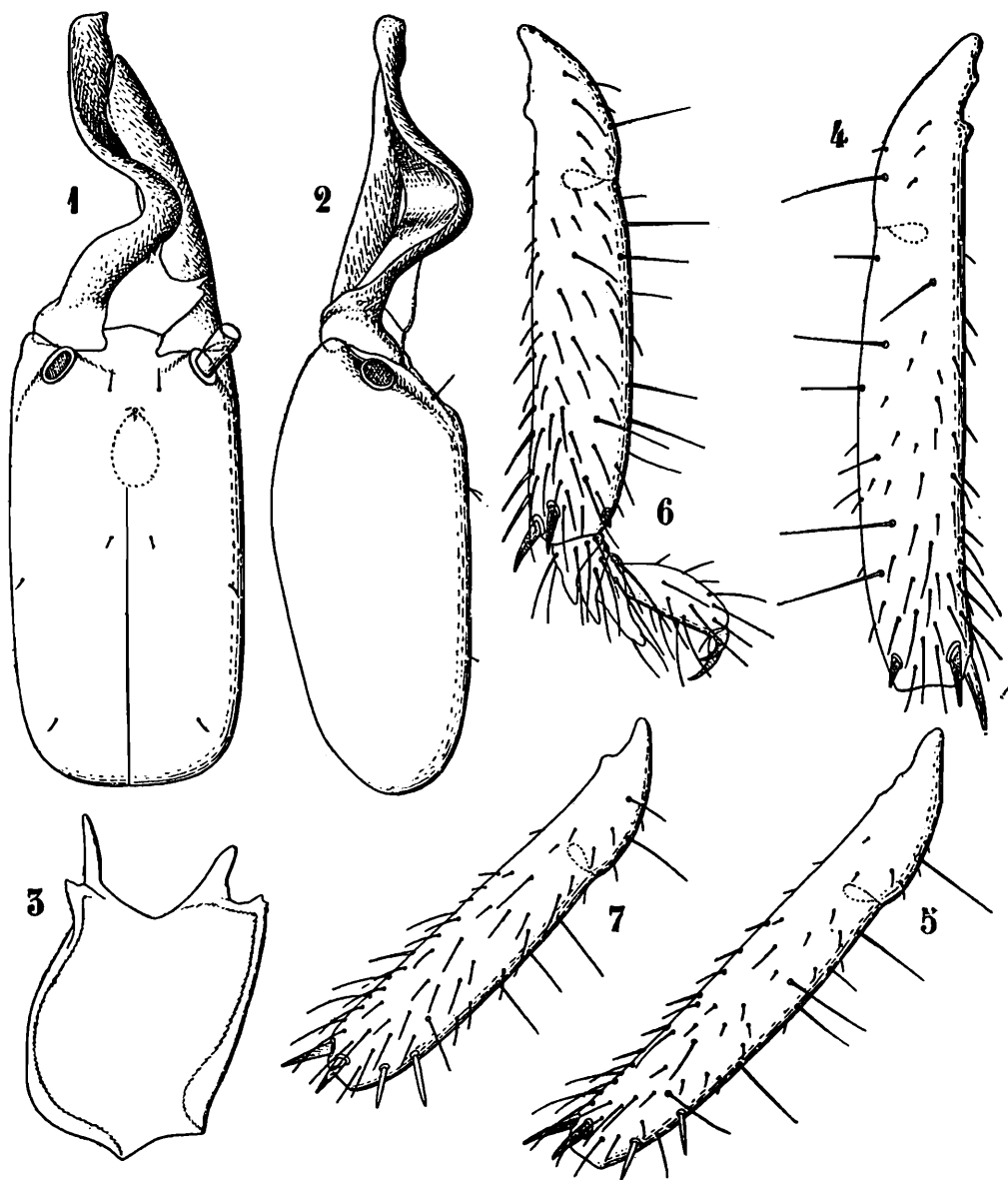


FIG. IV.—*Capritermes santschii*: 1. militis caput pronum; 2. idem lateraliter inspectum; 3. labrum; 4. tibia primi paris; 5. tibia secundi paris; 6. operarii pes primi paris a tibia; 7. tibia secundi paris.

long. antennarum 1.70, alae anticae 9.5, ejusdem lat. 2.5, long. tibiae III, 1.05.

*Miles.* Corpus cremeum capite ochroleuco, mandibulis nigris.

Caput duplo longius quam latius lateribus parallelis, dorso usque fere ad fontanellam subplanum antice discendens, setis nonnullis instructum, fontanella perparva glandula cephalica parva, labro aequo longo (processibus anticis exceptis) atque lato,

latere laevo convexiusculo, dextero parum obliquo, angulis anticis processuum iustar elongatis et margine ad processuum basim aliquantum producto ut fig. IV, 3, demonstrat, margine antico sinuato, mandibula dextera quam laeva aliquantum longiore et quam caput ca.  $\frac{1}{4}$  brevior, antennis 14-articulatis, articulo tertio quam secundus paullum et quam quartus ca.  $\frac{1}{3}$  longiore.

Pronotum quam caput ca.  $\frac{1}{3}$  minus latum, lobi antici margine parum sinuato, setis nonnullis sat longis et aliis brevissimis instructum, mesonotum postice paullum sinuatum, metanotum postice subrectum.

Pedes primi paris coxis setis 4-5 brevioribus, parum robustis et aliis brevissimis, tibia interne setis modice numerosis parum robustis, calcare externo quam interna multo brevior, secundi paris tibia spinis duabus distalibus externis elongatis.

Abdominis tergita et sternita setis brevibus, brevioribus et brevissimis simul sumptis numerosis instructa. Cerci articulo secundo elongato.

Long. corp. mm. 5, long. capitis 2.08, ejusdem lat. 1.04, long. mandibulae laevae 1.50, antennarum 2, tibiae III, 0.90.

*Operarius*. Corpus cremeum, capite ochroleuco, abdomine cibi contenti causa cinereo.

Caput paullum latius quam longius supra setis parum numerosis brevibus et aliis brevioribus et brevissimis instructum, fontanella circulari straminea, clypeo bene inflato, ejusdem dimidia parte subaeque longa atque lata, antennis 14-articulatis, articulo tertio quam secundus fere  $\frac{1}{3}$  brevior et quam quartus parum longiore.

Pronotum lobi antici margine vix sinuato. Pedes primi paris tibia calcare externo perparvo.

Abdominis tergita et sternita setis numerosis brevioribus et paucis brevibus vel sat longis instructa.

Long. corp. mm. 3.4 long. capitis 0.88, ejusdem lat. 0.96, long. antennarum 1.30, tibiae III, 0.78.

*Habitat*. Sumatra: Padang-Pandjang. Exempla nonnulla cl. F. Santschi mihi dedit.

*Observatio*. Species haec ad *C. nemorosus* Hav. proxima est, sed adulti alis longioribus, militis capite parum angustiore, labro processibus parum brevioribus, mandibulis parum brevioribus sat bene distincta est.

### *Capritermes distortus*, sp. nov.

(Fig. V.)

*Femina alata*. Corpus rufo-castaneum, thoracis parte ventrale et pedibus fulvescentibus, urosternitis ochroleucis lateraliter rufis, alis fumosis.

Caput paullum longius quam inter oculos latius, supra setis sat numerosis sat longis et setis magis numerosis brevioribus instructum, fenestra parva longitudinali quam capitis cetera superficies parum pallidiore, clypeo sat inflato, ejusdem dimidia

parte paulum longiore quam latiore, oculis parvis bene convexis et prominulis, ocellis ab oculis quam ocelli diametros transversalis paulum minus distantibus, antennis 15-articulatis, articulo tertio quam secundus parum magis quam dimidium brevior et quam quartus parum brevior.

Pronotum quam caput cum oculis ca.  $1/6$  minus latum, antice brevi tractu sursum vergens, lateribus postice convergentibus, angulis rotundatis, margine postico medio vix sinuato, meso- et metanotum lateribus convergentibus, margine postico angulatim profunde inciso, angulis ipsis plus minusve rotundatis.

Alae superficie tuberculis minimis 6-7 radiatis obsessis et setis nonnullis brevibus fere omnibus per venas et per marginem instructa, venis vide fig. V, 4-5.

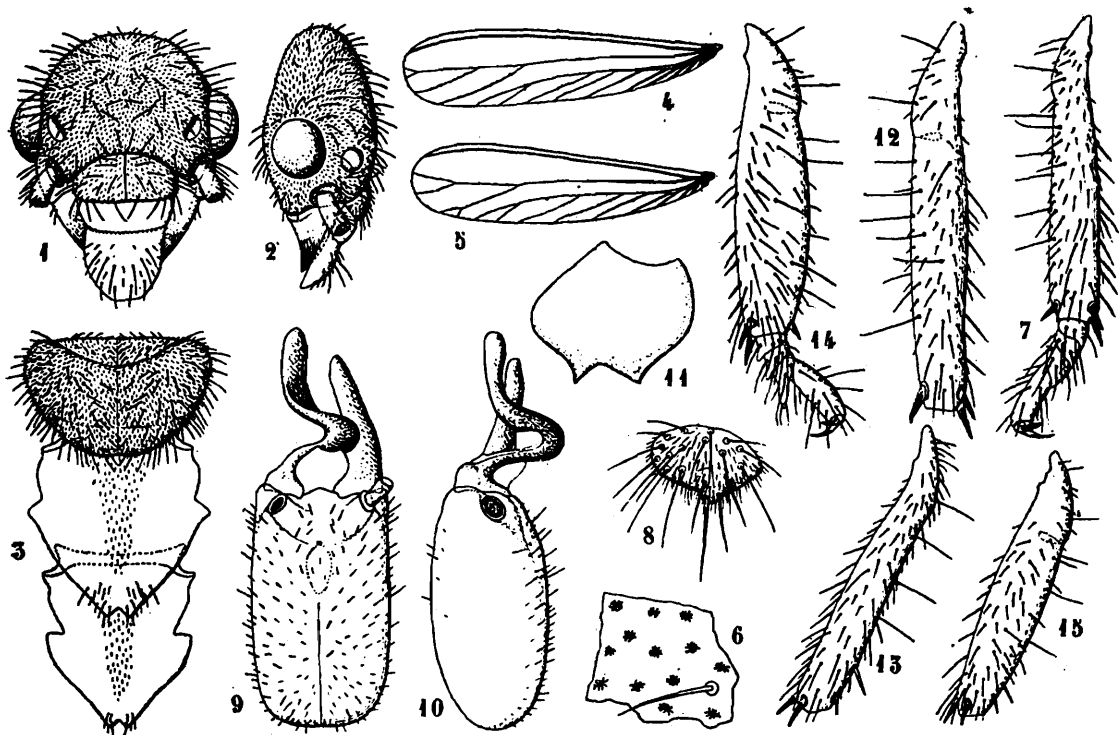


FIG. V.—*Capritermes distortus*: 1. feminae caput pronum; 2. idem lateraliter inspectum; 3. thorax pronum; 4-5. ala anterior et ala posterior; 6. alae particula multo ampliata; 7. pes primi paris a tibia; 8. cercus; 9. militis caput pronum; 10. idem lateraliter inspectum; 11. labrum; 12. tibia primi paris; 13. tibia secundi paris; 14. operarii pes primi paris a tibia; 15. operarii tibia secundi paris.

Pedes primi paris tibia interne setis sat numerosis et sat robustis, calcare externo quam interna paulum brevior, secundi paris tibia spinis externis duabus distalibus sat robustis.

Abdominis tergita et sternita setis brevibus sat numerosis et setis brevioribus pernumeris instructa, pleuris setis brevioribus numerosis. Cerci breviores.

Long. corp. cum alis mm. 10, sine alis 6, long. capitis 0.86, ejusdem lat. inter oculos 0.84 diametros longit. oculi 0.28, long. antennarum 1.60, alae anticae 8.5, ejusdem lat. 2.1, long. tibiae III, 0.97.

*Miles.* Corpus cremeum capite ochraceo, mandibulis nigris.

Caput magis quam  $1/3$  longius quam latius lateribus parallelis, fontanella parva, ab hac aliquantum descendens, supra setis numerosis brevibus instructum, labro brevi aliquantum latius quam longius, lateribus aliquantum convexis, margine antico sinuato angulis ipsis acutis, setis haud distinctis (in exemplo typico), mandibula dextera quam laeva aliquantum brevior, subacuta, mandibula laeva quam caput  $1/3$  brevior, forma vide fig. V, 9-10, antennis? (in exemplo typico articulis a decimo abruptis), articulo tertio quam secundus vix brevior et quam quartus aliquantum longior.

Pronotum quam caput ca.  $1/3$  minus latum, lobi anteriori margine supero vix sinuato, supra setis nonnullis sat longis instructum, mesonoti margine postico paullum sinuato, metanoti rotundato.

Pedes setis et calcaribus vide fig. V, 12-13.

Abdominis tergita et sternita setis sat longis parum numerosis et setis brevioribus et brevissimis instructa. Cerci breviores gradatim parum angustiores.

Long. corp. mm. 5, long. capitis 1.65, ejusdem lat. 0.98, long. mandibulae laevae 1.15, antennarum? ; tibiae III, 0.90.

*Operarius.* Corpus cremeum capite ochraceo, abdomine cibi contenti causa cinereo.

Caput aequae longum atque latum, supra setis sat numerosis brevibus et nonnullis brevioribus instructum fenestra parum distincta, clypeo bene inflato, ejusdem dimidia parte parum latiore quam longiore, antennis 14-articulatis, articulo tertio quam secundus aliquantum brevior et quam quartus aliquantum longior.

Pronotum lobi anteriori margine vix inciso, cetero thorace et abdomine eisdem militis similibus.

Pedes setis et calcaribus vide fig. V, 14-15, notandum est primi paris tibiae calcar externum quam interna, fere dimidio brevius.

Long. corp. mm. 3.5, lat. capitis 0.78, long. antennarum 1.25, tibiae III, 0.70.

*Habitat.* Exempla nonnulla alata, paucos operarios et militem unum cl. F. H. Gravely ad Kavalai (1300-3000 ft.), Cochin State, 24-27 ix 1914 legit.

*Observatio.* Species haec ad *C. ceylonicus* Holmgren affinis, sed statura minore, militis capitis labri forma bene distincta est.

### **Capritermes tetraphilus, sp. nov.**

(Fig. VI.)

*Miles.* Corpus ochroleucum capite ochraceo ferrugineo, antice ferrugineo testaceo, mandibulis nigris.

Caput magis quam  $1/3$  longius quam latius, lateribus subparallelis, supra subplanum, antice gradatim parum descendens, setis nonnullis instructum, fontanella perparva, glandula cephalica parva, labro brevi aliquantum latiore quam longiore, lateribus irregulariter convexis, angulis anticis angustioribus aliquantum

productis, margine antico subrecto setis nunnallis longis instructo, mandibula laeva quam dexteram aliquantum longiore et quam caput fere  $\frac{1}{3}$  brevior, forma vide fig. VI, 1-2, antennis 14-articulatis, articulo tertio quam secundus paullum brevior et quam quartus parum longior.

Pronotum quam caput aliquantum minus latum, lobo antico parvo margine medio vix sinuato, setis quatuor sat longis et setis nonnullis brevissimis instructum, meso- et metanotum margine postico vix sinuato setis 2+2 sat longis et setis brevissimis instructo.

Pedes primi paris tibia interne setis 9-10 sat robustis, calcare externo quam interna parum brevior, secundi paris tibia spinis externis duabus robustis (in pede nonnullo spina tantum una sistente).

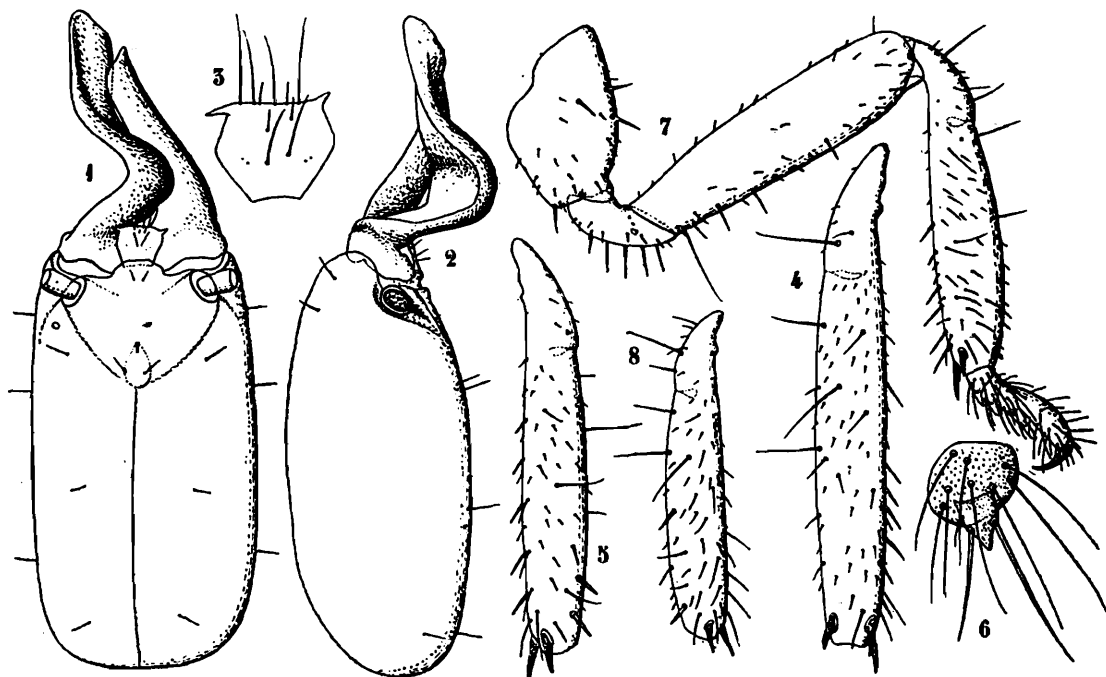


FIG. VI.—*Capritermes tetraphilus*: 1. militis caput pronum; 2. idem lateraliter inspectum; 3. labrum; 4. tibia primi paris; 5. tibia secundi paris; 6. cercus; 7. operarii pes primi paris; 8. tibia secundi paris.

Abdomen tergitis setis 2+2 sat longis, setis brevioribus 2+2 et setis brevissimis instructis, sternitis anticis setis sat longis paucis, posticis setis sat longis nonnullis, nec non setis brevioribus nonnullis et setis brevissimis numerosis instructis. Cerci breviores apice acuto, setis et sensillis vide fig. VI, 6.

Long. corp. mm. 6, long. capitis 2.60, ejusdem lat. 1.50, long. mand. laevae 1.82, antennarum 1.90, tibiae III, 1.30.

*Operarius*. Corpus stramineum capite cremeo, abdomine cibi contenti causa cinereo.

Caput paullum latius quam longius, supra setis nonnullis brevibus et brevioribus instructum, clypeo bene inflato ejusdem dimidia parte parum latiore quam longiore, fontanella sat magna straminea, antennis 14-articulatis, articulo tertio quam secundus ca.  $\frac{1}{3}$  brevior et quam quartus ca.  $\frac{1}{3}$  longior.

Pronotum lobi antici margine supero rotundato, setis nonnullis sat longis, brevibus et brevioribus instructum, meso- et metanotum margine postico vix sinuato.

Pedes primi paris coxis setis robustis 2-3, tibia setis brevibus robustis internis 5-6, calcare externo quam interna aliquantum brevior, secundi paris tibia spinis externis parum robustis inter sese remotis (in pede nonnulla spina una).

Abdomen tergitis et sternitis setis paucis sat longis, setis brevibus parum numerosis et setis brevissimis magis numerosis instructum. Cerci parte distali subconica.

Long. corp. mm. 4, long. capitis 1.02, ejusdem lat. 1.08, long. antennarum 1.52, tibiae III, 1.

*Habitat.* Rangamati, Chittagong Hill Tracts, Bengal (R. Hodgart).

*Observatio.* Species haec ad *C. ceylonicus* Holmg. proxima est, sed militis statura majore, capitis parte postica altiore praesertim distincta est.

#### *Capritermes modiglianii*, sp. nov.

*Miles.* Corpus ochroleucum capite ochraceo antice latericio conspurcato, mandibulis nigris.

Caput minus quam  $\frac{1}{3}$  longius quam latius lateribus subparallelis supra latissime convexum, setis nonnullis instructum, fontanella perparva, glandula cephalica parva, labro brevi subaeque longum atque latum, latere laevo ad basim parum convexo, dextero parum concavo, margine antico subrecto, angulis anticis acutis parum productis, superficie setis nonnullis brevibus instructa, antennis 14-articulatis, articulo tertio quam secundus fere  $\frac{1}{3}$  longiore et quam quartus fere duplo longiore.

Pronotum lobi antici margine antico medio paullum sinuato setis nonnullis longis et aliis brevioribus instructum, mesonotum postice paullum convexum, metanotum vix sinuatum.

Pedes primi paris coxis seta nonnulla sat robusta elongata, tibiae margine interno setis elongatis, calcaribus subsimilibus, secundi paris tibiae spinis duabus externis distalibus elongatis.

Abdomen tergitis et sternitis setis nonnullis sat longis et setis brevioribus et brevibus sat numerosis instructis. Cerci breviores apice subconico.

Long. corp. mm. 6, long. capitis 2.10, ejusdem lat. 1.21, long. mandibulae laevae 1.62, antennarum 1.80, tibiae III, 1.18.

*Operarius.* Corpus ochroleucum abdomine cibi contenti causa cinereo.

Caput paullum latius quam longius supra setis sat numerosis brevibus et brevioribus instructum, fontanella straminea sat magna, clypeo bene inflato ejusdem dimidia parte parum latiore quam longiore, antennis 14-articulatis, articulo tertio secundum longitudine aequante et quam quartus parum longiore.

Pronotum lobi antici margine rotundato cetero thorace et abdomine eisdem militis similibus.

Pedes primi paris tibiae calcare externo quam interna multo brevior.

Long. corp. mm. 3.6, long. capitis 0.95, ejusdem lat. 1.04, long. antennarum 1.70, tibiae III, 1.30.

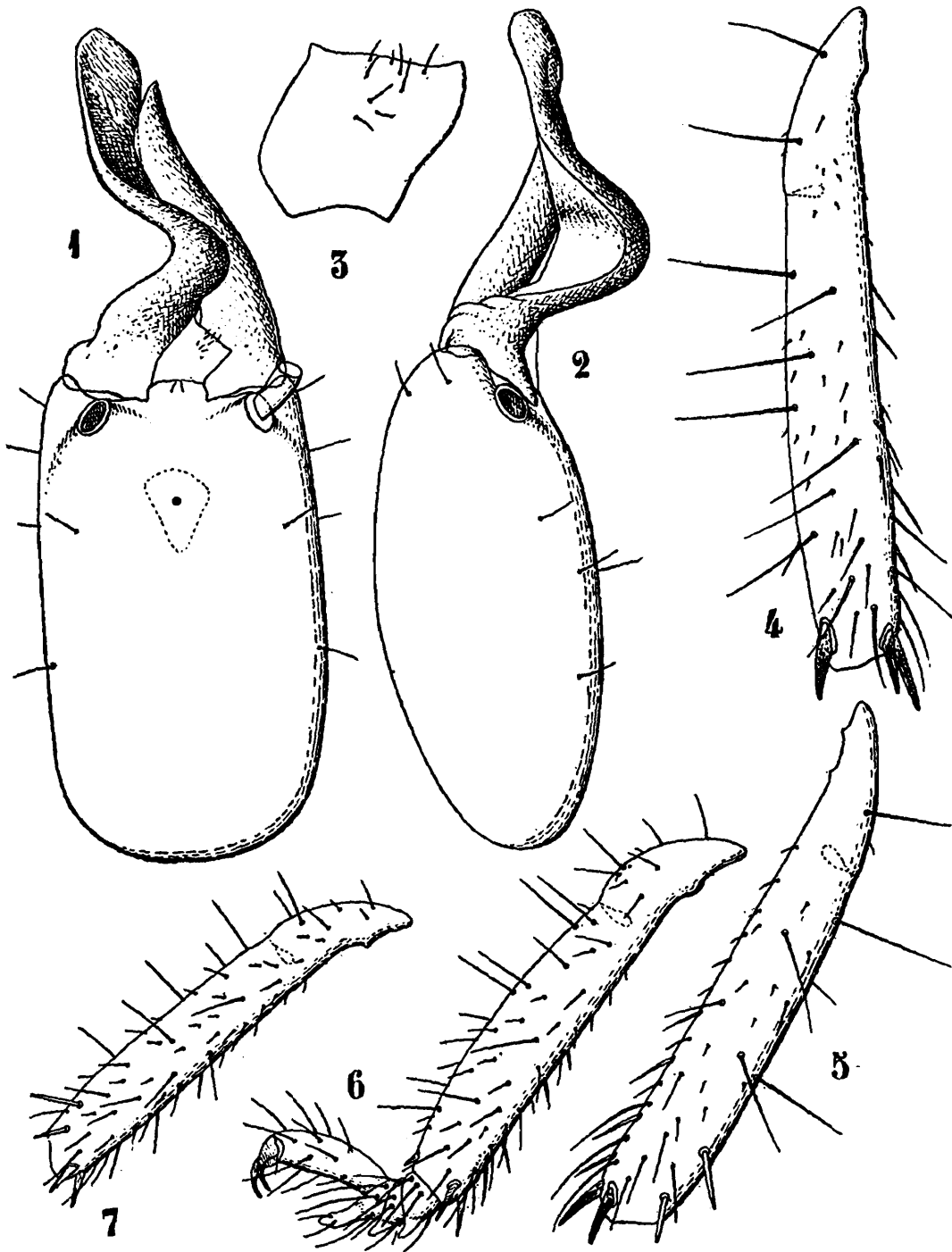


FIG. VII.—*Capritermes modiglianii*: 1. militis caput pronum; 2. idem lateraliter inspectum; 3. labrum; 4. tibia primi paris; 5. tibia secundi paris; 6. operarii pes primi paris a tibia; 7. tibia secundi paris.

*Habitat.* Militem et operarium tantum vidi ad Doloc-Tolong (Sumatra) a cl. E. Modigliani, cui species dicata est, collecta.

*Observatio.* Species haec statura minore militis labri forma et setis a *C. ceylonicus* Holmgr. bene distincta est et a *C. buitenzorgi* Holmg. saltem statura minore etiam distincta est.