RECORDS

of the

INDIAN MUSEUM

(A JOURNAL OF INDIAN ZOOLOGY)

Vol. XXIV, 1922

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[*N.B.*—An asterisk (*) preceding a line denotes a new variety or subspecies; a dagger (†) indicates a new species; a double dagger (‡) a new genus or subgenus; synonyms are printed in italics.]

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NEW AND RARE ODONATA FROM THE NILGIRI HILLS.

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

(Plate I.)

The Odonate fauna of the Nilgiris is of more than ordinary interest in that these hills have furnished some of the earliest known types of Dragonflies.

The Nilgiris were first explored by Europeans in 1822 and Rambur described several species of dragonflies in 1842 which had been collected from those hills during the two decades which had elapsed.

Unfortunately the descriptions given by this entomologist, although good, are often not too exact and lead to doubt as to what particular insect was described, especially in a case where there are several insects closely similar. Amongst these latter is the description of *Indoneura gomphoides* (*Argia gomphoides* Ramb.) which was obviously made from an immature insect and which does not give the exact measurements.

The Baron de Selys in his *Synopsis des Agrionines*, p. 20, 1842, redescribed *I. gomphoides* and gave the measurements of the abdomen and hindwing. It is evident that he knew the type and made his description from it, for in 1886, in his *Revision des Agrionines*, p. 171, he described under the same name, two specimens which he had received from Mr. McLachlan and, concerning them, noted that they differed from the type by being larger, by having the wings more rounded and Cu_1 rather longer. This implies a close; personal comparison of two types and leaves no doubt as to which was the original of *Indoneura gomphoides,* viz. the smaller of the two species.

Of the two other closely related species found in the Nilgiris *Disparoneura canningi* Fraser has no blue markings and *Disparoneura westermanni* Hagen is much larger than either of the two species described by Selys.

During the last decade I have had several opportunities of collecting and examining large numbers of specimens of *Indoneura* over a wide range of the Nilgiris, and I find that there are two very distinct types of *I. gomphoides* as described by Selys, the smaller of which is undoubtedly Rambur's type, and the larger a new species for which I propose the name *Indoneura ramburi*.

Indoneura gomphoides (Ramb).

Argia gomphoides, Ramb , *Ins. Nevrop.*, p. 256 (1842); *Alloneura et Disparoneura gomphoides*, Selys, *Syn. des Agrionines*, p. 448 (1860) *id.*, *Rev. des Agrionines*, p. 171 (1886); *Indoneura gomphoides*, Laid., *Rec. Ind. Mus.* XIII, p. 347 (1917).

Male. Abdomen 36 mm. Hindwing 26 mm.

The markings in the adult stage are all turquoise blue, the thoracic ground colour is citron yellow only in teneral specimens and soon passes to pale blue whilst the humeral stripes take on a deeper shade.

The abdomen is moderately robust and short, and built more on the lines of *Calicnemis eximia*.

The wings are moderately sharply pointed at the apex; *ac* is situated midway between the two antenodal nervures and meets *ab* well away from the posterior margin of the wing; Cu_2 is 11 cells in length: the stigma is dark brown framed in black nervures; the postnodal nervures in the forewing number 19-22.

Female. The markings in this sex are a dirty grey, the humeral stripe often having an ochreous hue. The markings on the end segments of the abdomen are bluish.

Habits. This species frequents streams on the kundahs (open grassy country) around Ootacamund, where in restricted localities it may be seen swarming during the early months of the year before the onset of the monsoon. The break of the rains in June leads in a few days to its total disappearance although on fine days or during temporary breaks in the monsoon, a few stragglers may be seen.

Indoneura ramburi, sp. nov.

Disparoneura gomphoides, Selys, l.c. (1886).

Male. Abdomen 44 mm. Hindwing 30 mm.

The markings do not differ markedly from those of *Indoneura gomphoides* and are coloured turquoise blue in the adult, citron yellow in immature specimens.

The abdomen is very long and slim when compared to that of *I. gomphoides* and is built more on the lines of that of *Coeliccia renifera*.

The wings are more blunt at the apex; *ac* is situated much nearer the basal antenodal nervure and meets *ab* almost or just at the posterior margin of the wing; Cu_2 is 13 or more cells in length; the stigma is black; the postnodal nervures number in the forewing 22–32.

The anal appendages do not differ from those of *Indoneura gomphoides*.

Female. Abdomen 42 mm. Hindwing 30 mm.

Except for its greater length, not differing from the female of *I. gomphoides*. Stigma pale brown. Postnodal nervures in forewing 22–23.

Habits. This species is found at a lower level than the former and has a much more scattered and extended range between 3000 ft. to 6500 ft. It is never found in swarms as is *I. gomphoides* and it often travels far from the neighbourhood of its native streams, extending deep into the jungle.

Unlike *I. gomphoides* it does not appear much before the onset of the monsoon in June and from that time onwards during the rains, gradually increases in number. I have never found the two species in company and they are certainly quite distinct. The type described by Selys is presumably in the McLachlan collection but I cannot say for certain as I omitted to take the measurements when examining the collection in 1920.

In males taken at an elevation of 3000 ft., abdominal segments 8 and 9 show an almost constant invasion of the blue by the black ground colour from the base. This latter colour projects into the blue as a subdorsal streak on each side and limits it also laterally so that on each segment an inverted blue "T" is formed. In all other respects these specimens agree with *Indoneura ramburi* so that they are probably not more than a local variety of it.

Type in my own collection, paratypes in British and Indian Museums.

Phylloneura westermanni (Selys).

Alloneura westermanni, Bull. Acad. Belg. (2) X, p. 447 (1860); *Disparoneura westermanni*, Selys, *Mem. Cour.* XXXVIII, p. 171 (1886); Laidlaw, *Rec. Ind. Mus.* XIII, p. 347 (1917).

Male. Abdomen 51 mm. Hindwing 38 mm.

This insect has been lost sight of for many years and some doubt exists as to what genus the insect really belonged to. Recently I have secured twelve male specimens of a dragonfly from near Gudalur, Nilgiris, 4500 ft., 26·vi·1921, which fit the description and measurements given for *P. westermanni* so exactly that there can be no doubt but that they belong to that species.

The colouring is closely similar to that of *I. gomphoides* so that the two insects are apt to be mistaken for one another when resting or on the wing and I fell into this error when I took the first specimen of *P. westermanni* and imagined that I had taken a particularly fine and large specimen of *I. gomphoides.* The former insect is, however, very much larger and the blue on the abdominal segments more extensive, covering the apical half of the 7th segment as well as the whole of the 8th to 10th.

The venation of the wing is irregular and is of interest in that it shows well-marked traces of a transitional reduction from a complex to a simple form of venation. Rudiments of intercalated sectors are found in the wings of many specimens and the straightening out of a zig-zagged M_2 is well illustrated.

P. westermanni is even more primitive than *Indoneura* and is not congeneric with the latter as Dr. Laidlaw had surmised; I have therefore placed it in a genus of its own. On the contrary it is more closely allied to *Disparoneura*, as *ab* extends outwards as far as Cu_2a which it joins, as in all species of the latter genus. It thus differs markedly from *Indoneura* in which *ab* curves downward to meet the posterior margin of the wing so as to enclose a marginal cell. The primitive nature of the venation, however, separates it from *Disparoneura* as sharply as the same feature separates *Indoneura* from typical *Caconeura.*

Postnodal nervures to the forewing 27–29; stigma black; Cu_2 is 13 cells in length or less than half the wing length.

Female. Abdomen 46 mm. Hindwing 35 mm.

Very similar to the male but of stouter build, differing as follows:—

Wings uniformly enfumed. In the right hindwing *ab* is connected to the posterior border by 2 transverse nervures. In both forewings it is nearly confluent with the posterior border at its outer part and the space between the 2 nervures can only be detected with the aid of a strong magnifying glass. In 3 out of the four wings there are rudiments of intercalated sectors. No blue on segment 7.

Segments 8 and 9 have blue dorsal markings shaped like a German helmet with the top spike directed basalwards but not quite reaching the base on the 8th. Segment 10 has the whole of the dorsum blue.

Ovipositor of great size and much more conspicuous than in *Indoneura*.

Habits. This species haunts the neighbourhood of mountain streams but, unlike *Indoneura*, is rarely found on low herbage but keeps to the shelter of overhanging branches at a height of 8 to 10 feet from the ground.

The female is described from a single specimen taken at the same place as the males, near Gudalur, 14·viii·21. It was captured *in copula* whilst ovipositing in water trickling over the surface of a rock.

Genus **Protosticta** Selys.

In addition to *Protosticta gravelyi* Laid. described in these *Records* from Cochin and Kanara, I have to record three new species from the Nilgiris, all closely allied but differing in markings and in the case of one species, in morphology.

Two of these were found in company and all have the same characteristic habits. They are found in the beds of rocky, mountain streams, where they keep to the cover of the banks or rocky boulders.

In the dark shadows of the latter they may be detected sitting with the body and abdomen held horizontally out and almost invisible save for the chain of tiny white spots on the head, prothorax and abdomen.

When disturbed they hover continually with the abdomen held rigidly out in spite of its enormous length and move forward with a series of short, jerky flights. The females are found in almost nocturnal darkness, small caverns amongst the rocks being especially favoured by them for purposes of concealment. They appear to breed in the patchy morass bordering the streams they frequent.

Sufficient stress has not been laid on the extraordinary morphology of these dragonflies. The enormous size of the eyes and the length of the abdomen are outstanding features and with regard to the latter, if compared to the length of the thorax, it is probably the longest abdomen found in any known dragonfly not excepting *Mecistogaster.*

Key to the Protosticta *from Southern India.*

1.	Abdominal segments 8 and 9 of nearly equal length; stigma blood red	*P. sanguinostigma.*
	Abdominal segment 8 more than twice the length of segment 9; stigma black	2.
2.	Prothorax white marked with a posterior, dorsal, triangular spot	3.
	Prothorax entirely bluish white	*P. hearseyi.*
3.	Abdominal segment 8 entirely black	*P. gravelyi.*
	Abdominal segment 8 with the basal third or half bluish white, the apical third or half black, the dorsal carina of this segment on its basal half finely black ...	*P. stevensi.*

Protosticta hearseyi, sp. nov.

(Plate I, figs. 3, 4.)

Two males and 15 females, 26·vi·21, Gudalur, Nilgiris, 4500 ft.

Male. Abdomen 35 mm. Hindwing 21 mm.

Head black, labium ashy white, labrum and genae palest blue, the former margined finely with black, the two basal joints of antennae pale blue. Eyes pale blue changing to olivaceous on the crown and paling beneath.

Prothorax pale blue, unmarked.

Thorax glossy black, almost metallic on the dorsum, pale blue at the sides. The mid-dorsal carina strongly defined in pale blue. Laterally a broad, black stripe on the 2nd suture and foreborder of metepimeron.

Beneath a black spot between the two hind legs and a pair of elongated spots posteriorly which converge on one another as they approach the first spot.

Legs bluish white, the two posterior pairs with a linear, black stripe on the femora.

Wings hyaline, the apices rather elongate; stigma black, its costal border shorter than the posterior, the inner border oblique; 14 postnodal nervures in the forewing.

Abdomen blackish brown marked with pale blue, this colour most marked on the end segments. The sides of segments 1 and 2 whitish, as is also a diffuse streak on the mid-dorsum, incomplete on the apical half of segment 2; pale basal annules on segments 3 to 7 which broaden laterally and obliquely; segment 8 turquoise blue marked narrowly and apically with black; segments 9 and 10 black, the former having a bluish marking on its side shaped like a crescent and star.

Relative size of the abdominal segments as for *P. gravelyi* Laid.

Anal appendages of subequal length, about as long as the two last abdominal segments. The superior stout at the base with a spine on the inner side of smaller size and nearer the base than that found in *P. gravelyi*, somewhat bayonet-shaped in profile and chelate at the apices, one arm however expanded and roughly quadrate (figs. 3 and 4). Inferior appendages stout at the base, simple, tapering to a fine point and curving up slightly.

Female. Abdomen 32·5 mm. Hindwing 22 mm.

Very similar to the male and differing as follows:—

The labrum is more broadly bordered with black; the eyes are pale olivaceous green changing to pale brown on the crown; the mid-dorsal carina of the thorax is only obscurely whitish at its upper part.

The basal annule on segment 7 is much broader and its border crenate, segment 8 is brownish black with a lateral, quadrate spot of white, whilst 9 is paler brown and marked with a broad, lateral spot of dirty white connected to a smaller spot subdorsally. Segment 10 very small, black.

Habits. Found in marshy spots hiding in the shadow of rocks or amongst scrub at the sides of precipitous ravines. This species differs from all others by the two sexes being of nearly equal length, by the male having the mid-dorsal carina of the thorax strongly marked with white, and by the prothorax being quite unmarked.

Protosticta sanguinostigma, sp. nov.

(Plate I, figs. 5, 6.)

Two adult males, 2 teneral males, 3·vii·1921 and 23·vii·1921, Coonoor Rd., 10th mile, 1500 ft., Nilgiris.

Male. Abdomen 47 mm. Hindwing 25·5 mm.

Head. Eyes bottle green, pale greenish blue beneath and marked uniquely with a broad band of dark blackish brown which begins above and behind and passes obliquely forward and downward along the sides.

Labrum turquoise blue, narrowly bordered with black: lower part of epistome blue, the rest of head jet black save for an obscure, transverse fascia of pale brown at the back of head. Anterior surface of the two basal joints of antennae pale.

Prothorax black above with an oval spot of blue at each side in the middle, the sides whitish.

Thorax jet black with a coppery, metallic sheen above, the sides pale blue marked with a lateral stripe of black on the 2nd suture which is bordered diffusely behind with brown.

Legs white with a broad, diffuse, pale brown annule near the dorsal end of the femora which are striped in their length with black on the extensor surface.

Wings hyaline, the stigma blood red, its costal side much shorter than the posterior, its inner side much shorter than the outer, the latter strongly convex; postnodal nervures to forewing 16–18.

Abdomen very long and slender, black on the dorsum, paler brown on the sides, marked with pale turquoise blue. Segment

3 with a very narrow and obscure basal annule, segments 4 to 7 with broader annules, increasing in breadth from the 4th to the 7th; 8th segment turquoise blue with the apical border more or less narrowly bordered with black, this colour being continued very narrowly along the dorsal carina and tapering gradually towards the basal end of the segment; segments 9 and 10 all black. The relative size of the segments is much the same as in the former species but 8 is only very slightly longer than 9.

Anal appendages much the same as in the last species but the spine at the base is more on the outer side and much stouter, the chelate ends are broader and the broader arm bifid at its extremity.

Female. Abdomen 39 mm. Hindwing 26 mm.

Very similar to the male but of much stouter build and with a shorter abdomen.

Head. Eyes deep bottle-green above, paler green beneath, these two shades of green separated by a thick, equatorial line of black. Rest of head as for male but the blue on labrum and lower epistome is of a deeper shade.

Prothorax blackish above, dirty white at the sides; the posterior lobe with lateral prolongations shaped as two projecting points.

Thorax as for male but blue markings of a deeper shade.

Wings hyaline; postnodal nervures to forewing 16, in the hind 15; stigma a cherry red; arc distal to the 2nd antenodal nervure.

Abdomen black with white or blue markings as follows:— 1st segment with a blue lateral spot, segment 2 has a bluish lateral basal marking prolonged along the ventro-lateral border, segment 3 has the middle two-thirds or three-fifths of its ventro-lateral border a pale whitish brown, segment 4 has very obscure basal and ventro-lateral markings, segment 5 has a well-marked basal white annule, segment 6 obscure basal and ventro-lateral markings, segment 7 has a broad basal annule bluish in colour, occupying about one-third of its length, the remaining segments entirely black.

Habits. Found in similar situations to the last but more retiring and never coming out into the open. The four specimens taken were in the deepest jungle clinging to maiden-hair fern sprouting from crevices in the rocks The insect is readily distinguished from others by its red stigma and by the equality in size of segments 8 and 9.

Type in my own collection, paratypes in British and Indian Museums.

Protosticta stevensi, sp. nov.

(Plate I, figs. 1, 2, 7.)

Five females and a considerable number of males taken on the Coonoor-Metuppalayam Rd., 10th mile, 1500 ft., 3·vii·1921 and 24·vii·1921.

Male. Abdomen 49 mm. Hindwing 22 mm.

This species is very closely related to *P. gravelyi* from which it differs by the greater length of the abdomen and by the 8th abdominal segment having its basal third of half pale blue instead of all black as in *P. gravelyi*. The dorsal carina of this segment is narrowly black in its basal half.

Female. Abdomen 37 mm. Hindwing 23 mm.

Differing from *P. gravelyi*, which it much resembles, by the difference in the relative lengths of hindwing and abdomen and the markings of the abdomen. The basal annule on segment 7 occupies about the basal fourth and there is no basal annule to segment 8 but a lateral, irregular spot. There is also a large diffuse white spot on the outer side of the eye which is not present in *P. gravelyi*.

The ovipositor of this and other species has a large, prominent, stout, upward-turned spine on its dorsal apical surface.

Habits. As for the genus, but bolder and to be seen frequently flying in mid-stream. Large numbers of males were seen on the 3rd of July all with their heads facing up stream and travelling slowly in that direction. A few were seen paired, but the females as a rule kept to the shelter of the scrub lining the stream, where apparently the males sought them. By the 23rd of July the numbers had greatly diminished and few were seen.

Type in my own collection, paratypes in British and Indian Museums.

Pseudophaea fraseri Laidlaw.

Rec. Ind. Mus. XIX, p. 23 (1920).

Two females and a large number of males, Gudalur, 4000ft., Nilgiri Wynaad, 9·vii·1921.

Thanks to the kindness of Mr. Laidlaw I have been able to compare the above specimens taken by myself with a paratype of *P. fraseri* and I find that the differences are so marked as to constitute a very distinct race if not a new species. For the present and until I receive Mr. Laidlaw's opinion I propose to call this race *wynaadensis*.

The differences are as tabulated :—

P. fraseri.	*P. fraseri*, race *wynaadensis*.
Length of forewing 35 mm.	Length of forewing 38 mm.
Greatest breadth 6·5 mm.	Greatest breadth 7 mm.
Apical third of hindwing opaque, from 8·5 to 10 mm. long.	Considerably more than the apical third opaque, from 12 to 13 mm. long.
Length of abdomen 38 mm.	Length of abdomen 43 mm.

In addition to the above the anterior pair of femora are brownish black on the flexor surface, bright yellow on the extensor. The dorsal wedge-shaped line is bright turquoise blue and is so sharply contrasted with the black background as to give the impression that it is phosphorescent and in fact it appears to glow like the lamp of a glowworm.

The second line on the thorax is ochreous in colour, and the first 6 segments of the abdomen are blood-red.

Female. Measurements of the two specimens:—

Abdomen	34 mm.	Forewing	35 mm.	Hindwing	32 mm.
,,	34·5 mm.	,,	36 mm.	,,	34 mm.

The wings are slightly enfumed throughout and the apices of both are tipped with brown, especially the hindwing where this colour extends in as far as the proximal end of the stigma. For the rest, the female does not differ from typical *P. fraseri* except that the antehumeral lines do not meet anteriorly on the thorax, but are parallel throughout.

Habits. This insect is found perched on plants and twigs overhanging the borders of the streams it frequents. Unlike most if not all other *Calopterygines* it is frequently seen settled with the wings outspread and the abdomen raised at an angle like many Libellulines.

The females are rarely found near water, but penetrate into the neighbouring jungle where they may be found paired with the males.

Type male and female in my own collection, paratypes in British and Indian Museums.

The distribution of this insect and *P. dispar* is extraordinarily local. The two never apparently occur together, but may be found on the same stream at different altitudes. At Gudalur *P. dispar* is found at an elevation of 4000 to 4500 ft., often in considerable numbers, whilst two miles further down the valley at an elevation of 3500 ft., *P. fraseri* is quite common. On the opposite side of the Nilgiris *P. dispar* is met with at elevations varying from 3500 to 6000 ft. at Coonoor, *P. fraseri* being entirely absent.

Phyllomacromia nilgiriensis Fraser.

Female. A single female, 24·vii·1921, near Kalar.

The type is in the British Museum and was taken in June, 1917, by myself at a stream not far above Kalar. I have now secured another specimen, also a female, taken on the same stream at about 100 yards from where the type was caught.

The wings of this specimen are enfumed throughout, the colouration forming a diffuse network corresponding to the nervures. The saffronation extends out nearly to the trigones; otherwise it does not differ from the type.

Taken whilst ovipositing in wet sand which formed the floor of a small, dark cavern amongst rocks bordering a mountain stream.

EXPLANATION OF PLATE I.

FIG. 1.—Terminal abdominal segments and anal appendages of *Protosticta stevensi*, dorsal view.

" 2.—The same seen from the side.

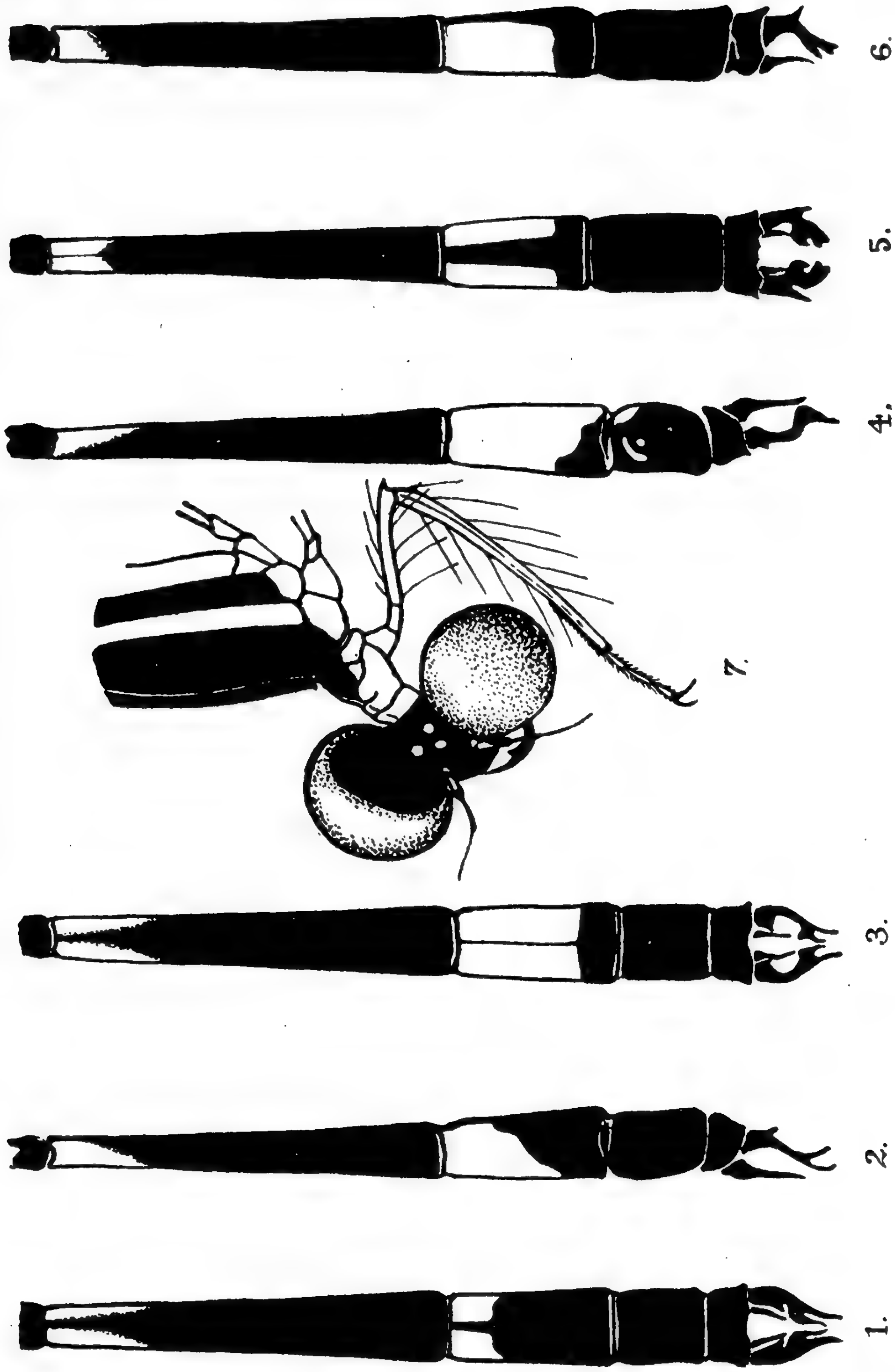
" 3.—Terminal abdominal segments and anal appendages of *Protosticta hearseyi*, dorsal view.

" 4.—The same seen from the side.

" 5.—Terminal abdominal segments and anal appendages of *Protosticta sanguinostigma*, dorsal view.

" 6.—The same seen from the side.

" 7.—Head and thorax of *Protosticta stevensi*.



ODONATA FROM THE NILGIRI HILLS

OBSERVATIONS ON THE INVERTEBRATE FAUNA OF THE KUMAON LAKES.

III. The Freshwater Mollusca.

By B. Prashad, *D.Sc., Assistant Superintendent, Zoological Survey of India.*

The present paper on the Mollusca of the Kumaon Lakes is a continuation of the two papers published by Dr. N. Annandale and Dr. S. W. Kemp in 1912[1] on the Invertebrate Fauna of the Kumaon Lakes. It is based on a small collection of molluscs made by Dr. Kemp in 1911, and the large series of specimens obtained by Mr. S. L. Hora and myself from the various lakes and streams in August, 1920. The lakes visited were: Naini Tal, Sariya Tal, Khurpa Tal, Sukha Tal, Bhim Tal, Naukuchia Tal, Sat Tal, Damianti Tal and Malwa Tal. Collections were also made in the hill-streams running in the vicinity of these lakes. Notes on the situation, etc., of most of these will be found in the paper cited already, and I only include here a few general observations on the physical conditions of the lakes during August, 1920, with more detailed notes on the areas not visited by Dr. Kemp in 1911.

The water-level in all the lakes was much higher at the time of our visit than at that of his, owing to large quantities of water that had been brought during the rains from the extensive catchment-areas around each of them; the area of the lakes also was much larger. The shallower regions of the lakes, which in May, 1911, had been found to harbour rich growths of sponges and Polyzoa, had five to six feet of water, and sponges and Polyzoa were practically non-existent. The water in most of the lakes was clear and held very little mud in suspension.

All the lakes with the exception of Malwa Tal had, along the margins and up to a depth of about ten feet, thick growths of aquatic plants such as *Chara*, *Potamogeton*, *Hydrilla* and *Nelumbium* and large quantities of algae, such as *Spirogyra*. Sponges and Polyzoa were in a few cases found growing on the stems and leaves of these aquatic plants.

The fauna as a whole was very poor. The Peridiniid, which was found to be very common in 1871[2] and rather scarce in 1911, was only found in very small numbers in Bhim Tal and in still smaller numbers in Naini Tal. Leeches were plentiful under

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[1] *Rec. Ind. Mus.* VII, p. 129 (1912).
[2] *Ann. Mag. Nat. Hist.* (4) VII, p. 229 (1871).

stones near the margins and a species of *Glossosiphonia* was found parasitic on *V. bengalensis mandiensis*. Dragon-fly larvae, both Libellulids and Aeschnids, were fairly common, but the number of aquatic Hemiptera and Coleoptera was very small; in Malwa Tal the Hemiptera were a little more numerous. A special feature of Bhim Tal was the large numbers of Chironomid larvae which were living in tubes attached to submerged stones and tree-trunks. Molluscs of the genera *Limnaea*, *Gyraulus*, *Segmentina*, *Hippeutis* and *Sphaerium* were found in varying numbers in almost all the lakes, but *V. bengalensis mandiensis* was only found in Naini Tal and Khurpa Tal. The conditions as to Crustacea were identical with what was found to be the case by Dr. Kemp in 1911. Fishes of the genera *Oreinus*, *Barilius*, *Barbus* and *Ophiocephalus* were common in all the lakes, and a species of the genus *Labeo* was also found in Malwa Tal.

SARIYA TAL.

This is a rather small lake, or rather a marsh in the course of a rapid hill-stream. It is situated at a distance of about three miles to the west of and at a slightly lower level than Naini Tal. It is a depression in the course of the hill-stream with about 3 to 8 feet of water; the area is not very large and the current in the lake is much slower than in the hill-stream. The entire area at the time of our visit supported a very thick vegetation consisting mainly of *Chara*, *Potamogeton* and large quantities of algae.

No Sponges or Polyzoa were seen. Dragon-fly larvae of *Sympetrum* sp.,[1] all too young to identify specifically, were fairly abundant. The Molluscan fauna was very poor; only a few *Limnaeae* and Planorbids were found after careful search.

KHURPA TAL.

Khurpa Tal is situated at a distance of about five miles from Naini Tal at an altitude of 5365 ft. It occupies a nearly circular depression surrounded on all sides by high hills. The area during the dry season is rather small, but the lake becomes much more extensive during the rains. The lake was stated to be over ten feet deep near the middle, though near the margins it is quite shallow. It is not fed by any streams and there is no regular outflow of water. At the time of our visit there was no real aquatic vegetation and the water was quite clear.

The fauna, which was very poor, consisted of the same species of fish as are found in the other lakes, a few dragon-fly larvae of the species *Anax parthenope* Selys, some *Limnaeae* and large numbers of *V. bengalensis mandiensis* along the banks, feeding on algae growing on stones. No Planorbids were seen.

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[1] I am indebted to Major F. C. Fraser, I.M.S., for the identifications of the dragon-fly larvae.

SUKHA TAL.

In May, 1911, this area was found to be quite dry, but a few Cladocera and Ostracoda were reared out of some earth brought back to Calcutta. In September, 1920, practically the whole of this area had 2 or 3 feet of water. The vegetation was very scanty, consisting only of a few stray plants of *Potamogeton*, but algae like *Hydrodictyon* and *Spirogyra* were very abundant.

A fair number of Cladocera and Ostracoda were collected and water-bugs were plentiful near the margins. Larvae of dragon-flies of the species *Anax parthenope* Selys, *Lestes cyanea* Selys and *Orthetrum triangulare* Selys were fairly abundant. No *Limnaea* was seen, but Planorbids of the genus *Gyraulus* were common amongst the algal filaments.

DAMIANTI TAL.

Situated at about the same level as the Sat Tal, but about a mile to the east of it, is a spring known as the Damianti Tal. A small stream, which has been greatly widened and deepened for irrigation purposes, leads down from the spring to the valley below. At the time of our visit both the spring and the mouth of the stream were full of cow-dung with many submerged grasses growing in them.

The only interesting animals collected here were a few *Limnaeae*, a few *Gyraulus* and some bivalves of the common Indian species, *Sphaerium indicum.*

The hill-streams were very uninteresting from the molluscan point of view. In the upper regions, where they are fairly rapid, no molluscs were found, but lower down they had a few Mollusca of the families Melaniidae, Planorbidae and Hydrobiidae. As these Molluscs were collected outside the limits of the Tal area and as they belong to common Gangetic species, I do not propose to include them in the present paper.

Family LIMNAEIDAE.

Genus **Limnaea** Lamarck.

Two species of this genus, *L. acuminata* and *L. luteola*, were collected in the Tal area. The former is the common species and is represented by a number of forms or phases, while the latter has a much restricted distribution and was found only once in a pond on the roadside near Naukuchia Tal.

Limnaea acuminata Lam.

1881. *Limnaea acuminata*, von Martens, *Conch. Mitth.* I, p. 75, pl. xiv.
1921. *Limnaea acuminata*, Annandale and Prashad, *Rec. Ind. Mus.* XXII, p. 568. pl. vii, figs. 1-3, text-fig. 12.

In the paper cited above Dr. Annandale and I have given reasons for considering most of the Indian species of the older authors as being only forms, variations or phases of this highly plastic species. A few further remarks are necessary in view of the material now collected from the Tal Lakes.

Large series of specimens collected in Naini Tal, Sariya Tal, Khurpa Tal and Malwa Tal are like the typical *L. patula* Troschel figured by von Martens. Some of the shells from Naini Tal are referrable to the form *amygdalum* Troschel, while quite a large series of specimens are intermediate between the two forms. In view of these facts our conclusions as to the desirability of suppressing these names seem to be justified. We were, however, in doubt as to the form *chlamys* Benson. With a large series of specimens from a marshy area near Bhim Tal and from Naukuchia Tal, I believe this to be a well marked phase. Its elongate shape with a subcylindrical body-whorl, the comparatively short spire, rather narrow and elongate mouth with a nearly straight outer lip and the sulcate sculpture are quite characteristic of this phase.

The form referred to as Sowerby's *ventricularius* by Annandale[1] and *ventricularius* Kuster in the paper cited above was included on the authority of some Indian Museum specimens identified by Preston. The three shells, as I now find on comparison with the large series of shells from Naini Tal, are all young specimens of the form *amygdalum* Troschel and have nothing to do with the species *L. ventricularius* Parreiss, from "Ostindien."

Limnaea luteola Lam.

1920. *Limnaea luteola,* Annandale, *Ind. Journ. Med. Res.* VIII, p. 109.

This species, as was stated by Annandale in the paper cited above, is identical with Deshayes' *L. succinea*, but as Lamarck's name has priority, it should be known as *L. luteola.* It is not very abundant in the Gangetic Valley, but is the common species of Peninsular India. The occurrence of large numbers of specimens in a muddy pool near Naukuchia Tal at an altitude of over 4000 ft. is, therefore, of special interest. In this pool the specimens were found attached to the stems of *Potamogeton* and to a grass which were growing abundantly in the muddy waters of the pool.

All the specimens are quite typical and are fully grown.

Genus Gyraulus Agassiz.

1919. *Gyraulus,* Annandale and Prashad, *Rec. Ind. Mus.* XVIII, p. 52.
1921. *Gyraulus. id.*, *ib.*, XXII, p. 582.

This genus is represented in the Tal Area by three species *G. convexiusculus* (Hutton), *G barrackporensis* (Clessin) and what appears to be an undescribed species. I do not, however, propose to describe it till the collection of the Indian Museum Planorbidae,

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[1] *Ind. Journ. Med. Res.* VIII, p. 110 (1920).

now with Monsieur L. Germain of the Paris Museum, is returned to India.

Gyraulus convexiusculus (Hutton).

1921. *Gyraulus convexiusculus*, Annandale and Prashad, *op. cit.*, p. 582.

Large numbers of specimens of this species were collected in Naini Tal, Sariya Tal and a hill-stream opening into the north-western corner of Bhim Tal, attached to the stems of *Potamogeton* and entangled in the filaments of algae like *Spirogyra*.

Gyraulus barrackporensis (Clessin).

1886. *Planorbis Barrackporensis*, Clessin, *Limnaeiden* Mart. Chemn. *Conch. Cab.*, p. 125, pl. xviii, fig. 7.
1886. *Planorbis Huttoni*, *id.*, *ib.*, p. 139, pl. xviii, fig. 4.
1909. *Planorbis barrackporensis*, Germain, *Rec. Ind. Mus.* III, p. 120.
1915. *Planorbis* (*G.*) *barrackporensis* and *P.* (*G.*) *huttoni*, Preston, *Faun. Brit. Ind. Freshw.-Moll.* pp. 121, 120.

I agree with Germain in considering *P. barrackporensis* and *P. huttoni* as being the same species. The species is known to occur in such widely separated localities as Barrackpore, Calcutta, Benares and Tibet.

In the Tal area we collected specimens of this species in Naukuchia Tal along with those of *Hippeutis caenosus* (Benson).

Genus Hippeutis Agassiz.

1921. ? *Hippeutis*, Annandale and Prashad, *op. cit.*, p. 584.

In the paper cited above Dr. Annandale and I recently suggested that Benson's *Planorbis caenosus*, which had hitherto been assigned to the genus or sub-genus *Segmentina*, agrees with his other species *P. umbilicalis* in shell-characters and is probably congeneric with it. We further questioned their being included in the genus *Segmentina* and suggested that they should probably be placed in the genus *Hippeutis*. An examination of the soft parts and radula of the European *H. fontanus* confirms this opinion.

Hippeutis caenosus (Benson).

1850. *Planorbis caenosus*, Benson, *Ann. Mag. Nat. Hist.* (2) V, p. 349.
1876. *Planorbis caenosus*, Hanley and Theobald, *Conch. Ind.* pp. xviii and 18, pl. xxxix, figs. 7–9.
1878. *Planorbis caenosus*, Sowerby, *Conch, Icon.* XX, pl. x, figs. 78, *a*, *b*.
1878. *Planorbis caenosus*, Nevill, *Hand List Moll. Ind. Mus*, I, p. 246.
1886. *Planorbis caenosus*, Clessin, *op. cit.*, p. 165, pl. xxiv, fig. 4.
1915. *Planorbis* (*Segmentina*) *caenosus*, Preston, *op. cit.*, p. 127.
1918. *Planorbis caenosus*, Annandale, *Rec. Ind. Mus.* XIV, p. 113.

This species has been recorded from Jamalpur, Bengal; Manbhum, Orissa; Bhim Tal, United Provinces; and Yawnghwe Province, Burma. A fair series of specimens was collected by us in

Naukuchia Tal. Unfortunately most of them were dead shells and are not, therefore, available for anatomical study.

Genus **Segmentina** Fleming.

1921. *Segmentina*, Annandale and Prashad, *op. cit.*, p. 585.

In the Tal area we found specimens of *S. calathus* (Benson), the only Indian species which Dr. Annandale and I were able to assign definitely to this genus.

Segmentina calathus (Benson).

1821. *Segmentina calathus*, Annandale and Prashad, *op. cit.*, p. 585.

We found only a few specimens of this widely distributed species amongst the algae in Naini Tal. The specimens were found only near the shores.

Family HYDROBIIDAE.

In spite of careful search no representatives of this family were discovered by us in the Tal Lakes and I am very doubtful as to whether any of them are really endemic in the lakes. While making this rather bold statement I am aware of the record of some specimens of *Tricula montana* and *Bythinia pulchella* from Naini Tal by Nevill in his Hand-List,[1] but that does not necessarily mean that the specimens referred to were collected in the lake itself. Benson's type-series of the former species was collected in a small stream flowing into Bhim Tal and probably Stoliczka's specimens referred to by Nevill were also obtained from some stream around Naini Tal. The only specimen of *B. pulchella* (also from Stoliczka's collection, but not now to be traced in the Indian Museum) must also have been collected outside the lake, as the species is not known to inhabit large areas of clear water.

Genus **Tricula** Benson.

1921. *Tricula*, Prashad, *Rec. Ind. Mus.* XXII, p. 67.

I have nothing further to add to my recent account of the genus and of the species, *T. montana*, of the Tal area.

Genus **Digoniostoma** Annandale.

1920. *Digoniostoma*, Annandale, *Ind. Journ. Med. Res.* VIII, p. 104.
1921. *Digoniostoma*, Annandale, *Rec. Ind. Mus.* XXII, p. 4.

The only species which we actually found in the Tal area was Benson's *Paludina pulchella*. It has, on shell-characters alone, been recently assigned to the genus *Digoniostoma*, but the radula and soft parts are certainly different from those of *D. cerameopoma*, the type-species of the genus. I do not, however,

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[1] *Hand-List Moll. Ind. Mus.* II, pp. 35 and 62 (1884).

discuss the generic position here, as, in view of Robson's [1] recent remarks, I propose revising all the Indian Hydrobiidae when more material is available.

Digoniostoma (?) **pulchella** (Benson).

1836. *Paludina pulchella*, Benson, *Journ. As. Soc. Bengal* V, p. 476.

Large series of specimens of this species were collected by us in a pond along the roadside near Naukuchia Tal at an altitude of over 4000 ft., together with specimens of *L. luteola.*

Family VIVIPARIDAE.

Genus **Vivipara** Lam.

In the Tal area this genus is represented by a race of the common Indo-Gangetic species *V. bengalensis.* Even this race was found to have a restricted distribution, as specimens were found only in Naini Tal and Khurpa Tal.

Vivipara bengalensis race **mandiensis** Kobelt.

1921. *Vivipara bengalensis* race *mandiensis*, Annandale, *Rec. Ind. Mus.* XXII, p. 271.

I have nothing to add to Annandale's detailed account of this and the allied races, beyond recording the occurrence of this race at such high altitudes as that of Naini Tal and Khurpa Tal.

Family CYRENIDAE.

Genus **Sphaerium** Scopoli.

1921. *Sphaerium*, Prashad, *Rec. Ind. Mus.* XXII, p. 614.

I have nothing to add to my recent account of this genus and of the widely distributed Indian species, *S. indicum* Desh., specimens of which were found by us in Damianti Tal.

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[1] *Ann. Mag. Nat. Hist.* (9) VIII, pp. 401–413 (1921).

A REVIEW OF THE INDIAN SPECIES OF *AMBLYCEPHALUS*.

By Colonel F. WALL, *C.M.G., I.M.S.*

I have recently had an opportunity of studying all the representative snakes of the genus *Amblycephalus* in the Indian Museum and in the Bombay Natural History Society's collections. I propose to add to this material the information derived from specimens I have collected myself, and to review the genus so far as it concerns Indian species. The Indian Museum contains types of what have been up to date accepted as three distinct species, viz. *modestus* (Theobald), *macularius* (Theobald) and *andersoni* (Boulenger), but which, I hope to show, should be regarded as a single species. It is to be noted that many of the head-shields in individuals of some of the species are subject to frequent variation owing to confluence. Further I notice that in many specimens the details of the periocular lepidosis are difficult to determine in spirit specimens. The praeocular, subocular, and postocular are difficult to differentiate owing to creases which simulate sutures, and it is sometimes impossible to be certain whether merely a crease is present or a genuine suture.

CHARACTERS OF THE GENUS.

General. Short snakes not exceeding about 610 mm. (2 feet) in length. Head bluntly rounded anteriorly, separated from the body by a much constricted neck. Snout short, feebly declivous, with no canthus rostralis. Nostril piercing about the middle of an entire shield. Eye large, with brilliant yellow iris, and a vertical pupil. Body strongly compressed. Tail short, about one-sixth to one-ninth the length of the body.

Lepidosis. Rostral rather broader than deep; the portion visible above less than the suture between the internasals. *Internasals*: a pair; broader than long; the suture between them less than half the internaso-praefrontal sutures. *Praefrontals*: a pair; the suture between them shorter than the internaso-praefrontal sutures. Touching the eye (except in *carinatus*). *Frontal* longer than the snout, longer than the supraoculars, shorter than the parietals. *Nasal* entire. *Loreal*: one; touching the internasal; touching the eye in some species. *Praeocular* variable; one usually present. Absent in some species. *Postocular* variable; usually one, sometimes none. *Suboculars* variable; one to four. *Temporals* variable; one to three anterior. *Supralabials*: 7 or 8; the 1st and 2nd touching the nasal, usually none touching the eye, the last longer than the two preceding shields. *Mental* variable; sometimes touching the anterior sublinguals, sometimes not. *Sublinguals*: three large pairs, roughly symmetrical, with no groove between them. *Infralabials* very small. *Costals*: in 15 rows in the whole body-length; smooth, or some of the median rows feebly keeled. No apical pits. Vertebrals usually enlarged; arising by a gradual development, not a confluence of rows. *Ventrals* well developed, broad; the first the largest of the series. *Anal* entire. *Supracaudals* in even rows, vertebrals not enlarged. *Subcaudals* in pairs.

OSTEOLOGICAL CHARACTERS.

Praemaxilla about as broad as high. *Nasals* forming an osseous suture with the frontals. *Frontals* contributing to the rim of the orbit; not constricted at midorbit. *Praefrontal* suture extending beyond the middle of the frontal. *Postfrontal* not touching the frontal. *Parietal* contributing to the rim of the orbit. *Supratemporal* rudimentary; not projecting beyond the quadrate anteriorly. *Quadrate* well developed; oblique from above backwards. *Columella auris* extending from about the middle of the quadrate to the exoccipital. *Maxilla* about half the length of the dentary; expanded in depth anteriorly; expanded laterally posteriorly. Teeth 1 to 6; anododont, syncranterian, scaphiodont. An edentulous space anteriorly, also posteriorly in some species. *Ectopterygoid* well developed; expanded anteriorly to overlie the posterior expansion of the maxilla. *Palatine* short; expanded laterally anteriorly. Teeth 1 to 3; anododont, kumatodont or scaphiodont. An edentulous space anteriorly, and in some species posteriorly. *Pterygoid* long. Teeth 7 to 20; anododont, scaphiodont. *Mandible.* Angular present. Splenial present. Coronoid absent. Dentary about twice its distance to the quadrate. Teeth 15 to 23; anododont, scaphiodont. *Occipitals.* The condyle is horseshoe-shaped, and formed by processes from the basioccipital and exoccipitals.

Vertebrae. Neural spines. Absent on the atlas. Well developed and as long as the body on the axis. Short and obliquely set backwards on the 3rd and 4th vertebrae, nearly as long as the body in the succeeding corporeal, and the caudal vertebrae. *Hypapophyses.* Well developed and vertical on the atlas. Bifid on the axis, the anterior vertical, the posterior obliquely set backwards. Disappearing in the vertebrae in the second-eighth of the body.[1] Absent on the first two caudal vertebrae. Two, laterally placed, on the 3rd and succeeding caudal vertebrae.

Costae. First as long as the second, articulated to the 3rd vertebra. Last bifid, the outer ramus about one-third as long as the inner. *Pseudocostal processes.* Bifid on the 1st, 2nd and 3rd caudal vertebrae, single on the succeeding vertebrae.

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[1] As I find is the case in over twenty five species of Colubridae where the hypapophyses are not continued to the last vertebra. This site suggests some connection with the shoulder girdle of some ancestral form.

Amblycephalus monticola (Cantor).

A. monticola, Annandale, *J.A.S. Beng.* 1905, p. 176; *Rec. Ind. Mus.* 1912, pp. 37, 50 and 54; Boulenger, *Cat.* III, 1896, p. 443; Sclater, *List. Sn. Ind. Mus.* 1891, p. 66; Wall, *J. Bomb. N. H. S.* 1908, p. 354; *id., ibid.*, 1909, p. 356; *id., ibid.*, 1910, p. 843.

Colour. Uniform brown of various shades dorsally, lighter in the flanks. A series of narrow, blackish, vertical bars laterally, most distinct in the anterior part of the body, and tending to disappear at mid-body or posteriorly. Belly uniform paler brown to sordid yellow, with darker spots or dots. Head brown above. A more or less distinct narrow black bar on the neck, sending forwards a branch to the supercilium, and often another between the parietal shields. A narrow blackish streak from the eye to the gape.

Length. My largest specimen, a female, measured 750 mm. (2 feet, 5½ inches).

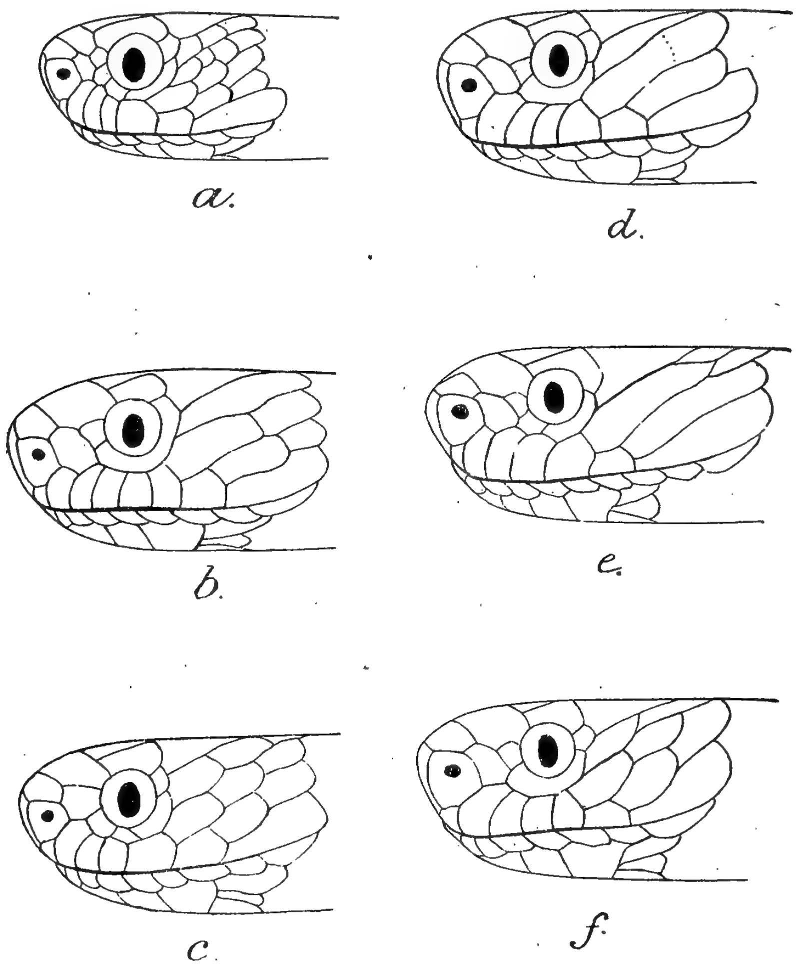
Disposition. A live specimen that I acquired in Assam apparently unscathed, proved to be a very quiet inoffensive creature, that allowed itself to be handled without betraying any malice. In spite of every provocation I could not induce it to assume an attitude of offence, or bite any object, but it emitted the tongue in a lazy fashion. Its movements were slow, which is not surprising in a snake that has so strongly compressed a body.

Food. The diet appears to consist exclusively of slugs and snails. I have on some occasions in Shillong removed one or two large black slugs from the stomach, which I was informed were a species of *Austenia*. Many other specimens contained small snails, some devoid of shell, others with broken shell attached, and once one with a perfect shell. I have known as many as five of these small snails in one specimen.

Breeding. I have examined three gravid females, and found eggs of such a size and character as to make it fairly certain that this species is oviparous. As many as six eggs were found in one example. The smallest specimens I have seen, apparently hatchlings, were 168 and 178 mm. (6⅝ and 7 inches) in length, but no dates of capture were available. The anal glands in both sexes furnish a custard-like secretion.

The genitalia are different from those of any other snake I have examined. They are slender cylindrical organs, which are bifurcate about half the length of their maximum extrusion. Each limb is cylindrical, and from base to apex there is no sign of any of those cartilaginous processes, which are seen in snakes of the families Colubridae and Viperidae.

Lepidosis. Praefrontal touching the eye. *Frontal* hexagonal in shape. Length much greater than the snout, greater than its breadth, two-thirds to four-fifths the parietals *Supraoculars* length subequal to, or rather greater than the praefrontals, half to three-fifths the frontal, two-fifths to half the parietals. *Loreal* touching the eye. *Praeocular* wanting; replaced by the contact of the loreal with the eye. *Postocular* one. I have seen this confluent with the supraocular on one side in one specimen. *Suboculars* usually two, sometimes three. *Temporals* two anterior, the lower about half the length of the last supralabials Usually two lying along the parietals. *Supralabials* 7, sometime.



TEXT-FIG. 1.—Lepidosis of the Head in

a. *Amblycephalus carinatus*, Boie.
b. *A. moellendorffi* (Boettger).
c. *A. monticola* (Cantor).
d. *A. andersoni*, Boulenger. Type.
e. *A. modestus*, Boulenger. Type.
f. *A. macularius* (Theobald). Co-type.

8 (rarely 6). In all my fresh specimens I found none touched the eye. In spirit specimens, however, it is not unusual to see the 4th, or the 4th and 5th touching the eye; 7th as long as, or longer than the 6th and 5th taken together. *Mental* usually touching the anterior sublinguals, rarely not. *Costals* in 15 rows in the

whole body length; obscurely keeled in the median rows of the posterior part of the body. Vertebral enlarged. *Ventrals* 181 to 198. *Subcaudals* 69 to 87.

Eye. Diameter subequal to the supraocular, three-seconds to four-thirds its distance to the edge of the lip.

Dentition. From three skulls in my collection. *Maxillary*: 5 to 7; syncranterian, anododont, kumatodont. An edentulous space anteriorly that would take two teeth. *Palatine*: 2 or 3; anododont, isodont. An edentulous space anteriorly that would take about two teeth, and another posteriorly that would take about three. *Pterygoid*: 11 to 13; anododont, very evenly scaphiodont. Mandibular: 20 to 24; anododont, very evenly scaphiodont.

Distribution. Eastern Himalayas: Sikkim. Assam: Abor Hills (*Ind. Mus.*); Naga Hills (Samaguting, *Ind Mus.*); Khasi Hills (*F. W.*); Sibsagar (*Ind. Mus.*); near Jaipur (*F. W.*); Dibrugarh (*F. W.*).

Note.—I discredit the authenticity of the record from the Nicobars on the authority of de Roepstorff. The specimen (No. 8888) in the Indian Museum is indubitably this species. De Roepstorff's name is associated with two other records equally untrustworthy in my opinion, he being the only authority to record the Indian *Polyodontophis sagittarius*, and the Ceylon *Oligodon sublineatus* from the Nicobars.

Amblycephalus moellendorffi (Boettger).

A. moellendorffi, Boulenger, *Cat.* III, 1896, p. 443; Sclater, *List Sn. Ind. Mus.* 1891, p. 67

Colour. Dirty white or greyish, heavily mottled with very fine purplish-brown specks on the dorsum. Many small round whitish spots outlined with purplish-brown, showing a decided tendency to form crossbars. A more or less conspicuous whitish collar. Belly irregularly spotted with blackish laterally. Beneath the tail densely mottled with fine blackish specks. Head uniform purplish-brown. Young marked exactly like adults.

Length. 350 mm. (1 foot, 1¾ inches). The smallest specimen I have seen was 162 mm. (6⅜ inches) in length.

Habits. The many specimens I acquired on Hong Kong Island were captured in the low scrub jungle on the slopes of the Peak.

Lepidosis. *Praefrontal* touching the eye. *Frontal* hexagonal in shape. Length subequal to or rather greater than the snout, subequal to its breadth, three-fifths to four-fifths the parietals. *Supraocular* shorter than the praefrontal, about half the length of the frontal, one-third to two-fifths the parietals. *Loreal* not touching the eye. *Praeocular* one. *Postocular* usually none (confluent with the subocular). *Subocular* a single crescentic shield from the supraocular to the praeocular (sometimes not united with the postocular). *Temporals* the upper usually as long as the parietals, sometimes divided into two. The lower subequal to the last labial. *Supralabials* usually 7 (sometimes 8). None touching the eye; 7th as long as the three preceding shields. *Mental* not touching the anterior sublinguals. *Costals* in 15 rows in the whole body length, not keeled. Vertebrals not enlarged. *Ventrals* 136 to 159. *Subcaudals* 31 to 50.

Eye. Diameter subequal to the supraocular, equal to or rather less than distance to lip.

Distribution. Burma, Tenasserim (No. 4870, *Ind. Mus*). Siam, Cochin China, S. China and coastal Islands.

Amblycephalus macularius (Theobald).

A. macularius, Boulenger, *Cat.* III, p. 444; Sclater, *List. Sn. Ind. Mus.* 1891, p. 67; Wall, *Rec. Ind. Mus.* 1909, p. 149.
A. modestus, Boulenger, *Cat.* III, p. 444; Sclater, *List. Sn. Ind Mus.* 1891, p. 66.
A. andersoni, Boulenger, *Cat.* III, p. 444; *J. Bomb. N.H.S.* XVI, p. 235; Wall and Evans, *J. Bomb. N.H.S.* XIII, p. 611; Wall, *J. Bomb. N.H.S.* XVIII, p. 783.

Colour. Dorsally densely mottled with very fine specks of purplish-brown, with several small round whitish, or parti-coloured whitish and purplish spots interspersed. Ventrally beautifully dappled with purplish-black and white, especially laterally. Head uniform blackish-purple with speckling on the upper lip.

A female specimen sent to me from the Southern Shan States is very dark, and has no small round white or parti-coloured spots. Another from the same locality in the Bombay collection (ventrals 161, subcaudals 42) is uniform in colouration like the type of *A. modestus*.

Length. The largest I have seen measured 483 mm. (1 foot, 7 inches) in length.

Habits. Captain Venning wrote when sending me a specimen from Kalaw, that it was found at dusk clinging to the tops of some rank grass.

Food. As far as I am aware no observations have been made.

Breeding. Captain Venning's specimen, just alluded to, was a gravid female. It was killed on the 9th of June, 1913, and contained six large eggs.

Lepidosis. Praefrontal touching the eye. *Frontal* hexagonal in shape. Length much greater than the snout, three-seconds to four-thirds its breadth, rather shorter than the parietals. *Supraoculars* three-fourths, to equal to, the praefrontals, half to three-fifths the frontal, about two-fifths the parietals. *Loreal* not touching the eye. *Praeocular* usually one. (In specimen No. 8024 in the Indian Museum it is confluent with the praefrontal). *Postocular* usually one. (In the type of *modestus* it is confluent with the supraocular on the left side, normal on the right.) *Suboculars* usually one crescentic shield. (In the type of *modestus*, and in specimens Nos. 8025 and 8026 in the Indian Museum it is divided into two.) *Temporals* very variable. One or two anteriorly. (In the type of *modestus* the upper appears to be confluent with the parietal.) There are usually two subequal shields lying along the parietals, but these may be confluent, as in the type of *andersoni*. (In the types of *andersoni* and *modestus* there is one long inferior temporal, apparently due to a confluence of the two normal shields.) *Supralabials* 7 (8 on one side in one example). None touching the eye. *Mental* sometimes touching the anterior sublinguals, sometimes not. *Costals* in 15 rows in the whole body length. Some of the median rows keeled. *Vertebrals* not enlarged. *Ventrals* 150 to 169. *Subcaudals* 37 to 51.

Eye. Diameter subequal to the length of the supraocular, subequal to or rather greater than its distance to edge of the lip.

Dentition. From one bad skull in my collection, nearly all the teeth being broken. *Maxillary*: 3 (4? in the type of *modestus*). An edentulous space anteriorly that would take three teeth, and one posteriorly that would take two. *Palatine*: 1?. An edentulous space anteriorly that would take three teeth, and one posteriorly that would take two. *Pterygoid*: 7? left, 9? right; no edentulous space anteriorly. *Mandibular*: 23? on the right side, ? left; no edentulous space anteriorly or posteriorly.

Distribution. Eastern Himalayas: Sikkim (Gopaldhara, Darjeeling District, No. 18665, *Ind. Mus.*, type of *A. andersoni*). Burma: S. Shan States (Tounggyi, *Wall* and *Evans*, and *Bombay collection*; Kalaw, *F. W.*, Mogok, *Brit. Mus.*); Rangoon (No. 8028, *Ind. Mus.*, type of *A. modestus*); Tenasserim (Martaban, Nos. 8024, 8025 and 8026, *Ind. Mus.*, types of *A. macularius*); Sukli, Dawna Hills (No. 17034, *Ind. Mus.*) Indo-China (Mocquard, *Rept. l'Indo-Chine*, 1907, p 48).

Note.—I have examined most critically four times during the last sixteen years the monotypes of *A. modestus* and *A. andersoni*, and the three types of *A. macularius* in the Indian Museum, and can come to no other conclusion but that all represent a single species. *A. macularius* has page priority over *A. modestus*, and both antedate (1868) Boulenger's *A. andersoni* (1888).

I have now examined sixteen specimens.

Amblycephalus carinatus Boie.

A. carinatus, Boulenger, *Cat.* III, 1896, p. 445; Sclater, *List. Sn. Ind. Mus.* 1891, p. 67.

Colour. Dorsally brown of various shades, with numerous dark small spots arranged with a tendency to form cross bars. Ventrally yellowish or whitish with darker spots or mottling, which is often heaviest in the median line. An X-shaped dark mark on the nape, and a narrow dark streak behind the eye, sometimes connected with the X. A specimen in the Indian Museum (No. 8022) from Tenasserim is a uniform drab colour.

Length. The longest I have examined is 603 mm. (1 foot, 11¾ inches) long, the tail 120 mm. (4¾ inches). The smallest, apparently a hatchling, was 184 mm. (7¼ inches).

Lepidosis. Praefrontal not touching the eye. *Frontal* pentagonal in shape. Length much greater than the snout, three-seconds to four-thirds its breadth, subequal to the parietals. *Supraoculars* longer than the snout, subequal to the frontal, subequal to the parietals. *Loreal* not touching the eye. *Praeocular* one. *Postocular* usually one, sometimes absent being confluent with the subocular; rarely two. *Subocular* variable. Sometimes one crescentic shield, sometimes confluent with the postocular, sometimes divided into three or four. *Temporals* usually three anterior, the longest about three-fifths to two-thirds the last supralabial. Three or four lie along the parietals. *Supralabials* usually 7 or 8 (6 on the right side in specimen No. 8022 in the Indian Museum, 9 on the left side in specimen No. 11434 in the Indian Museum). None touching the eye. The last longer than the two preceding taken together. *Costals* in 15 rows in the whole body length; several of the median rows keeled. Vertebrals not enlarged. *Mental* not touching the anterior sublinguals. *Ventrals* 161 to 199. *Subcaudals* 53 to 92. Specimen No. 12781 in the Indian Museum from the Burma-Siam Hills has 92 (ventrals 193). Another, No. 11434 from Deli, Sumatra, has 87 (ventrals 187).

Eye. Diameter less than the supraocular, subequal to the length of the snout.

Dentition. From the figure in Boulenger's Catalogue. Vol. III, p. 438. *Maxillary*: 5; anododont, syncranterian, scaphiodont. An edentulous space anteriorly that would take two teeth. *Palatine*: 3; anododont, coryphodont. An edentulous space anteriorly that would take two teeth. *Pterygoid*: 15; anododont, scaphiodont. No edentulous space anteriorly. *Mandibular*: 18; anododont, strongly scaphiodont.

Distribution. Burma: Tenasserim (Mergui; Tavoy; Burma-Siam Hills; *Ind. Mus.*). Siam (*Malcolm Smith*). Cochin China: Lao Mountains (*Brit. Mus.*). Malay Archipelago: Sumatra (*Ind. Mus.*); Java (*Brit. Mus*).

Note. I have examined nine examples in the Indian Museum.

Amblycephalus hamptoni Boulenger.

A. hamptoni, Boulenger, *J. Bomb. N.H.S.* 1905, p. 236.

Colour. "Pale brown above with numerous blackish bars interrupted on the middle of the back; two black longitudinal streaks on the back of the head and nape; sides of head and lower parts yellow; a few black dots on the belly, and under the tail."

Length. 555 mm. (1 foot, $9\frac{3}{4}$ inches); tail 150 mm. ($5\frac{7}{8}$ inches).

Lepidosis. Praefrontal touching the eye. *Frontal of* hexagonal in shape. Length greater than the snout, equal to its breadth, three-fifths the parietals. *Supraoculars* length equals the praefrontals, three-fifths the frontal; two-fifths the parietals. *Loreal* not touching the eye. One on the right side, two ($\frac{1}{1}$) on the left. *Praeocular* one. *Postocular* confluent with the subocular. *Temporals* one ; about as long as the last supralabial. *Supralabials* 8 on the right side, 7 on the left ; none touching the eye. *Mental* touching the anterior sublinguals. *Costals* in 15 rows in the whole body length. Median rows feebly keeled. Vertebrals feebly enlarged. *Ventrals* 202 (Boulenger), I count them 197. *Subcaudals* : 96.

Eye. Diameter subequal to the supraocular, greater than its distance to the edge of the lip.

Distribution. Burma : Mogok, S. Shan States (*Brit. Mus.*).

Note.—Known from a single specimen in the British Museum.

A NEW SNAKE FROM THE NORTHERN FRONTIER OF ASSAM.

By Colonel F. WALL, *C.M.G., I.M.S.*

Oligodon melanozonatus, sp. nov.

O. erythrorhachis, Annandale, *Rec. Ind. Mus.* VIII, 1912, p. 48.

Type, No. 16799; co-type, No. 16798. Both in the Indian Museum.

Length 513 mm. (1 foot, 8¼ inches). Tail 83 mm. (3⅜ inches).

Lepidosis. Rostral touching six shields, the rostro-nasal shorter than the rostro-internasal sutures. Portion visible above three-fifths to three-fourths its distance from the frontal, one-third to two-fifths the length of the frontal. *Internasals*: a pair. The suture between them equal to that between the praefrontal fellows, about half the internaso-praefrontals. *Frontal*: length greater than the snout, equal to the parietals. *Supraoculars*: length about equal to its distance to mid-internasals, two-thirds the frontal, three-seconds the temporal; breadth two-fifths the frontal. *Nasal* entire. *Loreal* absent. *Praeocular*: one. *Postoculars*: two. *Temporal* 1+2. *Supralabials* 6.[1] The 1st and 2nd touching the nasal, the 2nd the praefrontal, the 3rd and 4th the eye, and the 5th the temporal. *Posterior sublinguals* shorter than the anterior pair; touching the 4th infralabial. *Infralabials* 4; the 4th largest, longer and broader than the posterior sublinguals, and touching two scales behind. *Costals* two heads-lengths behind the head 17, midbody 17, two heads-lengths before the vent 15. *Ventrals* 171 to 173. *Anal* divided. *Subcaudals* 42 to 45, divided.

Colour. Dorsally light brown, obscurely mottled with blackish. Twenty rather ill-defined black bars cross the body to end low in the flanks, and four such bars cross the tail. In the smaller and half-grown specimen these bars are as light centrally as the dorsal brown, and are edged anteriorly and posteriorly with black as in *albocinctus*. A whitish, black-edged sagitta on the nape, the point directed forwards. Just before this is a black-edged, light brown sagitta with the point on the middle of the frontal shield. An obscure, blackish, praefronto-frontal bar, reappearing below the eye. Belly white with transverse, black, irregularly-disposed cross-bars, many as broad as the ventral shields. Similar marks beneath the tail.

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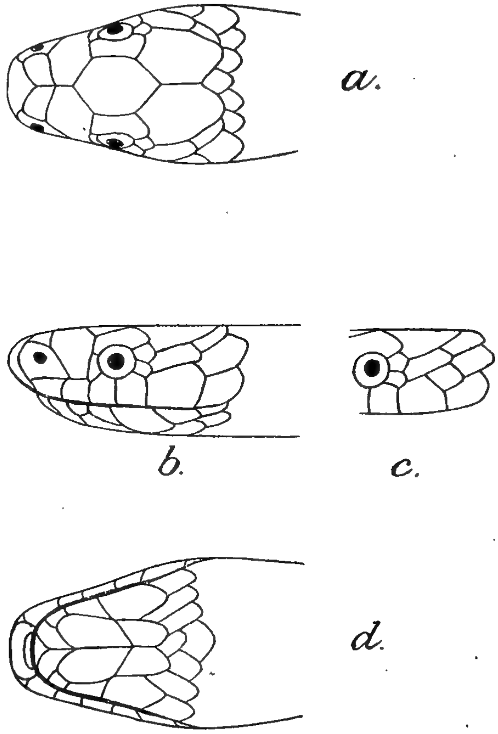
[1] These shields in the larger specimen are as shown in figure *b* on both sides, but in the smaller specimen as shown in figure *c* on the left side only, a 6th labial being wedged between the 5th and 7th.

Locality. Upper Rotung Valley, Abor Hills, Assam frontier, at about 2000 feet elevation.

Note. Dr. Annandale referred these specimens to *O. erythrorhachis* Wall, but a revision of the species of this genus from



TEXT-FIG. 1.—*Oligodon melanozonatus*, sp. nov.
Lepidosis of head: × 2.

the material available in the Indian Museum and Bombay collections, convinces me that they represent a species hitherto not described. In *O. erythrorhachis* the costals are 15 anteriorly, 13 two heads-lengths before the vent. The ventrals are 154 and subcaudals 64. The supralabials are 7.

STRUCTURAL MODIFICATIONS IN THE FISH OF MOUNTAIN TORRENTS.

By SUNDER LAL HORA, *M.Sc., Assistant Superintendent, Zoological Survey of India.*

CONTENTS.

INTRODUCTION.

Although in recent years considerable advance has been made in the study of animal adaptations to different types of environment, little attention seems to have been paid to the wonderful modifications exhibited by the fauna of mountain torrents. Except for a few casual remarks found in descriptions of hill-stream fishes, no detailed account, so far as I know, has been published of the subject. Nikolsky [1] in 1891 published a paper dealing with the correlation between the shape of the body of fishes and the strength of the current of streams and Annandale,[2] in two recent papers, has described some adaptive features in the fauna of hill-streams. Nikolsky's paper is unfortunately in Russian and is not available in Calcutta. From Annandale's papers I have received much help. Dr. Annandale has visited a large number of hill-streams in India and elsewhere, and was greatly impressed by the interesting adaptations exhibited by the various groups

[1] Nikolsky, *Rev. Soc. Nat. S. Petersb.*, pp. 137–139 (1891).

[2] Annandale, *Rec. Ind. Mus.* VIII, pp. 29–32 (1912), and *ibid.*, XVI, pp. 113–117 (1919).

of animals inhabiting these streams; it was at his suggestion that the work here published was undertaken.

Apart from their natural position in the animal kingdom, hill-stream fishes may be divided bionomically into two primary groups. The first group comprises those forms that migrate upstream at certain periods of their lives for spawning, etc.; these may be called the temporary inhabitants of these streams. Fishes of this group travel against the current by muscular effort and do not show, to any great extent, special modifications for life in rapid waters. The members of the second group are the permanent residents of the streams and of still smaller torrents and many exhibit extreme adaptations. It is with the latter group that the present paper is concerned.

The greatest handicap in dealing with the subject was the paucity of material available in the Museum or to be obtained from the streams. Species of many of the genera dealt with in this paper were not only poorly represented, but the specimens often consisted of old and badly preserved individuals quite unfit for detailed morphological investigation. In the hill-streams, on the other hand, there may be plenty of fish, but the readiness with which they seek shelter underneath stones or the swiftness with which they dart away makes it extremely difficult to obtain a good series of specimens. Most of the species are, therefore, known from very few individuals. Through the kindness of the Director, Zoological Survey of India, I was allowed to make tours in the Naga Hills, the Manipur Valley, the Khasi Hills, the Kumaon Hills, the Kharagpur Hills and the Darjiling Himalayas. Good collections were made at all these places. For histological investigation the material, wherever practicable, was fixed either in formol-alcohol or corrosive sublimate; haematoxylin and eosin have chiefly been used in staining sections of the adhesive apparatus.

The taxonomy of the Indian hill-stream genera has hitherto been involved in a state of great confusion and this factor greatly impeded the progress of my work. In a series of papers,[1] chiefly dealing with hill-stream forms, I have tried to elucidate the taxonomy of those genera of which sufficient material was present in the collection of the Indian Museum, and I have also worked out completely the collections made by myself in Manipur[2] in order to find out the correct names of the fishes with which this paper is concerned. Besides these I have published recently a paper on some rare and new forms kindly sent to us by Mr. G. E. Shaw from the base of the Darjiling Himalayas. In interpreting the generic position and specific limits of the various species assigned by Day to *Erethistes* and *Psilorhynchus*, I have derived great help from this collection.

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[1] Hora, *Rec. Ind. Mus.* XXIX, pp. 195–215, pls. x, xi (1919); *ibid.* XXII pp. 13-19, *ibid.*, XXII, p. 633, pl. xxiv-xxvi (1921).

[2] Hora. *Rec. Ind. Mus.* XXII, pp. 165-214 (1921).

The figures illustrating this paper were drawn by me with the help of a camera lucida.

The types selected for the study of hill-stream adaptations belong to the two chief orders of Indian freshwater fishes, the Cyprinoidea and the Siluroidea. The genera on which observations have been made are the following :—

Cyprinoidea.	Siluroidea.
Balitora Gray.	*Erethistes* Mull. & Trosch.
Bhavania Hora.	*Glyptosternum* [1] McClelland.
Psilorhynchus McClelland.	*Pseudecheneis* Blyth.
Parapsilorhynchus Hora.	*Glyptothorax* [1] Blyth.
Garra Ham. Buch.	*Laguvia* [2] Hora.

All these genera are found only in small mountain torrents, with the exception of certain species of the genus *Garra* which descend into streams of fair size. All show special adaptations to this environment.

The Schizothoracinae and some of the species of *Nemachilus* which live in rapid-running rivers show similar but less well-marked adaptations. Some remarks on the nature of the adhesive apparatus of these forms are also included in this paper.

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[1] While recently attempting to revise the species of the genus *Exostoma* Blyth, I have found that this generic name canot be employed for the forms to which it is usually assigned. I propose the following changes in view of the facts given below :—

Exostoma Blyth = *Glyptosternum* McClelland.
Glyptosternum McClelland = *Glyptothorax* Blyth.

McClelland (*Calcutta Journ. Nat. Hist.* II, pp. 584–585, and 587–588, 1842) described five species, *Glyptosternon reticulatus, G. sulcatus, G. striatus, G. pectinopterus* and *G. labiatus* under the new generic designation *Glyptosternon.* Blyth (*Journ. As. Soc. Bengal* XXIX, pp. 153–155, 1860) split up these five forms into four distinct genera, *Glyptosternon, Pseudecheneis, Glyptothorax* and *Exostoma.* He regarded *G. reticulatus* from Afghanistan as the type-species of McClelland's *Glyptosternon.* According to McClelland this species is stated to be "without spines ; the first ray of the pectoral and ventral fins soft and pinnate, giving off soft pointed cartilaginous rays along the anterior margin ; which are enveloped in the membrane of the fin. The under surface and anterior portion of the body form a flat corrugated surface." Of the several species of *Exostoma* in the collection of the Indian Museum, all except *E. berdmorei*, possess the outer ray of the pectoral and the ventral fins similar to that of McClelland's *Glyptosternon reticulatus* ; they ought, therefore, to be included in the same genus. *Exostoma berdmorei*, Blyth, which is known from a single specimen from Tenasserim, now in a very bad condition, is the type-species of the genus *Exostoma.* The pectoral spine of this species is totally different from that of the others and corresponds to those forms which were included by Blyth under his genus *Glyptothorax.* The absence of a "pectoral disk," which led Blyth to separate the genus *Exostoma* from *Glyptothorax*, is not a valid generic distinction, because the thoracic adhesive apparatus of almost all the species included in the genus *Glyptothorax* may become indistinct in specimens which are old or have been badly preserved.

The generic name *Glyptosternon*, McClelland was latinised into *Glyptosternum* by Günther (*Cat. Fish. Brit. Mus.* V, p. 185, 1864).

[2] In a paper published recently (*Rec. Ind. Mus.* XXII, p. 739, 1921) I have given reasons for separating *Erethistes asperus* (McClelland) (*Calcutta Journ. Nat. Hist.* IV, p. 404, pl. xxiv, fig. 2) along with the two new species from the base of the Darjiling Himalayas from the genus *Erethistes* and have placed them all in a new genus *Laguvia.* This genus is intermediate in certain respects between *Erethistes* and *Glyptothorax.*

CONDITIONS AFFECTING FISH IN RAPID WATERS.

The conditions that influence the fauna of hill-streams are the following :—

(i) The chief factor is the strength of the current, and all the remaining conditions are due to it. The adaptations which are dealt with further on are all due primarily or secondarily to this one cause. The rate of flow of water varies considerably according to the season, but throughout the year its average flow is much higher than that of any stream in level country. This rapid flow of water would render life impossible to many animals if they did not possess special organs of adhesion or other appliances to counteract its influence. In places like Cherrapunji (Khasi Hills), where 458 inches of rain falls in a comparatively short time, the rate of flow of the water must at times be extremely rapid, and at such times some even of the most powerful fish cannot withstand it for more than a few minutes. It is unfortunate that I have not been able to collect any precise data to compare the rate of flow of water and the fauna inhabiting it. This is a case in which co-operation between a zoologist and a physicist is called for.

(ii) Next in importance are two factors on which the very existence of the animals depends—food and shelter. In a hill-stream there is always a sufficient quantity of food, but the only type usually available consists of algal slime covering stones and rocks. There is no opportunity for any other type of vegetation to grow, as it is liable to be uprooted and carried away by the strength of the current. In pools and ditches that are sometimes formed on the bank of the streams, there is generally a growth of water-weeds, but these cannot be referred to as rapid streams. Certain fishes such as the species of *Nemachilus* feed on May-fly and Dragon-fly larvae, but this type of food is usually scarce.

As regards shelter, there is plenty of it in a hill-stream for little fish. The species of *Nemachilus*, on the slightest provocation, hide themselves underneath stones. Those who have made collections in the hill-streams know how advantageous it is to run the net among small stones and sometimes to pick up stones in the net, because in this way all those forms which rest underneath stones are netted.

(iii) Hill-streams are never very deep, and their water is usually very clear. Consequently during the day-time the animals have to withstand intense light.

(iv) The water is well aerated as it is constantly in motion.

These conditions do not apply to pools that occur in the course of hill-streams, and the fish-fauna of these pools is very different from that of the rapid current. It is possible that those forms which live in rapid waters are sometimes carried into these pools, but I have never come across any instance in which the typical sluggish-water forms have been found in rapid waters. Species of *Danio*, *Lepidocephalichthys*, *Barbus*, *Barilius* are generally met with in the pools. Of these genera only smaller forms like *Danio rerio* are usually found, for they alone are able to find during the flood season sufficient shelter underneath rocks and stones. The pools are, however, sometimes inhabited by large species of *Barbus* and *Barilius* which are sufficiently powerful to withstand floods.

MODIFICATIONS FOR LIFE IN HILL-STREAMS.

The modifications for life in hill-streams may be considered under the following heading :—

1. The external form of the fish and its size.
2. The scale-covering, etc.
3. The paired fins and the skeletal and muscular structures connected therewith.
4. The caudal fin and its peduncle.
5. The mouth, its position and shape; the jaws, the barbels, the lips and their muscles.
6. The eyes.
7. The gill-openings, branchiostegal rays and membranes.
8. The air-bladder.
9. Special modifications of the skin.

1. *The external form.*—Nikolsky (*op. cit.*) has dealt with this subject but as the text of his paper, which I have not seen is in Russian, I give my own observations in full. The fish with which this paper is concerned all live on the bottom, and the form is so modified as to offer the least resistance to the rapid current. The head and body are greatly flattened and in *Balitora*, *Glyptosternum* and in the most specialized hill-stream species of *Garra* and *Glyptothorax* the form is almost leaf-like. The ventral profile becomes straight and horizontal throughout and the dorsal profile is but slightly arched. The head is usually small and semicircular and the snout is trenchant. The Bornean genus *Gastromyzon* is in shape a typical hill-stream form.

The shape of the body depends upon the strength of the current and any deviation from the characteristic form of the fish is directly proportional to the rate of the flow of water. Thus the form of those fishes that live in places where the intensity of the flow is intermediate between that of a sluggish stream and of a hill-torrent is almost cylindrical, as in *Crossochilus latia*. Confining our attention to the members of the genus *Garra*, one can find all possible gradations in shape between such forms as *Crossochilus latia* and the most specialized hill-stream form such as *Balitora*. *Garra mullya*, one of the most widely distributed forms in the genus, lives in ponds, tanks and sometimes in rapid waters. The specimens collected from ponds and tanks are cylindrical, while those collected from rapid waters are sometimes flattened. Great modification in form is exhibited by *G. lissorhynchus*, *G. kempi* and *G. nasutus*, all of which are known from rapids in the Eastern Himalayas. In dealing with the fishes of the Manipur Valley I have shown how the fauna of a stream changes within very short limits according to whether the bed is rocky or muddy. Small size is a distinct advantage in hill streams, firstly because the streams are small and secondly because small forms can find more shelter under pieces of rocks and stones during floods.

2. *The scale-covering, etc.*—In those Cyprinid fishes that take to hill-stream life, the lepidosis undergoes considerable modification. In the Schizothoracinae the scales are small and partly buried in the skin or are totally absent except in the anal and scapular regions. If in a normal Cyprinid genus in which the scales are large and imbricate, the hill-stream forms be compared with those from other types of environment, it will usually be found that the scales are greatly reduced on the under surface, and in some cases they disappear altogether. The region of the chest, which is to some extent employed in the process of adhesion, is the first to be modified, and then, with the increased rapidity of the flow of water, more and more of the under surface becomes naked. In two species of *Garra*, *G. abhoyai* and *G. rossicus*, the dorsal surface in front of the dorsal fin is also naked.

The reduction of scales on the lower parts is necessitated by the fact that a plain and smooth surface is necessary in order to allow adherence to rocks. I have not been able to understand why the scales should be reduced on the dorsal surface in *Garra abhoyai* and *G. rossicus*. Both possess a subcylindrical shape and are not among the most specialized hill-stream forms.

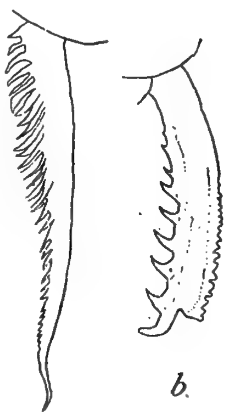
3. *The paired fins and the skeletal and muscular structures connected therewith.*—The fins are very plastic structures in the anatomy and they have been employed for various functions by diverse groups of fishes. The modifications of the pectoral fins in Flying-fishes, of the first dorsal fin in Sucking-fishes and of the ventral fins in Gobiidae and Gobiesocidae are a few instances among many. In hill-stream fishes the paired fins are used as organs of adhesion or of locomotion and for both these functions powerful muscles are required. In certain cases they are probably used also for respiration.

The outer rays of the paired fins are employed for the function of adhesion and the number of the inner rays is consequently increased. In *Gastromyzon borneensis* there are as many as 26–28 rays in the pectoral and 20–21 in the ventral fins. In an allied Indian genus, *Balitora*, there are 21 rays in the pectoral and 11 in the ventral fins. The outer rays of these fins are greatly thickened and much flattened.

Besides an increase in the number of fin-rays of the paired fins, their position and shape undergoes considerable change. The fins, instead of being situated on the under surface of the fish, are pushed outwards and ultimately are placed horizontally on the sides of the body. This change is brought about for two reasons, firstly to allow the ventral surface to be firmly applied to rocks, and secondly to enable the fins to act as organs of adhesion. As regards the shape of the fins, some of the inner rays are directed upwards against the sides of the body, so that when the outer rays are used for the purpose of adhesion, the inner rays can be kept constantly in motion, probably for the purpose of respiration. I have embodied my observations on this point in an immature specimen of *Psilorhynchus* in a former paper.[1] In the genus *Glyptosternum* (fig. 8) only a few rays of the paired fins are visible from the under surface, while the remainder are reflected upwards. I have not observed these fishes in nature, but on a recent tour to the base of the Darjiling Himalayas, I was able to verify the observation that I had previously made on the immature specimens of *Psilorhynchus* from the Naga Hills, by keeping a half-grown specimen of *Garra annandalei* in an artificial pond of water in the course of the Mahanadi River. In *Parahomaloptera microstoma*[2] the shape of the fins is somewhat less modified than is the case in *Glyptosternum*.

The greatest specialization as regards fin-structure is found in *Gastromyzon borneensis*. The pectorals begin with a long base, vertically below the eyes: the ventrals possess long curved bases, which are united posteriorly. Between the bases of the ventral and the pectoral fins there is a lateral extension of the abdominal skin. "By this arrangement the whole flattened abdominal surface, together with the fins and the flattened lower surface of the head forms an enormous suctorial disc."[3]

I have already pointed out that the outer rays or the spines, as the case may be, of the paired fins are greatly flattened. Interesting modifications take place in the outer ray of these fins in the genus *Glyptosternum*, "soft pointed cartilaginous rays" are given off along the anterior margin (fig. 1*a*) to support the striated skin which forms the adhesive apparatus. This is described in detail below when dealing with the modification of the skin in the formation of the adhesive apparatus.



TEXT-FIG 1.—Pectoral spine of *Glyptothorax* and *Glyptosternum*.

a. Outer pectoral ray of *Glyptosternum labiatum*.

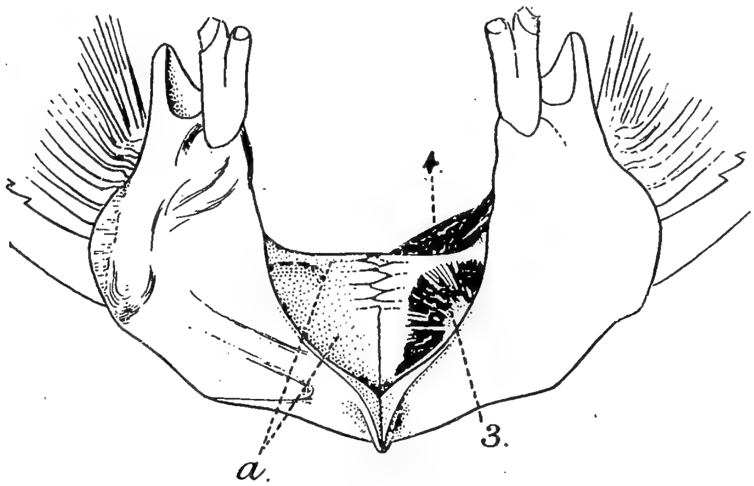
b. Pectoral spine of *Glyptothorax berdmorei*.

The pectoral and the pelvic girdles are modified in certain hill-stream fishes, owing to the acquisition of new functions by the paired fins. It is unfortunate that I have not been able to study these structures in *Psilorhynchus*, *Bhavania*, *Balitora* and *Homaloptera*, on account of the paucity of

[1] Hora, *Rec. Ind. Mus.* XIX, p. 212 (1920).
[2] Weber and Beaufort, *Fishes Indo-Austr. Arch.* III, p. 20. fig. 5 (1916).
[3] Weber and Beaufort, *ibid.*, p. 2 (1916).

material; but even in those Cyprinid genera of which material was available in sufficient quantity, I am unable to find any striking modifications. In *Garra*, for instance, the whole structure is more or less similar to that found in *Labeo*, except that the adductor and abductor systems of muscles are better developed. At the same time it must be remembered that the fins do not form the chief organs of adhesion in this genus.

In the Siluroids, *Glyptothorax* and *Pseudechencis*, in which the chief adhesive organ is situated on the chest, the only modifications consist in the fusion of the various bony elements for strengthening of the girdle. On account of the horizontal position of the fin, the shape of the girdle is considerably changed (fig. 2).



TEXT-FIG. 2.—Dorsal view of the pectoral girdle in *Glyptothorax madraspatanus.*

a = interclavicle; 3, 4 = muscles of the pectoral spine.

Great difficulty has been experienced in adopting suitable terms for the description of the various structures. I have followed Parker [1] in preference to McMurrich [2] in drawing up my descriptions.

Besides the modifications enumerated above, other characteristic specializations are also found in *Glyptothorax* and *Pseudecheneis.* On the ventral aspect of the interclavicular bones (fig. 3) there are keel-like ridges (fig. 3*b*) for the attachment of the muscles. These ridges are greatly elevated posteriorly and end in spine-like processes; but they slope down anteriorly and meet each other in the mid-ventral line close to the union of the clavicles and the interclavicles.

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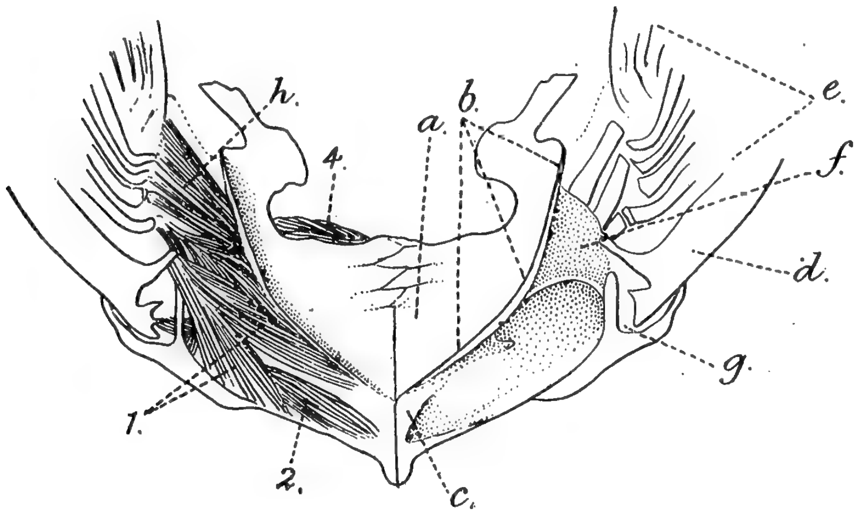
[1] Parker, *A Monograph of the structure and development of the Shoulder girdle and Sternum in the Vertebrata* (1868)

[2] McMurrich, *Proc. Canadian Inst.* (n.s.) II, pp. 301–306 (1884).

The muscles controlling the movement of the pectoral fin (figs. 2, 3) in *Glyptothorax* are also interesting. Besides the abductor



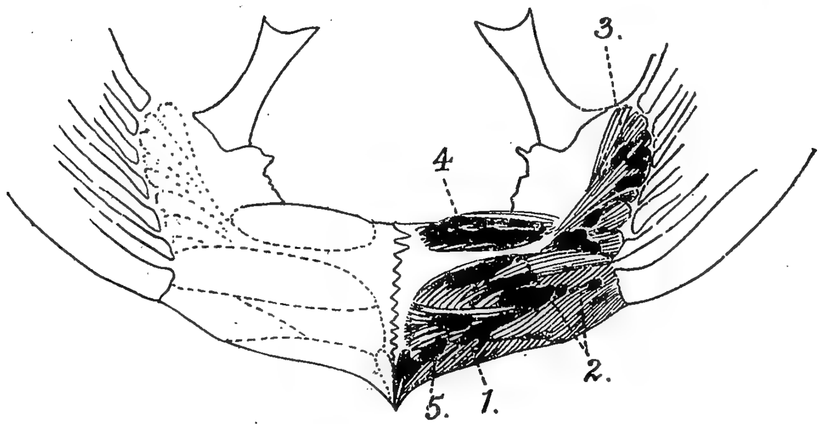
Text-fig. 3.—Ventral view of the pectoral girdle in *Glyptothorax madraspatanus*.

a = interclavicle : *b* = interclavicular ridge ; *c* = clavicle ; *d* = pectoral spine ; *e* = pectoral fin rays ; *f* = groove for the attachment of abductor muscles ; *g* = groove in the cubito-humeral process ; *h* = abductor muscles ; 1, 2 and 4 refer to the muscles of the pectoral spine.

and the adductor systems, there are four special muscles to move the spine. Muscle 1 arises from the anterior grooved and thickened border of the clavicle and also from along its posterior border near the base of the interclavicular ridge against the sides. Its action is to pull the spine towards the body and fold the rays. Muscle 2 takes its origin from the anterior border of the clavicle, further forward than muscle 1. In its course, it passes underneath muscle 1 and its function is that of expanding the fin. Muscle 3 is very extensive and fan-shaped. It arises along the whole of the surface of the clavicle and the interclavicle on the dorsal side and in its course passes through a bony canal. Its action is the same as that of muscle 2. Muscle 4 is very strong and passes through a passage in the bone. The muscle takes a curved course and its action is somewhat like that of a rope passing over a pully. Its function is that of folding the fin. It arises from the grooved and thickened posterior border of the clavicle.

The actions of the various muscles were studied by moving the muscles and by watching their effect upon the fin. It is clear that muscles 1 and 4 are stronger than 2 and 3, because it is in the action of folding of the fin that the adhesive function of the outer rays is involved. In those species of *Glyptothorax* in which the adhesive apparatus is present on the under surface of the pectoral spine, muscle 1 is the better developed.

In the genus *Glyptosternum*, where the fins act as organs of adhesion, the moidfications in the musculature are more marked (fig. 4) and the arrangement is different. The muscle labelled 2 in *Glyptothorax* correspond to 5 in *Glyptosternum*; muscle 4 is the same in both cases. Muscle 1 arises close to the mid-ventral suture of the clavicle and is inserted in the form of a glistening tendon on the anterior border of the pectoral spine. Its action is to expand the fin. Muscle 2 arises near the mid-ventral line and is inserted on the bases of the spine and the first few rays. Its function is, in all probability, to keep the spine and the few outer rays closely pressed against the substance on which the fish may be resting. This muscle is large and is not found in any other genus that I have studied; it has no other muscles to counteract its action.



TEXT-FIG. 4.—Muscles of the pectoral fin in *Glyptosternum labiatum*. Numbers 1, 2, 3, 4 and 5 indicate the muscles referred to in the text.

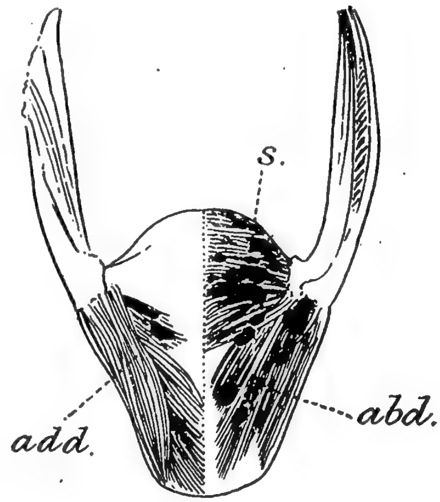
As regards the skeleton of the pectoral girdle in *Glyptosternum*, there are no bony ridges for the insertion of muscles. Otherwise it is very similar to that of *Glyptothorax*.

The pelvic fins also possess a special muscle (fig. 5) beside the abductor and abductor systems. This keeps the fins closely pressed against rocks, when the fish is resting, thus enabling it to adhere to rocks by means of striated skin on the under surface of some of the outer rays of the pelvic fin.

4. *The caudal fin and its peduncle.*—There is a general tendency amongst hill-stream fishes to possess a long, narrow, band-shaped caudal peduncle. For example in *Nemachilus tenuis* and *N. lhasae* the caudal peduncle is more narrow and elongated than in any other species of the genus that I have seen. These two species resemble the Central Asiatic forms figured by Herzenstein[1] and it is possible that these features are correlated with high

[1] Herzenstein, *Wiss. Res. Przewalski Central. As Reis.*, Theil III (2), pls. i-vii (1888).

altitudes and rapid running streams. Similarly in the genus *Glyptothorax*, two species, *G. striatus* and *G. saisii*, from the Khasi and the Parasnath Hills respectively, have a different form of caudal peduncle from the remaining species. It is long and narrow. In almost all species of *Homaloptera*, *Bhavania* and *Balitora* and in the most specialized species of the genus *Garra* the caudal peduncle is similarly modified.



TEXT-FIG. 5.—Muscles of the pelvic fins in *Glyptosternum labiatus*.

The right side of the figure shows the ventral view and the left side the dorsal view of the pelvic girdle. *add* = adductor muscles ; *abd* = abductor muscles ; *s* = special muscle.

As regards the fin, the chief modification consists in the inequality of its lobes. In most cases the lower lobe is somewhat longer than the upper, as in *Balitora brucei*, *Bhavania australis*, *Glyptothorax striatus*, *Glyptosternum labiatum* and *Garra nasutus*. In *Gastromyzon borneensis*, though the caudal fin is not deeply forked, the lower portion is longer and stronger than the upper.

I was not able to follow the true significance of these modifications, because the movements were too rapid for detailed analysis.

It may be pointed out in this connection that in Elasmobranch fishes, where the mouth is on the under surface considerably behind the tip of the snout, the lower lobe of the caudal fin is much shorter than the upper. I hope to make further observations on this point on another occasion.

5. *The mouth, its position and shape ; the jaws ; the barbels ; the lips and their muscles.*—The mode of life and the nature of food in mountain-rapids necessitates a change in the position of the mouth and the structure of the jaws. The mouth, instead of being a transverse cleft at the anterior end of the fish, is situated on the under surface considerably behind the tip of the snout. It is usually crescentic or semicircular in outline. The jaws are greatly strengthened and their edges become sharp and cutting. In most cases, *Oreinus* for example, the jaws are covered with a strong horny covering. This is due to the fact that hill-stream fishes have to strip algal slime from stones for their food.

Barbels in rapid-waters would be a source of great encumbrance and, therefore, they are much reduced. In most of the hill-stream species they can only be made out after a careful examination.

In *Balitora* they are short and stumpy and liable to be overlooked. In the remaining hill-stream genera discussed in this paper they are short and thread-like. In *Parapsilorhynchus*, however, they are short and cylindrical.

In *Nemachilus* and the Homalopterid genera the lips are so modified as to form a sucker with the help of the mouth, and consequently they exhibit diverse modifications and specializations. In the genus *Nemachilus* the lips are divided in the middle and are greatly swollen, so that when they are pulled outwards away from the mouth, their divided parts form a continuous ring-like sucker. In most cases the skin of the swollen region is plicated, but I have not been able to find any trace of definite spines such as will be described later in the structure of the adhesive apparatus of other genera. I have already described in a previous paper[1] the way in which, by the action of certain muscles, the lips of *Bhavania annandalei* are converted into a sucker. In *Balitora* the thick lips are cut up into several tentaculate processes and when pulled apart they form an effective sucker. In most of the species of the genus *Glyptosternum* the lips are "reflected and spread continuously round the mouth, so as to form a broad flat sucker." Similar modifications occur in certain of the most specialized forms of the genus *Glyptothorax*.

6. *The eyes.*—With the flattening of the form in hill-stream fishes the eyes are more and more pushed towards the upper surface. In forms like *Balitora brucei*, *B. maculata*, *Glyptothorax saisii*, *G. striatus.*, *Pseudecheneis sulcatus* and in almost all species of the genus *Glyptosternum* the eyes are situated on the dorsal surface and are placed close together. Besides this change in position, they are much reduced in size. To what cause this reduction is due, I do not know; but it is quite probable that the intensity of the light in the clear shallow waters of the hill-streams may have something to do with it.

7. *The gill-openings, branchiostegal rays and membranes.*—With the employment of the under surface for the purpose of adhesion to rocks and stones, the gill-openings are generally restricted to the sides. Except in the genera *Glyptothorax* and *Laguvia*, the gill-openings, in almost all the genera dealt with in this paper, do not extend beyond the base of the pectoral fin on the under surface. In certain species of *Garra* the openings are somewhat wider, but even in them they are separated from each other by a considerable distance. The greatest modification as regards this character has taken place in two species of *Glyptosternum*. In these the gill-openings are situated above the base of the pectoral fin and there is a short narrow passage from the interior of the gill-chamber to the exterior.

With the restriction of the gill-openings to the sides, it is natural to suppose that respiration will suffer to some extent. Moreover, when a fish is feeding on the algal slime, the under

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[1] Hora, *Rec. Ind. Mus.* XIX, p. 203, pl. x, fig. 2.

surface of the head and body are firmly and closely applied to the rock to which it may be clinging at the time, and this also will make respiration difficult. In all probability the following factors help hill-stream fishes in respiration :—

(i) The water in the hill-stream is better oxygenated and is purer than that of a sluggish stream in a flat country.

(ii) By reducing the gill-openings, the fishes are enabled to retain water in their gill-chambers for a comparatively longer time.

(iii) The inner rays of the pectoral fins in fishes of rapid streams are held in constant motion when the fish rests against a piece of rock. The movements of these rays may help respiration in two ways :—

(*a*) The blood may be oxygenated in the rays themselves,
or (*b*) they may force water in and out of the gill-opening.

The following quotation from Mr. Chapin's notes given by Nichols and Griscom [1] on the mechanism of respiration in *Enchilichthys dybowskii* (Vaillant) when clinging to rocks is very interesting :—" Two examples were brought alive in a basin where they stuck fast to the smooth enamel surface. When thus attached, the water for respiration enters by the back of the mouth, and the movement of the gills often makes the whole fish quiver or move slightly back and forth. Natives say they cling to rocks and eat algae. They can swim rapidly. The mouth is here drawn as though slightly extended ; while sucking, it of course contracts." The above observations were made on fishes in a state of captivity and require confirmation. The sucker by means of which the fish adheres appears from the figure to surround the mouth completely, and it is probable that the fish uses both lips for adhesion as in the Indian hill-stream forms. The posterior jaw is in almost all cases more highly specialized for rasping the algal slime from the rocks than the anterior jaw and under the circumstances detailed above, it seems highly improbable that water can enter the gill cavities from the back of the mouth when the fish is either feeding on algal slime or clinging to a rock.

With the reduction of the gill-openings and the backward shifting of the mouth on the under surface considerably behind the tip of the snout, the branchiostegal rays and membranes are greatly reduced. Usually these structures on the two sides of a fish such as *Labeo rohita* meet and overlap on the under surface, but in hill-stream fishes, with the exception of those belonging to the genera *Glyptothorax* and *Laguvia*, they form an obtuse angle on the under surface, if they meet at all.

8. *The air-bladder*.—The bladder in the hill-stream forms shows considerable degeneration and in 1893 Bridge and Haddon [2]

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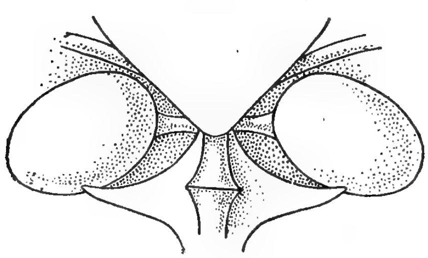
[1] Nichols and Griscom, *Bull. Amer. Mus. Nat. Hist.* XXXVII, p. 720, pl, lxxvi, fig. 3 (1917).

[2] Bridge and Haddon, *Trans. Phil. Soc. London*, vol. 184, part I (B), p. 305 (1893).

attributed the reduction to the following causes, which bear repetition even to-day. They say :—"The causes that have led to the degeneracy of the air-bladder in so many forms are in many instances not difficult to trace, and, as in so many Physoclist Teleostei, the assumption of a purely ground habit of life is probably the most important one. Not a few of the genera of Siluridae abnormales inhabit the comparatively shallow waters of rapidly flowing mountain streams and torrents often living at a considerable altitude, and in general habit are not unlike our common English Loaches. Many are provided with an adhesive apparatus on the ventral surface of the body between the pectoral fins for attachment to stones, so that they may be enabled to withstand the force of mountain torrents. Such fishes when not in motion by the exercise of their fins probably rest upon, or attach themselves to, the river bottom, and the utter uselessness and probable harmfulness of an air-bladder as a hydrostatic organ under such conditions is no doubt the cause of its degenerate and rudimentary conditions in such Siluroids as *Sisor*, *Pseudecheneis*, *Glyptosternum*, *Euclyptosternum*, *Exostoma*, *Amblyceps*, etc." I have dealt with this interesting organ at some length in my previous paper and have shown in the case of the genus *Garra* that the reduction in the organ is directly proportional to the strength of the current of the streams in which the fish live.

In almost all the highly specialized hill-stream forms such as certain species of Loaches, Homalopterid fishes and the forms included under the Silurid genera, *Glyptothorax*, *Glyptosternum* and *Pseudecheneis* the bladder is, divided into two lateral chambers (fig. 6) which are more or less connected with each other by a short, narrow transverse tube. Moreover the bladder is wholly or partially encapsuled by a bony case in almost all cases.

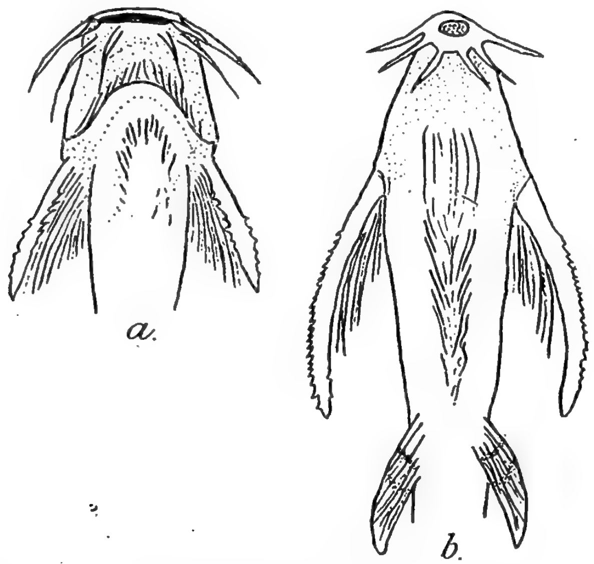


TEXT-FIG. 6.—Air-bladder of *Glyptothorax madraspatanus*.

9. *Special modifications of the skin.*—Under this heading I include the diverse forms of modifications exhibited by the skin in the formation of adhesive organs. The simplest form of specialization occurs in Cyprinid fishes, where the skin covering the under surface of the few outer rays of the paired fins is greatly thickened and becomes cushion-like in places. By these cushion-like pads the fishes are enabled to cling to rocks and hold their own against a rapid flow of water. In the Silurid genera the skin instead of being plain is thrown into grooves and ridges. Such striated portions of skin may occur anywhere on the under surface of the fish but are generally found in the anterior third of the body. I have found such striated surfaces on the barbels, on the sides of the mouth,

on the chest between the bases of the pectoral fins and lastly on the under surface of the pectoral and pelvic spines, and I have been able to make out a series showing the gradual specialization of the adhesive apparatus in the Silurid genera.

The genus *Erethistes* comprises small hill-stream forms in which the under surface of the body is smooth and greatly flattened. In one member of the genus, *E. elongata*, the structure is, however, somewhat different. The whole of the chest and the belly (fig. 7, *b*) is rugose and shows low, but well-marked striations. In the forms which I have assigned to my new genus *Laguvia*, these corrugations are restricted to the chest and the belly is quite smooth (fig. 7, *a*). This feature is still further marked in the

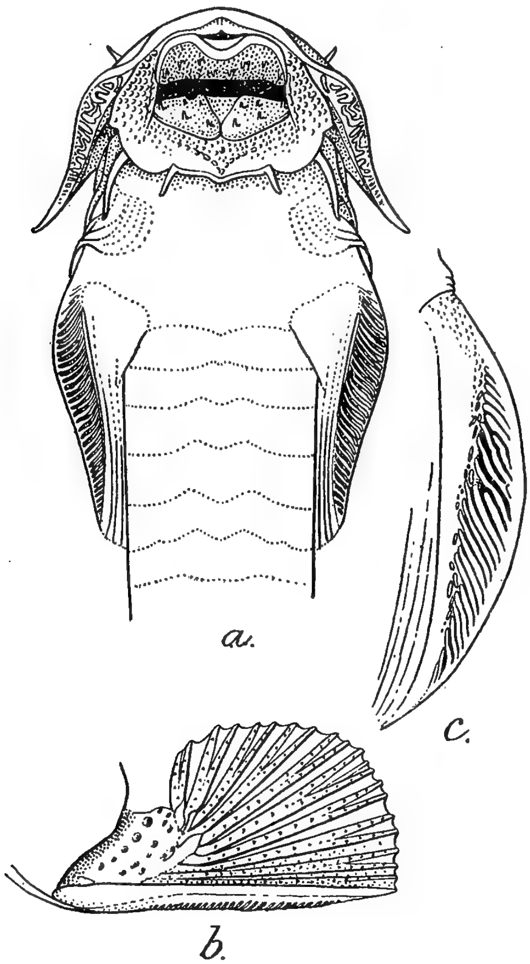


TEXT-FIG. 7.—Under surface of head and chest of *Laguvia* sp. and *Erethistes elongata*.

a. *Laguvia* sp. *b*. *Erethistes elongata*.

members of the genus *Glyptothorax*, where a definite U-shaped or V-shaped adhesive apparatus consisting of folds of skin is present on the chest between the bases of the pectoral fins. In certain species of the last genus from very rapid waters an adhesive apparatus of a similar nature is also present on the under surface of the pectoral and pelvic spines. In *Pseudecheneis sulcatus* the skin is somewhat differently modified on the chest, but the striations on the spines of the paired fins are of a similar nature to those of the preceding genus.

Specialization has proceeded along another direction in the genus *Glyptosternum*. Here the skin on the under surface of the spines (figs. 8*a* and *c*) is striated and each ridge is supported by a short, pointed, cartilaginous ray given off from the outer side of the first pectoral and pelvic rays (fig. 1, *a*). Besides this the striated region is supported by a definite, highly specialized tissue (fig. 16, *s.t.*). The chest is absolutely devoid of any adhesive apparatus. In certain species of the same genus the under surface of the barbels and the skin near their bases is striated (fig. 8*a*).

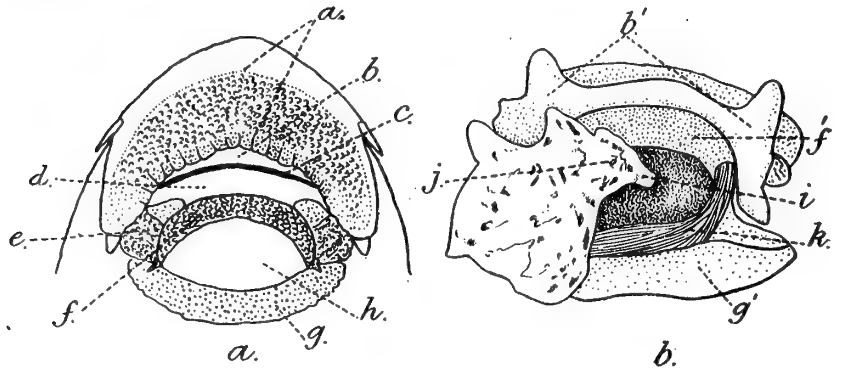


TEXT-FIG. 8.—Structure and form of the pectoral fins and the position of the adhesive apparatus in *Glyptosternum labiatum*.

a. Under surface of head and chest showing striated skin on pectoral spines and on maxillary barbels.
b. Pectoral fin showing reflected inner rays.
c. Under surface of pectoral spine highly magnified.

The disc of *Garra* (fig. 9*a*) with its associated structures is an efficient type of adhesive organ. The disc consists of a central callous portion (*h*) and of free tuberculated lateral and posterior borders (*g*). Its anterior border is formed by the posterior labial fold (*f*) which in its development has replaced the posterior lip. The anterior labial fold (*a*) is fringed and tuberculated and helps the fish in adhering to rocks. A rudimentary form of disc has recently been described by me[1] in *Parapsilorhynchus discophorus*.

The disc of *Garra* works on the suction principle. In the middle of the under surface of the callous portion, a strong tendon (fig. 9*b*, *i*) is inserted and attached to the urohyal (*j*), so that when the urohyal is elevated, the callous portion of the disc is drawn in and thus a cavity is produced which is surrounded by fringed borders. These fringed and tuberculated borders are provided with efficient organs of adhesion as will be seen later when dealing with the minute structure of the adhesive organs.



TEXT-FIG. 9.—The disc of *Garra* and its associated structures.

a. Disc as seen from the under surface.

b. Dissection of disc from the dorsal surface to show the mechanism for suction.

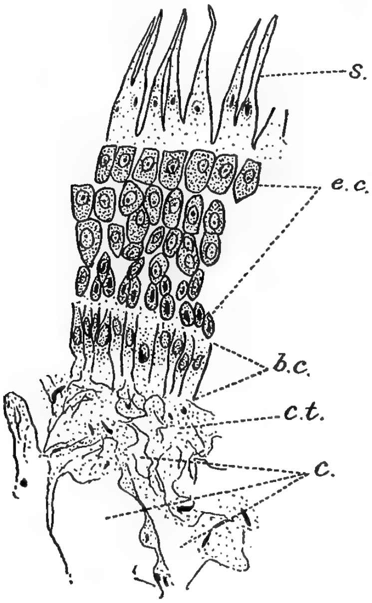
a = anterior labial fold; *b*, *b'* = anterior jaw; *c* = mouth opening; *d* = posterior jaw; *e* = connectives; *f*, *f'* = posterior labial fold; *g*, *g'* = free tuberculated border of the disc; *h* = callous portion of the disc; *i* = tendon joining the centre of the callous portion of disc with urohyal; *j* = urohyal; *k* = muscle joining the two sides of the anterior jaw.

THE MINUTE STRUCTURE OF THE ADHESIVE APPARATUS.

The simplest form of adhesive apparatus is found among hill-stream fishes of the order Cyprinoidea. It consists of the thickened skin covering the under surface of the few outer rays of the paired fins. In a transverse section of such a structure in *Bhavania annandalei* (fig. 10) the following arrangement may be seen:—The epidermis consists of several tiers of cells, varying in shape and size with their depth and resting on a loose connective tissue (*c.t.*), which constitutes the dermis. The outer epidermal layer is modified into stiff and strong spine-like processes (*s*), which are somewhat curved near their extremities. The inner limit of these processes is not well-defined and they appear to rest

[1] Hora, *Rec. Ind. Mus.* XXII, pp. 13–19, figs. (1921).

upon a homogeneous layer of protoplasm; they occupy as much as one-third of the total thickness of the epidermis and their inner ends are broad. The nuclei of the spines are somewhat oval in outline and are placed in the proximal half; each is surrounded by a whitish halo. The protoplasm of the spine and of the basal homogeneous layer stains lightly with hematoxylin, eosin and borax carmine. The deeper tissue takes up the stain readily. Below the homogeneous protoplasmic layer, the tissue consists of several layers of almost rectangular cells (*e. c.*) each with a distinct nucleus in the centre. The cells diminish in size with the depth of the tissue and become more and more irregular in form and arrangement. The interspaces between them become broader and in certain cells two nuclei are present. Below these and immediately above the basal epidermal layer (*b.c.*) there is a tier of small, more or less regularly arranged cells, the nuclei of which are solid, deeply staining ovoidal bodies. The basal layer of epidermal cells is made up of columnar tissue; the nuclei are oval and lie almost in the middle of the cell, or nearer its upper than its lower ends. The upper as well as the lower limits of the basal cells are hardly distinguishable and both these ends stain lightly. The nuclei appear to be in a state of mitotic division as the chromatin substance in them is greatly diffused.



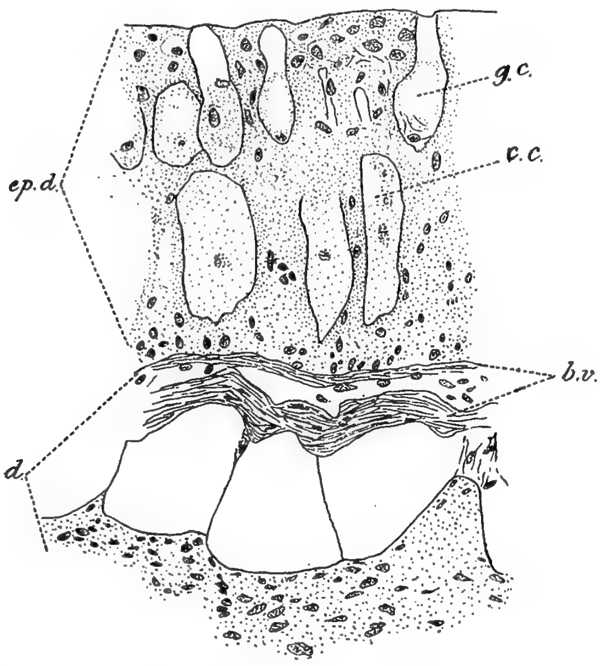
TEXT-FIG. 10.—Transverse section through a portion of the adhesive pad on the outer rays of the pectoral fin in *Bhavania annandalei.*

s = spine; *e.c.* = epithelial cells; *b.c.* = basal epithelial cell; *c.t.* = connective tissue; *c* = cavities for blood vessels.

The connective tissue (*c.t.*) below the basal layer of the epidermis is very loose and is richly interspersed with cavities (*c*) of the nature of blood-spaces. The nuclei are greatly elongated and stain deeply. The cell-limits in this tissue are not marked and the whole of the tissue is not so deeply stained as the middle layer of epidermal cells.

In the genus *Garra* this form of adhesive apparatus is supplemented by the presence of the characteristic disc behind the posterior jaw on the under surface. Before dealing with the structure of the adhesive disc, I propose to give a short account of that of the integument in this genus.

In a vertical section of the skin (fig. 11) covering the tip of the snout, where scales are of course absent, the epithelial region (*ep.d.*) is made up of a homogeneous mass of protoplasm with a large number of nuclei scattered in it. The nuclei are aggregated either near the base or near the apex of the epithelial region; some of them are surrounded by a white zone. Near the upper surface are present a number of large ampulliform gland-cells (*g.c.*). The protoplasm of the gland-cells is restricted to the periphery or to the base and the nucleus generally occupies the centre of the basal protoplasm. In the middle of the homogeneous epithelial mass

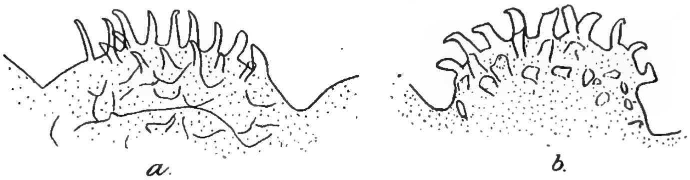


TEXT-FIG. 11.—Transverse section of the integument of *Garra annandalei* from the tip of the snout, x 435.

ep.d. = epidermis; *d* = dermis; *g.c.* = gland-cell; *c.c.* = clavate cell; *b.v.* = blood vessel.

are found big " clavate cells " (*c.c.*) forming as it were a distinct row by themselves. Below the epithelium are blood vessels (*b.v.*) whose walls stain rather deeply with eosin. Underneath the blood vessels are a number of big cavities, which probably represent the adipose tissue. The adipose tissue is said to be present below the skin of most of the fishes, but its presence in this position between the epithelial and dermal regions, is interesting. Below the fat-cells is the connective tissue, which is marked by a large number of nuclei which are not surrounded by a white zone. The cell-boundaries in this region are not distinguishable.

The structure of the mental disc in *Garra* may be treated under two headings, (i) the structure of the central callous portion of the disc and (ii) the structure of its tuberculated borders and of the fringed tuberculated anterior labial fold (fig. 12). The structure of the former is very similar to that of the integument



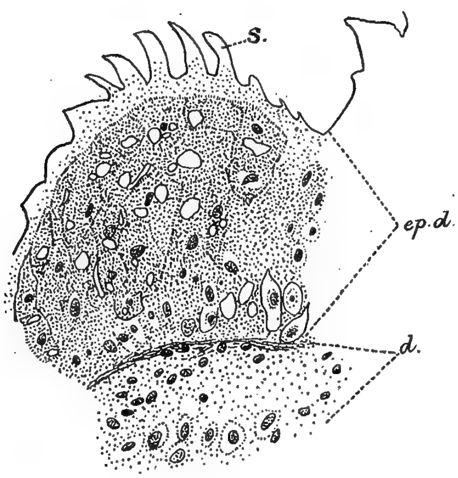
TEXT-FIG. 12.—Structure of tubercles on the disc and the anterior labial fold of *Garra annandalei*.

a. Tubercle on anterior labial fold.
b. Tubercle on lateral free borders of the disc.

described above. The following are, however, some salient points of difference:—

(i) The epithelial cells are better defined and in certain places the ampulliform gland-cells are more numerous.

(ii) The "clavate cells" are fewer in number and are situat-



TEXT-FIG. 13.—Transverse section through a portion of the tuberculated anterior labial fold of *Garra annandalei*, x 435.

s = spine; *ep.d.* = epidermis; *d* = dermis.

ed at great intervals. The protoplasm of these cells has receded inwards from near their upper cell-limits.

(iii) The dermis is chiefly composed of an adipose tissue, which is bounded both above and below by a thin layer of fibrous connective tissue.

The structure of the tuberculated region, on the other hand, is totally different. In a vertical section (fig. 13) of the fringed portion of the anterior labial fold, the superficial epidermal layer covering a tubercle is modified into spines (*s*). It is perhaps significant that I have not been able to find any nuclei in the spines; the spines are, otherwise, shorter, thicker and stouter than those described in *Bhavania annandalei.* On examining a large number of sections of this region and of the free tuberculated borders of the disc, I have observed that the spine is formed as a prolongation of the outer cell-wall of the superficial epidermal layer. Below the spinous layer, there are several tiers of polygonal cells (*ep.d.*) which are vacuolated. In the basal region the cell-limits are not well marked and the nuclei stand out prominently with haematoxylin stain. In some cells the nuclei are surrounded by a whitish halo. The dermis (*d*) consists of a compact connective tissue, with a large number of nuclei scattered just below the epidermis. The cell-boundaries in this region are not well-defined.

In the region of the posterior labial fold and also in that of the free border of the disc, the tubercles are provided with a dermal plug. The dermis consists of a large number of branched irregular cells, forming a primitive type of connective tissue.

The structure of the tuberculated region in *Garra* differs from that of the integument and of the central callous portion of the disc in the following points:—

(i) The gland-cells are absent.

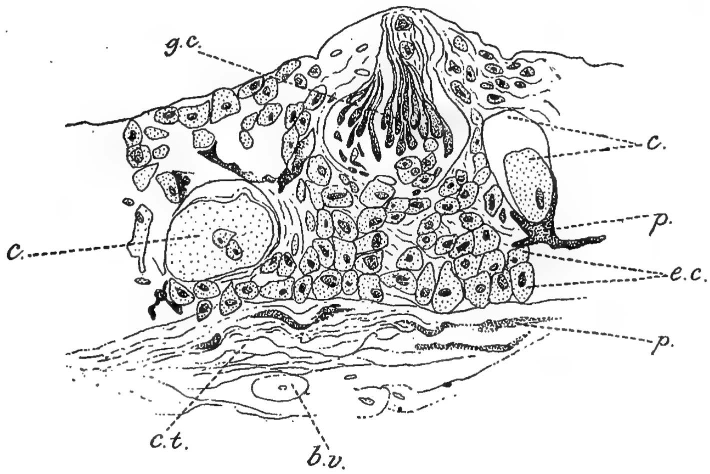
(ii) The " clavate cells " are absent.

(iii) The superficial epithelial layer of cells is modified into spines which do not possess any nuclei.

(iv) The adipose tissue is totally absent, and the dermis, therefore, presents a compact, solid structure.

In the order Siluroidea the modification of the skin to form an adhesive apparatus is very different. It is thrown into folds and ridges, which are characterized by a special structure. Any portion of the skin may thus be modified to serve the purpose of adhesion. To illustrate the structure of the adhesive apparatus in Silurid fishes, I will first describe that found in *Glyptosternum labiatum.*

The structure of the integument found in this genus may in the first place be considered. In a vertical section (fig. 14) of the non-striated skin covering the dorso-lateral surface of the pectoral spine, the epithelium consists of several layers of small, more or less flattened and rectangular cells which possess well-marked cell-walls and relatively large oval nuclei. The cells near the surface are smaller than those immediately below them. Their outline varies considerably according to the extent to which they may be packed together in a particular place. Black pigment (*p*) is present at certain places in the tissue. Most of the central space of the epithelium is occupied by a number of big " clavate cells " (*c*), which are distributed at regular intervals and form a distinct layer of their own. They are fairly well developed and sometimes their nuclei may be as big as an ordinary epithelial cell. The "clavate cell" possesses a distinct cell-wall and in most cases it contains more than one nucleus. The contents of the "clavate cell" are very different from those of the surrounding epithelial cells, as it is only lightly stained with haematoxylin and eosin. The nucleus is surrounded by a whitish area. The most interesting point is the degree of vacuolation that is generally met with in these cells. The process of vacuolation sets in from the outer wall and the protoplasm gradually recedes towards the inner side. In extreme cases more than half of the cell is emptied of protoplasm. I have not been able to make out the structure of the contents of a vacuole. The nucleus is generally vesicular with a distinct membrane and in those cells, which contain only



TEXT-FIG. 14.—Transverse section through the integument of *Glyptosternum labiatum* x 435.

e.c. = small epithelial cells ; *p.* = pigment ; *c.* = clavate cell ; *g.c.* = gland-cell ; *c.t.* = connective tissue ; *b.v.* = blood vessel.

one nucleus, its chromatin matter is diffused as if preparing for a mitotic division. I have not been able to observe distinct nuclear figures in any of these cells. If more than one nucleus is present in a cell, the nucleolus can also be readily made out. Ramsay Wright[1] described these cells in the integument of *Amiuris catus*. He observed, "there can hardly be any doubt that the clavate cells have an important physiological role to play. What that is remains still obscure." I have found these cells in the integument covering the tip of the snout in *Garra* and in the position described above in *Glyptosternum labiatum;* but am unable to understand their exact significance. It may, however, be pointed out that they are always absent in an adhesive tissue in fishes.

The gland-cells in *Glyptosternum* are not scattered as has al-

[1] Ramsay Wright, *Proc. Canadian Inst.* (n. s.) II, pp. 254–255 (1884).

ready been described in the integument of *Garra* ; but are aggregated to form definite structures. Each one of these structures is flask-shaped with the neck almost half as long as its total length. The mouth of the flask along with the adjoining tissue projects slightly above the surface of the integument. The body of the flask is occupied by a number of characteristic cells. The cells are elongated and are drawn out into long, fine processes which travel through the neck of the flask and open on the surface of the skin. The nuclei are very big and occupy almost the whole of the cell. The cells forming this characteristic structure do not begin at the same level and thus present an irregular bunch of cells hanging in the cavity of the flask by means of fine threads. Sometimes one or more epithelial cells make their way inside the flask and when seen they are usually found in the neck region.

It is after long hesitation that I have assigned to these cells the function of secretion. The following are the main reasons for holding this view :—

(i) The unicellular glands, usually present in the integument of fishes, are absent.

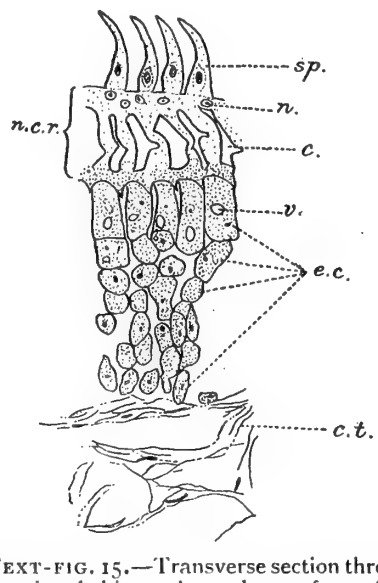
(ii) The mouth of the flask projects beyond the surface of the integument.

(iii) The cells have fine canals which open on the surface of the skin.

(iv) The cells are provided with big nuclei.

Such glandular structures are found at a considerable distance from each other, and I have not been able to find more than three in any one section.

In the structure of the adhesive apparatus (fig. 15) formed by the striation of the skin on the under surface of the pectoral and pelvic spines, a distinct advance is made upon that observed in *Bhavania* and *Garra*. The upper layer of epithelial cells is modified into curved spines (*sp.*), whose inner limits are not well defined. The spines are provided with definite nuclei, which are situated in their lower swollen portions. In the non-cellular region immediately below the spinous layer are a number of deeply staining bodies forming a definite row. What these bodies are, I have

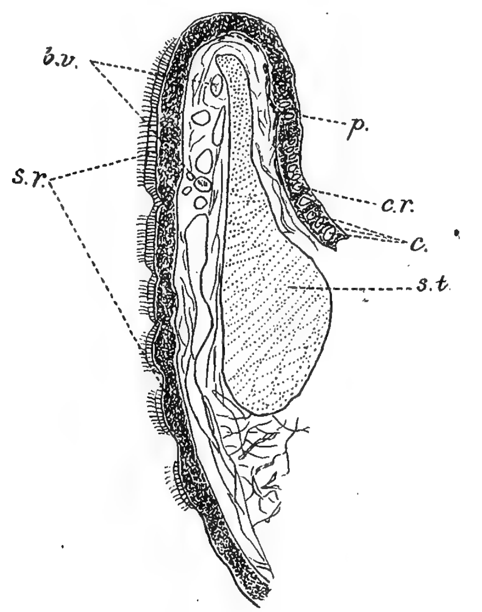


TEXT-FIG. 15.—Transverse section through the striated skin on the under surface of the outer ray of the pectoral fin in *Glyptosternum labiatum*, x 435.

s. p. = spine ; *n.* = nuclear bodies ; *n.c.r.* = non-cellular region ; *c.* = cavity ; *e.c.* = epithelial cells ; *v.* = vacuole ; *c.t.* = connective tissue.

not been able to determine definitely. Below the spines is a deep non-cellular layer (*n.c. r.*) in which are scattered a number of spaces (*c*) having a definite shape. They are almost crescentic in outline and possess a short spine-like process along their convex borders. The lower limit of the non-cellular region is formed by a regular wavy line. In the curves of this wavy line are situated a number of characteristic columnar cells. Each is provided with a nucleus, a distinct nucleolus and a small well-marked vacuole (*v*). Between two neighbouring cells there is generally a small chink-like cavity. Below these columnar cells, are a number of small epithelial cells which are irregularly arranged in four to five tiers. Usually they possess small, solid, deeply staining nuclei, but in certain cells the nuclei are altogether absent. Beneath the epithelial tissue is a loose connective tissue (*c.t.*) forming the dermis.

In the genus *Glyptosternum*, the adhesive apparatus is supported by a definite tissue as has already been remarked. The supporting tissue (fig. 16) consists of a mass of polyhedral cells (fig. 17) which are very turgid and are closely packed together. The nuclei of these cells are fairly large and in certain cases there may be more than one nucleus in a cell. The cells vary in form and size to a considerable extent and towards the base they are so much pressed together that the cell-limits become almost obliterated and the nuclei become spindle-shaped. The supporting tissue (*s.t.c.*) is surrounded by a loose connective tissue (*c.t.c.*).

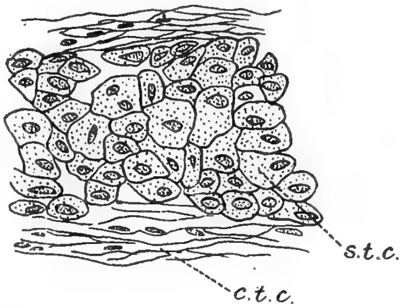


TEXT-FIG. 16.—Transverse section through the thickened skin covering the pectoral spine in *Glyptosternum labiatum*, x 42.

s.t. = supporting tissue ; *c.r.* = clavate cell region ; *p.* = pigment ; *s.r.* = striated region ; *b.v.* = blood vessel ; *c.* = clavate cells.

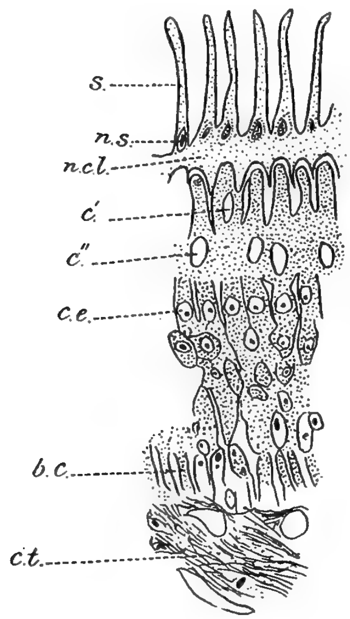
The structure of the thoracic adhesive apparatus of *Pseudecheneis sulcatus* is different from all the three types described above. The nuclei of the spines are situated in the non-cellular region and the cell-walls in the epithelial region are not well defined. In the cells of the first epithelial layer, immediately below the non-cellular region, there are ill defined vacuoles. The connective tissue is not so loose and is richly dotted with a large number of nuclei of various forms.

Within the genus *Glyptothorax*, the structure of the adhesive apparatus shows considerable variation. In *G. dorsalis*, a large number of specimens of which were collected in the sluggish and muddy streams of the Manipur Valley, the spines are small and the spinous layer as a whole is not well developed. The epithelium is composed of several tiers of small, squarish cells; of these the uppermost and the basal layers are highly vacuolated. The cell-walls are quite distinct and the basal layer is somewhat columnar. Below the epithelium is a dense sheet of connective tissue, in which are scattered big cavities full of blood corpuscles. Underneath the connective tissue are fat-cells with eccentric nuclei. In *G. madraspatanus* the structure (fig. 18) of the adhesive tissue is more advanced in so far as the cell-limits are not distinguishable. Immediately below the non-cellular region there are two layers of cavities ($c'.c''.$); the upper is in the form of elongated spaces with intervening columns of protoplasm, while the second layer consists of rounded cavities in the substance of the protoplasm. Below this the epithelium consists of a row of columnar cells which are followed by a number of small, rounded cells. In the basal epithelial layer I have not been able to find any nuclear structures. The greatest specialization in the structure of the adhesive tissue within the genus is reached in those forms that possess an adhesive surface on the chest as well as on the under surface of the pectoral and pelvic spines. I take *G. sp.* from Madras as an example of this kind of structure.



TEXT-FIG. 17.—Transverse section through the supporting tissue of the adhesive apparatus on the fins of *Glyptosternum labiatum*, x 435.

c.t.c. = connective tissue cells; *s.t.c.* = supporting tissue cells



TEXT-FIG. 18.—Transverse section through a portion of the thoracic adhesive apparatus of *Glyptothorax madrasapatanus*, x 435.

s. = spine; *n.s.* = nucleus of the spine; *n.c.l.* = noncellular layer; *c.* = first row of cavities; *c''.* = second row of cavities; *c.e.* = columnar epithelium; *b.c.* = basal cells of epithelium; *c.t.* = connective tissue.

In a vertical section of the striated skin covering the under surface of the pectoral spine of *G.saisii* (fig. 19, *a*) the structure in all essential points corresponds to that of the previous examples. The spines (*s*) are hooked and more regular; their nuclei (*n.s.*) are situated near the base and each of them is surrounded by a whitish halo. The nuclei project into the non-cellular region (*n.c.r.*). Underneath the non-cellular region there are two rows of cavities or open spaces. The cavities of the first row (*c'*) are greatly elongated; they are broader near the upper than near the lower end. On focussing, a part of the cavity is found to contain a lightly stained protoplasmic substance. The second row of spaces (*c''*) is similar to the first, but here the lower portion of the cavity is filled with protoplasm; the upper margin of each cavity is deeply stained and in the section there appears an interrupted band. Then follow large columnar cells (*c.e.*) which are provided with big nuclei. The nuclei are oval and possess a well-defined nucleolus; they are surrounded by a whitish halo. Below these there are several rows of small, rounded epithelial cells, some of which are devoid of any nuclear substance. The basal layer (*b.c.*) is represented by finger-like processes of protoplasm which do not possess any nuclei. It may be pointed out for the sake of clear understanding that the whole of the structure is one continuous mass and that the cell-boundaries are nowhere marked, but in drawing up the description it has been convenient to treat the structure as if it were composed of a number of distinct layers.

It is interesting to note the changes in the structure as we pass from the ridge to the grooved portion of the striated skin. Attention may be drawn to the following points of difference in the grooved area (fig. 19*b*):—

(i) The spines become smaller and smaller till they are represented by small knob-like projections on the surface. In the middle of the groove the surface becomes entirely smooth.

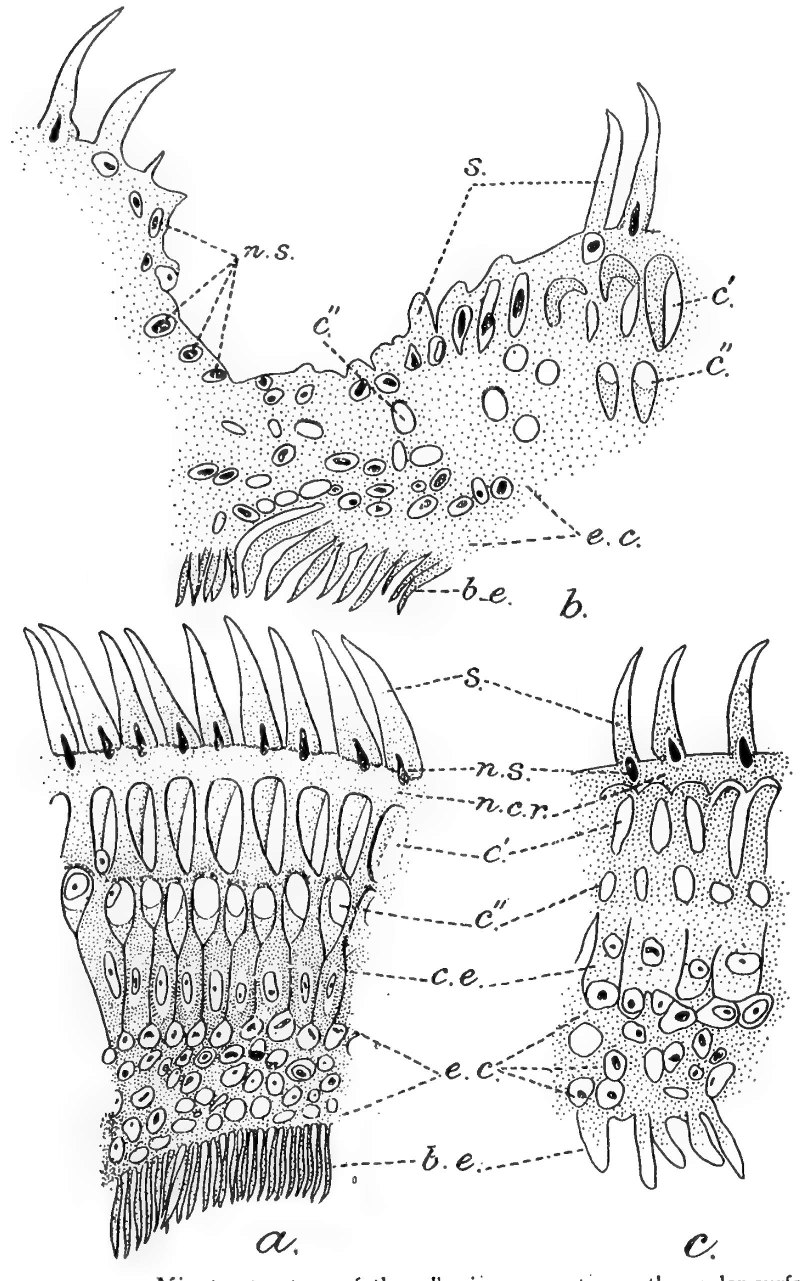
(ii) The nuclei of the spines recede inwards and ultimately form a continuous layer just below the surface of the skin.

(iii) The first layer of cavities is represented by small, oval or rounded spaces in the grooved region. In some cases this layer may be totally absent.

(iv) The second row of spaces is represented by small cavities; they are provided with a deeply staining upper margin.

The structure, on the whole, appears as a mass of protoplasm in which the nuclei are scattered either near the base or near the apex and a few cavities are present in the middle. The basal epithelium is represented by finger-like processes as described above.

In a horizontal section (fig. 19*c*) the structure of the adhesive tissue does not differ greatly from that seen in a vertical section. The chief difference lies in the form and extent of the various elements noted above. The non-cellular region is separated from the underlying tissue by a regular wavy line of demarcation. The



TEXT-FIG. 19.—Minute structure of the adhesive apparatus on the under surface of the pectoral spine of *Glyptothorax sp.*

a. Transverse section through a portion of the ridge, x 650.
b. Transverse section through a portion of the groove, x 650.
c. Horizontal section through a portion of the ridge, x 650.

s = spine; *n.s.* = nucleus of the spine; *n.c.r.* = non-cellular region; *c'.* = first row of cavities; *c''* = second row of cavities; *c.e.* = columnar epithelium *c.e.* = small, rounded epithelial cells; *b.e.* = basal epithelial cells.

cavities are considerably smaller and do not show any protoplasmic elements within their limits. The so-called columnar epithelium is not well-marked. The underlying structure corresponds to that described for the vertical section.

Having described the structure met with in the different forms selected above, it will be advantageous to consider the lines along which evolution has taken place from the simplest to the most complicated structure. In the simplest type of adhesive apparatus the skin is thickened and its outer epithelial layer of cells is modified into curved spines; the gland cells and the "clavate cells" of normal skin-tissue totally disappear. Specialization proceeds along two lines, firstly there is an increasing tendency at every step towards vacuolation of the superficial epithelial cells and this ultimately results in the formation of definite cavities, and secondly the cell-walls of epidermal cells become indistinguishable. The final stage is reached in *Glyptothorax sp.* where the whole of the epidermal tissue appears as a syncytium. The adhesive apparatus of the Silurid fishes is distinguished from that of the Cyprinid forms by the fact that in the former the skin is thickened and striated, whereas in the latter it is only thickened and forms a plain cushion-like pad. I have not been able to understand the true significance of increased vacuolation or of the syncytium formation in the tissue of the adhesive apparatus.

There is, however, no doubt as to the function of the epidermal spines. All of them are curved in the same direction and probably they point posteriorly. As the fish sticks to a stone with the head pointed up stream, and the current of water tends to move it backwards, the spines when closely applied to a stone, fix it securely by taking hold of the unevennesses of the rock. In Silurid fishes the ridges are pulled outwards and a sort of vacuum is produced in the grooves which helps the fishes in adhering to rocks.

So far as I know, the type of structure described above is not met with in tissues of adhesion in any other group of animals. Dahlgren and Kepner,[1] who have given a summary of the subject, have not anywhere referred to a spinous structure. Even in a longitudinal vertical section through a small region of the grasping organ on the head of *Remora*, the characteristic structure that I have described above apparently is not found.

CONCLUSION.

In conclusion I wish to refer briefly to the origin of the hill-stream fauna and to the means of dispersal and propagation adopted by it. In the following discussion I take up these points one by one.

Origin of the Hill-stream Fauna.—There are two possibilities, firstly, that the forms now living in the mountain-rapids were once

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[1] Dahlgren and Kepner, *Principals of Animal Histology*, pp. 409–417 (1908).

accidentally carried into them, and secondly, that there has been a step by step colonisation of the hill-torrents from the sluggish-streams that flow in level country. As regards the first possibility it may safely be inferred that forms which have not previously acquired adaptive characters, cannot live in rapid waters because at every move they are liable to be swept away down stream. The second view is more probable and the following are some of the main points in its favour:—

(1) As a hill-stream changes into a sluggish stream in almost level country its fauna changes accordingly and intermediate forms, like *Crossochilus latia*, between the typical hill-stream fishes and the fishes of the slow streams are always met with in the intermediate regions where the water is neither flowing very fast nor very slowly.

(2) The very fact that the members of certain genera such as *Glyptothorax* and *Garra* can be arranged in a series according to the degree of modification they exhibit in response to the strength of the current of stream, shows that there has been a gradual colonisation of rapid streams.

(3) The hill-stream fishes in the course of their development pass through many different stages which clearly show, at any rate in the case of *Garra*,[1] that the evolution of such forms is from those that live in sluggish streams. Not only is this shown by the form of the body but also in the modifications of such organs as the air-bladder, the position and form of the mouth and the eyes, and in the reduction of the branchiostegal membrane and rays. In short, the developmental series of *Garra* as given in a previous paper recapitulates the history of the evolution of the genus.

Having subscribed to the view that the hill-stream fauna has originated by the process of gradual colonisation from the slow streams, it will not be out of place to discuss the causes that might have led to the migration of these forms. There are two chief factors which might compel such a migration:—food and safety. In the hill-streams there is always plenty of food in the form of algal slime on the exposed surface of rocks; but only those animals can make use of it which have their jaws specially adapted for rasping it off the stones on which it grows. As regards safety, it may be said that there is very little competition in the hill-streams among the fishes themselves. Moreover, they are practically safe from the ravages wrought by birds and large predaceous fishes, crocodiles, etc. Certain fishes like *Nemachilus* can find shelter underneath stones and the readiness with which they hide themselves is marvellous. Probably the fishes inhabiting slow-running waters originally ascended the hill-streams step by step in search of food and gradually acquired certain characters which made them specially suitable for living in the newly chosen environment.

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[1] Hora, *Rec. Ind. Mus.* XXII, p. 639 (1921).

Annandale,[1] when discussing the evolution of the adhesive apparatus in hill-stream fishes, made the following remark about the genus *Garra* :—" Whereas the chief factor in the case of *Psilorhynchus* was rapid-running water in a rocky stream-bed, in *Discognathus* the primary factor was a peculiar mode of feeding.'' Quite recently I[2] also subscribed to this view, but a more detailed study of the adhesive apparatus has led me to modify my previous ideas. I believe that the mental disc of *Garra* has not primarily been evolved for the '' peculiar mode of feeding,'' which is practically similar in all the genera of hill-stream fishes, but for securing adhesion to rocks in rapid running waters. The adhesive apparatus on the under surface of the paired fins is an additional organ of adhesion in species that live in very rapid waters. In certain highly evolved species of *Garra*, which have secondarily taken to live in lakes and pools, the peculiar pad-like structure on the under surface of the paired fins have disppeared though the characteristic mental disc is still present, as it is probably of use to the fish in its " peculiar mode of feeding '' which was acquired as a direct response to a life in hill-streams.

I am, therefore, led to conclude that none of the hill-stream forms are ancestral forms; but that all of them are descended from migrants from the slow-running streams. The modifications that some of these forms exhibit are due to the physical conditions prevailing in mountain-rapids; and it is to this cause that we must ascribe the similarity in form and structure exhibited by the more advanced members of the genera dealt with in this paper.

Means of dispersal.—When dealing with the fish of Manipur it was pointed out by me that most of the new species from the hill-streams had a localised distribution. This is the case with almost all the hill-stream fishes and naturally it is difficult to imagine a wide range of distribution of these forms. The most highly modified forms are not capable of living for a long time in muddy channels, on account of the form of their bodies and the structure of their jaws. In cases where a very wide range has been attributed to a hill-stream species, it has always been found on comparison of material from different localities that several allied forms had been grouped together under the same name and that most of them are capable of specific separation. For example *Glyptosternum labiatum* which was described from the Mishmi Hills in Upper Assam, was recorded by Vinciguerra[3] from the Kachin Hills, Upper Burma. Regan[4] in 1905 separated the Burmese specimens from those collected in the Mishmi Hills under the new name *G. vinciguerrae*. A remarkably wide range of distribution was attributed to *Garra lamta*, but as

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1 Annandale, *Rec. Ind. Mus.* XIV, p. 117 (1919).
2 Hora, *Rec. Ind. Mus.* XIX, p. 213 (1920).
3 Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova*, (2), IX, p. 252 (1889).
4 Regan, *Ann. Mag. Nat. Hist.* (7) XV, p. 184 (1905).

has been shown elsewhere,[1] the forms from various localities are not specifically identical.

Methods of propagation.—All the hill-stream fishes with which I am acquainted are oviparous. The rapid current in these streams makes it impossible for them to lay their eggs loose in the rocky beds, as they are liable to be carried down stream and destroyed. In my tours to the hill-streams I have always found that the pools in the courses of these streams were full of young specimens of the genera *Nemachilus* and *Barilius* and of a few other small fish that are usually found in pools. In no case was I able to find young of *Garra* or of any other highly modified hill-stream forms. Dr. Annandale and Major Sewell, however, found *Garra* and *Psilorhynchus* in pools of hill-torrents in the Western Ghats. There appear to be two possibilities, (i) that the hill-stream fishes migrate to slow running waters to lay their eggs and that every generation has later on to ascend up-stream to its natural habitat or, (ii) that the eggs are tightly fixed to stones. I am unable to say at present which hypothesis can be accepted as correct.

[1] Hora, *Rec. Ind. Mus.* XXII, pp. 633-687 (1921).

NOTES ON FISHES IN THE INDIAN MUSEUM.

III. On Fishes belonging to the Family Cobitidae from high altitudes in Central Asia.

By Sunder Lal Hora, *M.Sc., Assistant Superintendent, Zoological Survey of India.*

The Cobitid fishes [1] from the high altitudes of Central Asia are generally characterized by the absence of a suborbital spine, by the elongate form of their body, especially of the caudal peduncle, and by the total absence of any scales. The belly is generally rounded and not depressed. The Indian Museum possesses a large number of specimens of this family from Tibet, Northern Kashmir, Western Turkestan and Seistan. When dealing with the fish of Seistan it was pointed out by Annandale and myself [2] that among those specimens which have been referred by several ichthyologists to *Nemachilus stoliczkae* Steind. there were several forms capable of specific separation. In this note an attempt is made to elucidate these points and to discuss the specific validity of the various species represented in our collection.

Here are also incorporated the results of an examination of the loaches recently collected in Kashmir by officers of the Zoological Survey of India.

At the end I have added a short note on the sexual dimorphism exhibited by some of these species.

The Central Asiatic forms belonging to the family Cobitidae dealt with in this note may be grouped into three distinct genera, which can be distinguished in the following manner:—

A. Two bladders; one lying free in abdominal cavity and second divided into two lateral chambers enclosed in bone ... ... *Diplophysa.*

B. One bladder, consisting of two lateral chambers enclosed in bone.

- I. Soft dorsal fin between spiny dorsal and caudal fins present ... ... *Adiposia.*
- II. Soft dorsal fin absent ... ... *Nemachilus.*

Genus **Diplophysa** Kessler.

1874. *Diplophysa*, Kessler, *Bull. Soc. Sci. Moscou* XI, pp. 1-63.
1888. *Lefua*, Herzenstein, *Wiss. Res. Presewalski Central Asia. Reis., Zool.* III (2), p. 91,

Unfortunately the paper in which Kessler proposed the generic

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[1] A large number of specimens of the Cobitid genus *Botia*, which possesses spines below the eye, have recently been collected in Kashmir. The genus extends to China as well, but I have not dealt with it here.

[2] Annandale and Hora, *Rec. Ind. Mus.* XVIII, p. 179 (1920).

name *Diplophysa*, is not available in Calcutta, so I take from Day [1] the characters on which this genus was erected. The genus *Diplophysa* comprises those fishes in which the body is greatly elongated and strongly compressed posteriorly; the eyes are surrounded with a fold of skin forming a lid; the lips are fleshy, the upper more or less denticulated, the inferior bilobed and more or less papillated and the air-vessel is divided into two parts, the anterior enclosed in a bony capsule and the posterior elongated and free in the abdominal cavity. I agree with Day (*op. cit.*) that the first three characters do not possess any generic value, but the last feature, that of the air-vessel, is quite sufficient to distinguish the genus *Diplophysa* from *Nemachilus*, to which it is closely allied. Day did not dispute the validity of the last character but suggested a re-examination of the Western Turkestan specimens and remarked that, "it would be very remarkable were the *Nemacheili* found in Europe, in fact throughout Asia, even in the Oxus, to have their air-vessel enclosed in bone, whereas in the river Ili going to Lake Balkash, and the river Urdjar falling into Lake Ala (Ala-Kul), to have the same organ partially free in the abdomen, as is seen in the genus *Botia*." Day did not think himself justified in recognising *Diplophysa* as a distinct genus from *Nemachilus* even on the character of the air-bladder, which is so remarkable.

Kessler [2] in 1879, when dealing with the Central Asiatic fishes, upheld his genus *Diplophysa* and described two new species under this generic designation. In reviewing Day's criticism of the genus he pointed out that in all probability Dr. Stoliczka's collection was made in the area south west of the Tarim river-system, while Przewalski's collection, which contained several representatives of the genus, was made much further to the east. Moreover he considered the air-bladder to be as important for taxonomic purposes as the pharyngeal teeth, on which the two families Cobitidae and Cyprinidae are distinguished.

Herzenstein [3] in his valuable monograph of Central Asiatic fishes agreed with Day and considered *Diplophysa* synonymous with *Nemachilus*. But at the same time he instituted a new genus *Lefua* to accommodate *Diplophysa costata* Kessler and *Octonema pleskei* Herz. He characterized the genus *Lefua* as follows:—"Caput valde depressum. Os fere terminale. Spina suborbitalis nulla. Nares anteriores cirro sat longo instructae. Cirri rostrales 4, supra-maxillares 2. Vesicae natatoriae pars posterior in cavitate abdominali libere suspensa." No notice seems to have been taken of this genus till 1907 when Berg [4] recognised it and considered the Japanese genus *Elixis* Jordan and Fowler [5] as a synonym of

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[1] Day, *Proc. Zool. Soc. London*, p. 793 (1876); *Sci. Res. 2nd. Yarkand Mission, Ichthyol.*, p. 12 (1878).

[2] Kessler, *Bull. Acad. Sci. St. Pétersbourg* XXV, p. 302 (1879).

[3] Herzenstein, *Wiss. Res. Przewalski Central As. Reis., Zool.* III (2), p. 1 (1888).

[4] Berg, *Proc. U.S. Nat. Mus.* XXXII, p. 437 (1907).

[5] Jordan and Fowler, *Proc U.S. Nat. Mus.* XXVI, p. 768 (1903).

Lefua, the definition of which he modified as follows:—"Cirri 8, four rostral, two maxillary and two at the anterior nostrils. Scales present. No erectile spine below the eye. Dorsal fin about over the ventral, with few rays; caudal rounded. Air-bladder with a posterior part free in the abdominal cavity." The genus *Elixis* was established to comprise those species of *Nemachilus* which possessed a pair of nasal barbels in addition to six others that surround the mouth. In *E. nikkonis*, the genotype of the genus, and in *E. coreanus* subsequently described by Jordan and Starks[1] no mention is made as to the nature of the air-bladder in them. I have examined some Indian species of the genus *Nemachilus*, such as *N. evezardi* Day[2] which possess a pair of well-developed nasal barbels but have not found in them a free bladder in the abdominal cavity. It is quite probable that the Japanese species with eight barbels may not possess a free bladder as is said to be present in the Chinese species with eight barbels assigned to the genus *Lefua* by Herzenstein. I am led, therefore, to believe that Berg united the two genera merely on the consideration of the nasal barbels and paid little attention to the character of the air-bladder. He, moreover, considered *Nemachilus dixoni* Fowler,[3] *Elixis coreanus* Jordan and Starks and the two forms included by Herzenstein under his genus *Lefua* as representing only one species, having examined a large number of specimens from widely different localities in China and Korea. I doubt the validity of this statement and suggest a re-examination of these specimens. There seems to me nothing at present in the definition of *Lefua* and *Elixis*, except the presence of nasal barbels, which could justify their separation from *Diplophysa* and *Nemachilus* respectively, but Annandale and I (*op. cit.*, p. 185) have already pointed out that we do not consider it a character of generic value. I conclude, therefore, that *Lefua* is a synonym of *Diplophysa* and *Elixis* of *Nemachilus*.

Quite recently Weber and Beaufort[4] have recognised the genus *Elixis* and have referred *Nemachilus obesus* Vaill,[5] to it only on the character of the nasal barbels.

In a recent contribution to the ichthyology of Central Asia, Zugmayer[6] has recognised the genus *Diplophysa* as distinct from *Nemachilus*, though closely allied to it. The chief distinction between the two genera lies in the fact that according to Zugmayer a part of the air-vessel lies free in the abdominal cavity in *Diplophysa*, whereas in *Nemachilus* it is wholly enclosed in a bony capsule. Having examined the air-bladder in *Diplophysa papilloso-labiata* Kessler, Zugmayer states that the two parts are distinct from each other.

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[1] Jordan and Starks, *Proc. U.S. Nat. Mus.* XXVIII, p. 201, fig. 7 (1905).

[2] Day, *Fish. India* II, p. 613, pl. cliii, fig. 11 (1878).

[3] Fowler, *Proc. Acad. Nat. Sci. Philadelphia*, p. 181 (1899, 1900).

[4] *Weber and Beaufort, Fishes Indo-Austral. Archipel.* III, p. 35, fig. 16 (1916).

[5] Vaillant, *Notes Leyden Mus.* XXIV, p. 134 (1902).

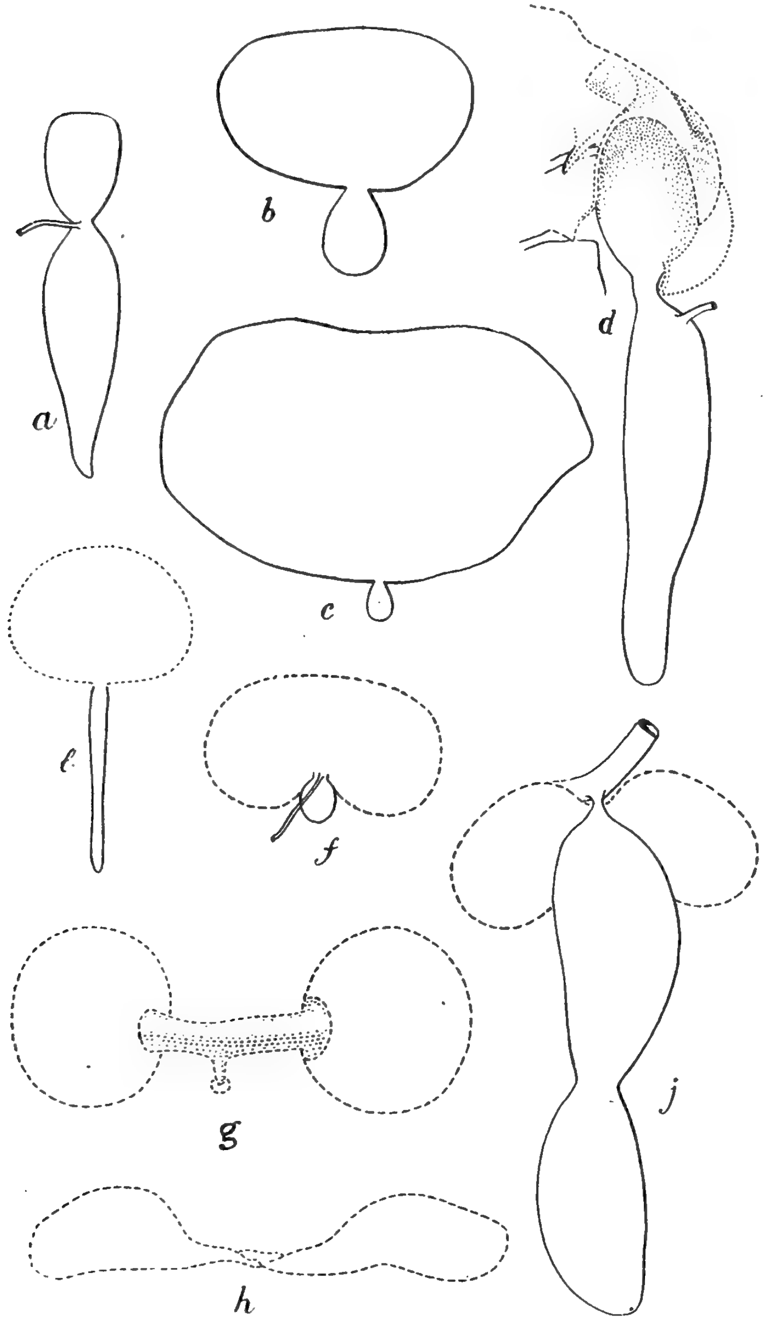
[6] Zugmayer, *Zool. Jahrb. Syst.* XXIX, p. 294 (1910).

I have myself examined specimens of the same species in our collection and agree with Zugmayer's statement. Both Kessler and Zugmayer believe that there is only one bladder in *Diplophysa* and that the anterior part is enclosed in bone while the posterior lies free in the abdominal cavity. Zugmayer found the two bladders to be quite distinct from each other but regarded them as parts of the same bladder. On examining the bladder in young specimens of a new species from Eastern Tibet (Rham-tso) I find that the two bladders are totally distinct from each other and that they are not the two parts of a single structure. The posterior bladder, that lies free in the abdominal cavity, is connected with the oesophagus by a short pneumatic duct given off from its anterior end. This duct is only distinct in young specimens and atrophies in the adult. In order to understand the true significance of the posterior bladder and its relation to the anterior, it is necessary to examine the various types of bladder commonly met with among the different genera of Cyprinoidea.

The swim-bladder of a typical Cyprinid fish such as *Labeo rohita* is large and lies free in the abdominal cavity. It is constricted in the middle to form an anterior and a posterior chamber (fig. 1*a*). The pneumatic duct from the oesophagus opens into the constricted region. In those genera that live in rapid running waters the bladder undergoes considerable degeneration; this consists firstly in the gradual reduction of the two chambers and the ultimate disappearance of the posterior, and secondly, in the thickening of their walls. In extreme cases the bladder becomes completely enclosed in a bony capsule derived from the transverse processes of the adjacent vertebrae.

In the genus *Psilorhynchus* the posterior chamber is greatly reduced and the anterior is covered by a thick fibrous coat (figs. 1*b*, 1*c*). In *Nemachilus vittatus* from the Kashmir Valley the anterior chamber is laterally flattened and covered by a bony capsule while the posterior chamber is small and thick walled (fig. 1*f*). The pneumatic duct still opens into the constricted region between the two chambers. In other species of this genus the anterior part is divided into two lateral chambers which are enclosed in a bony capsule and all remains of the posterior chamber are wanting. In *Adiposia rhadinaea* there is still a short bulb-like structure representing the posterior chamber (fig. 1*g*) otherwise it is very similar to that found in most species of *Nemachilus*. In extreme cases such as *Balitora brucei* the two lateral halves of the anterior chamber are much reduced and are somewhat separated from each other (fig. 1*h*).

Among the members of the genus *Diplophysa* the anterior bladder (fig. 1*j*), which is enclosed in a bony capsule, is in all probability similar to that found in the genus *Nemachilus* and, thus, it may represent the primary or the true original bladder of the fish. The posterior bladder, that lies free in the abdominal cavity, is a secondary structure and in its origin and position is



TEXT-FIG. 1.—Types of air-bladder found in Cyprinoid fishes.

a, *Labeo rohita*. *b*, *c*, *Psilorhynchus balitora*.
d, *Botia hymenophysa*. *e*, *Botia almorhae*.
f, *Nemachilus vittatus*. *g*, *Adiposia rhadinaea*.
h, *Balitora brucei*. *j*, *Diplophysa stewarti*.

The dotted line in the figure indicates that the portion thus outlined is enclosed in bone.

quite different from the normal Cyprinoid bladder. The following are the chief points of difference:—

(i) There is a short pneumatic duct from the anterior end of the bladder to the oesophagus, while in the normal Cyprinoid type the pneumatic duct is long and opens into the middle of the bladder in the constricted region.

(ii) The bladder may or may not be constricted in the middle.

(iii) The pneumatic duct is present only in young specimens, while it is lost in the adult.

In the genus *Botia*, the structure of the air-bladder differs considerably. Though in many respects of a typical Cyprinoid form, the anterior chamber is partially (fig. 1*d*) or wholly (fig. 1*e*) enclosed in a bony capsule formed by the transverse processes of the neighbouring vertebrae. On comparing drawings *d* and *j* in figure 1, it will be seen that Day was in error in suggesting that the bladder of *Diplophysa* would have to be similar in structure to that in *Botia*.

The reduction of the swim-bladder in fishes that live in rapid-running waters is in all probability due to the fact that they live on the bottom and do not require to make vertical movements. The enclosure of the bladder in a bony capsule presumably has some special biological significance, but of this nothing is yet known. Zugmayer believed that the free bladder in *Diplophysa* is to be explained by the assumption that the members of the genus have not yet acquired a true ground habit and that consequently the posterior half has not yet been affected. This, however, does not appear to be a correct interpretation of the fact as there are two distinct air-bladders in *Diplophysa*, the one enclosed in a bony capsule being possibly the original Cyprinoid bladder, while the other that lies free in the abdominal cavity is either a secondary acquisition or, as Dr. Annandale suggests to me, represents the modified posterior chamber of the normal Cyprinoid bladder. In the latter case the anterior chamber has become enclosed in bone, as in *Nemachilus vittatus*, and the posterior chamber was nipped off, retaining its connection with the oesophagus through the primary pneumatic duct. The members of the genus *Diplophysa* have in all probability come to live secondarily in the deep muddy waters of the lake-basins of Central Asia in which situation they require a hydrostatic organ for vertical movements; I believe that they have originated from forms like *Nemachilus* in which the air-bladder is reduced and enclosed in a bony capsule. When the primary air-bladder became enclosed in bone it probably could not again be modified for the performance of a hydrostatic function to suit the new environment. I thus believe that *Diplophysa* is a more specialized genus than *Nemachilus*, whereas Zugmayer regards it as more primitive. Of the species of *Diplophysa* at present known, all described by Kessler, the following have been recorded either from lakes or from deep muddy waters at great altitudes in Central Asia:—

Diplophysa strauchii,	Ili river flowing into Lake Balkash.
,, *labiatus,*	Urdjar river flowing into Ala-kul.
,, *intermedius,*	Lake Dalai-nor.
,, *nasalis,*	,,
,, *costata,*	,,
,, *dalaicus,*	,,
,, *kungessana,*	Kinges River.
,, *papilloso-labiata,*	Juldus.
,, *microphthalmus,*	Chami.

Of the nine species enumerated above the first two are from Eastern Turkestan, the next four from Lake Dalai-nor, which is situated in the lake basin of Mongolia, and the remaining three from the Tarim river-system which ultimately drains into lake Lob-nor. It is significant that all the Cobitid fishes known from Lake Dalai-nor belong to the genus *Diplophysa*. A new species of this genus described here was obtained by Capt. Kennedy and Capt. Stewart in a small stream flowing into Rham-tso, a lake of considerable dimensions at an altitude of 14,700 ft. in Eastern Tibet.

It will thus be seen that the genus is known from Eastern Turkestan and Mongolia on the one hand and from Rham-tso in Eastern Tibet on the other. This apparently discontinuous distribution may be accounted for by the fact that very little is at present known of the ichthyology of the intermediate region.

There is yet another possibility which may explain the distribution of this genus. It is possible that the genus is polyphyletic in origin, because the character of the bladder on which it is solely based, may have originated on more than one occasion in response to life in deep waters which necessitated some hydrostatic mechanism.

The genus *Diplophysa* is represented by two species in the collection of the Indian Museum, one of which is new to science.

Diplophysa papilloso-labiata Kessler.

1878. *Diplophysa papilloso-labiata*, Kessler, *Bull. Acad. St. Pétersbourg* XXV, p. 299.

1878. *Diplophysa papilloso-labiata*, Kessler, *Mél. biol.* X, p. 257.

1888. *Nemachilus strauchii* var. *papilloso-labiatus*, Herzenstein, *Wiss. Res. Przewalski Central As. Reis., Zool.* III (2), p. 50, pl. vi, fig. 5.

1910. *Diplophysa (Nemachilus) strauchii papilloso-labiata*, Zugmayer, *Zool. Zahrb. Syst.* XXIX, p. 297.

This is the only species of the genus *Diplophysa* collected by Dr. Stoliczka. There are seven specimens in our collection and they are labelled as having come from Yarkand, probably from the Yarkand river which forms a part of the Tarim river-system. Of the seven specimens four are males and the rest females. The species exhibits a well-marked sexual dimorphism.

The free air-bladder is not constricted in the middle and lies almost in the middle of the abdominal cavity. In my dissections I have not been able to find any pneumatic duct.

The eggs of this species are very small and almost fill the whole of the abdominal cavity.

Diplophysa papilloso-labiata is known only from the Tarim river-system (Eastern Turkestan). The longest specimen in our collection is 105 mm. in length without including the length of the caudal fin.

Diplophysa stewarti, sp. nov.

(Text-figs. 2*c*, 2*d*.)

1908. *Nemachilus stoliczkae*, Lloyd (in part), *Rec. Ind. Mus.* II, p. 341.
1911. *Nemachilus stoliczkae*, Stewart (in part), *Rec. Ind. Mus.* VI, p. 70.
1920. *Nemachilus lhasae*, Annandale and Hora (in part), *Rec. Ind. Mus.* XVIII, p. 179.

This species is represented in our collection by several young and half-grown specimens. It closely resembles *Nemachilus lhasae* Regan with which Annandale and myself [1] confused it when dealing with the fish of Seistan. Both Lloyd and Stewart referred these specimens along with *Nemachilus lhasae* to *N. stoliczkae*. *Diplophysa stewarti* is, however, readily distinguished by the presence of a second air-bladder and also by the nature of its skin, which is tuberculate all over.

The dorsal profile is highest near the nape, in front of which it slopes considerably to the tip of the snout. The body is thickest anteriorly and gradually and regularly slopes to the base of the caudal fin. The head is round, narrow and pointed; its length is contained 4·2 times in the length of the fish without the caudal fin. The body is deepest at its commencement and the greatest depth of the body is contained 1·6 times in the length of the head. The eyes are placed in the middle of the head and are scarcely visible from below; the diameter is contained 3·4 to 3·7 times in the length of the head. There are six barbels, 4 rostral and 2 maxillary. The maxillary barbels are the longest; they are slightly longer than the diameter of the eye. The upper lip is fringed and the lower is interrupted in the middle and is strongly papillated. The lateral line is complete; anteriorly it is continued as a series of open pores below the eyes. There are a few open pores on the dorsal surface of the head near its posterior border extending downwards on each side to join the lateral line. The dorsal fin commences considerably in advance of the ventrals and its origin is equidistant from the tip of the snout and the base of the caudal fin. It is higher than the depth of the body immediately below it. The ventrals extend beyond the anal opening and almost reach the base of the anal fin. The caudal peduncle is long and narrow; its least height is contained 6·1 to 6·6 times in its length. The caudal fin is deeply concave with the upper lobe considerably longer than the lower.

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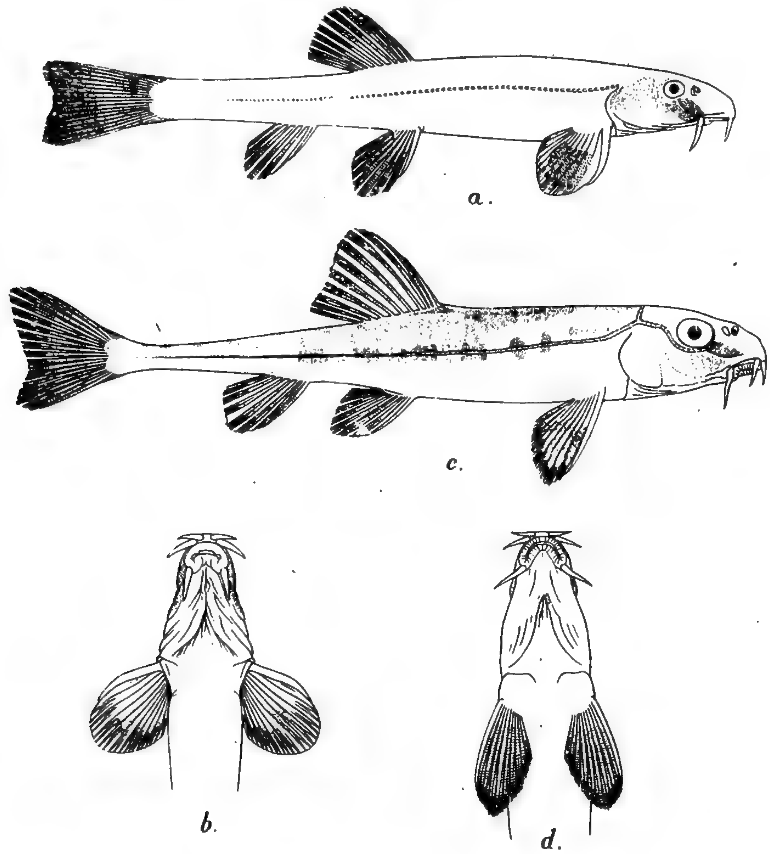
[1] Annandale and Hora, *Rec. Ind. Mus.* XVIII, p. 179 (1920).

This species exhibits sexual dimorphism and the males can readily be distinguished by a tuberculate pad below the eye.

The secondary bladder is large and constricted in the middle. It differs from the normal Cyprinoid type in the fact that the pneumatic duct here opens at the anterior end instead of in the constricted region.



TEXT-FIG. 2.—Cobitid fishes from Eastern Tibet.

a. Lateral view of *Nemachilus tibetanus* Regan.
b. Under surface of head and chest of same.
c. Lateral view of *Diplophysa stewarti*, sp. nov.
d. Under surface of head and chest of same.

The colour in spirit is characteristic of the species. There are short black bars along the lateral line and on the back. The belly and under surface of the head and also the general colour of the body is pale olivaceous. The dorsal and the caudal fins are marked with black.

Type-specimen.—F. 2894/1, *Zoological Survey of India* (*Ind. Mus.*).

Locality:—The specimens were collected by Capt. R. S. Kennedy, I.M.S., and Capt. F. H. Stewart, I.M.S., in a small stream flowing into Rham-tso (Eastern Tibet). There are two young specimens from Se-Chen in Tibet, which I also refer to this species.

Genus **Adiposia**, Annandale & Hora.

1920. *Adiposia*, Annandale and Hora, *Rec. Ind. Mus.* XVIII, p. 182.

The genus was recently proposed by Annandale and myself for two species of Cobitid fishes from Seistan with a long soft dorsal fin between the bases of the dorsal and the caudal fins. We also referred a species from Turkestan, *Adiposia longicauda* (Kessler),[1] to this new genus.

Genus **Nemachilus** v. Hass.

The thirteen species of the genus *Nemachilus* from Central Asia in the collection differ from the numerous forms known from the Indian Empire in their large size and almost subcylindrical form. None of them, moreover, possesses the vertical bands of pigment which characterize those from lower altitudes.

The following is an artificial key to the Central Asiatic species of *Nemachilus* in the collection of the Indian Museum :—

I. Ventrals terminating a considerable distance in front of anal opening.
- *A.* Eyes wholly in anterior half of head, dorsal commencing in advance of ventrals. ... ... *N. yarkandensis.*
- *B.* Eyes in middle of head ; ventrals commencing in advance of dorsal ... ... *N. gracilis.*

II. Ventrals just reaching or extending beyond anal opening.
- *A.* Anterior origin of dorsal almost equidistant between tip of snout and base of caudal.
  - 1. Lateral line incomplete, ending shortly after its commencement ... ... *N. vittatus.*
  - 2. Lateral line complete or becoming somewhat obscure behind anal fin.
    - *a.* Eye almost in middle of head.
      - i. Pectorals as long as head ... ... *N. yasinensis* ♂.
      - ii. Pectorals shorter than head.
        - α. Least height of caudal peduncle almost equal to diameter of eye ... ... *N. lhasae.*
        - β. Least height of caudal peduncle considerably greater than diameter of eye. ... ... *N. kashmirensis.*
    - *b.* Snout longer than postorbital part of head ... *N. tenuis.*
- *B.* Anterior origin of dorsal not equidistant between tip of snout and base of caudal.
  - 1. Anterior origin of dorsal nearer tip of snout than base of caudal ... ... *N. ladacensis.*
  - 2. Anterior origin of dorsal nearer base of caudal than tip of snout.
    - *a.* Eye in middle of head.
      - i. Ventrals distinctly extending beyond anal opening.
        - α. Least height of caudal peduncle 4 times in its length, lower lip almost continuous ... ... *N. stoliczkae.*
        - β. Least height of caudal peduncle 5 times in its length, lower lip widely interrupted ... *N. tenuicauda.*
      - ii. Ventrals just reaching anal opening ... ... *N. marmoratus.*

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[1] Kessler "Pisces" in Fedtschenko's "*Reise in Turkestan*," p. 38, pl. vi, figs. 22, 23 (1874).

b. Eye not in middle of head.
  i. Snout shorter than postorbital part of head.
    α. Anal fin separated from caudal by a distance almost equal to its own length ... ... *N. microps.*
    β. Anal fin separated from caudal by a distance considerably less than its own length ... *N. yasinensis* ♀.
  ii. Snout longer than postorbital part of head. ... *N. tibetanus.*

Nemachilus yarkandensis Day.

1876. *Nemachilus yarkandensis*, Day, *Proc. Zool. Soc. London*, p. 79.
1878. *Nemachilus yarkandensis*, Day, *Sci. Res. 2nd Yarkand Mission, Ichthyol.*, p. 14, pl. v, fig. 3.
1889. *Nemachilus yarkandensis*, Herzenstein (in part), *Wiss. Res. Przewalski Central As. Reis., Zool.* III (2), p. 74.
1910. *Nemachilus yarkandensis*, Zugmayer, *Zool. Jahrb. Syst.* XXIX, p. 295.

The Indian Museum possesses a large number of specimens of this species from Yarkand, Pas Robat, Yankihissar and Kashgar. Besides these there is one specimen about 132 mm. in length labelled as having come from Kashmir which I am convinced also belongs to this species. So far *N. yarkandensis* has been recorded only from the Tarim River system and its extension into Kashmir is very doubtful and requires confirmation. My specimens correspond in every detail to the typical form. The various varieties described and figured by Herzenstein are not represented in our collection ; probably they are all far Eastern or Chinese forms.

Nemachilus tarimensis Kessler[1] has been considered to be synonymous with *N. yarkandensis* by Herzenstein, who figures Kessler's original specimen of *N. tarimensis* as *N. yarkandensis* (*s. st.*). After a careful comparison I am lead to believe that the two species are different and that *N. tarimensis* as figured by Herzenstein differs from *N. yarkandensis* in the following points:—

N. tarimensis.	*N. yarkandensis.*
The commencement of the dorsal fin is almost equidistant from the tip of the snout and the base of the caudal fin.	The commencement of the dorsal fin is distinctly nearer to the base of the caudal fin than to the tip of the snout.
The eyes are large and are not situated entirely in the anterior half of the head.	The eyes are small and are situated in the anterior half of the head.

As regards the three varieties of this species, it is difficult to discuss their true relationships without examining Herzenstein's specimens. *N. yarkandensis longibarbus* differs from the typical form in the commencement of the dorsal fin, which is situated in the middle of the body, the longer barbels and the curve of its dorsal profile. Probably it represents a new species. The other two varieties, *brevibarbus* and *macropterus* somewhat resemble our specimens.

[1] Kessler, *Bull. Acad. St. Petérsbourg* XXV, p. 300 (1878).

Nemachilus gracilis Day.

1876. *Nemachilus gracilis*, Day, *Proc. Zool. Soc. London*, p. 798.
1878. *Nemachilus gracilis*, Day, *Sci. Res. 2nd Yarkand Mission, Ichthyol.*, p. 16, pl. iv. fig. 5.
1878. *Nemachilus gracilis*, Day, *Fish. India* II, p. 621.
1889. *Nemachilus gracilis*, Day, *Faun. Brit. Ind. Fish.* I, p. 237.
1898. *Nemachilus stoliczkae*, Alcock, *Rep. Nat. Hist. Res. Pamir Bound. Comm.*, p. 38.

This species is readily distinguished by the nature of its lower lip which is widely interrupted in the middle and is thrown into a longitudinal fold on either side. I have examined Day's type-specimen "from Basgo, on the head waters of Indus."

I also refer to this species a specimen from Lukong River and several others from the affluents of the Yasin River near Darkot. The latter were collected by Col. Alcock. The waters of both these streams flow directly or indirectly into the Indus River. These specimens were previously recorded as *N. stoliczkae.*

Several young, half-grown and adult specimens have recently been collected in the Kashmir Valley. The specimens were obtained from a lake about four miles from Sonmarg. The species exhibits marked sexual dimorphism. The eggs are minute.

The adult individuals possess 6 to 7 broad black bands across the back. In young specimens there is a series of black dots along the lateral line and the dorsal surface is mottled with black and brown.

Nemachilus vittatus (Heckel).

1838. *Cobitis vittata*, Heckel, *Fische Kaschm.*, p. 80, pl. xii, figs. 3 and 4.
1844. *Cobitis vittata*, Heckel, in Hügel's *Kaschmir* IV, p. 382, fig.

Günther [1] combined Heckel's two species of this genus from Kashmir and adopted for them the specific name *marmoratus*. Day [2] followed Günther and recognised only one form from the Kashmir lakes. Zugmayer [3] perhaps doubted Günther's identification and in recording *Nemachilus marmoratus* from "Wular Lake" gave Günther as the author of the species. On examining the old collection of the Indian Museum, I find that out of 17 specimens from the Kashmir lakes, 16 belong to *N. vittatus* and one to another species. *N. vittatus* can be readily recognised by the nature of its lateral line which ends shortly after its commencement.

I have not included references by Günther, Day and Zugmayer under the title of this species as it is impossible to be sure of the identity of the species they recorded. They do not make any

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[1] Günther, *Cat. Brit. Mus. Fish.* VII, p. 356 (1868).

[2] Day, *Proc. Zool. Soc. London*, p. 798 (1876); *Fish. India* II, p. 620 (1878).

[3] Zugmayer, *Zool. Jahrb. Syst.* XXIX, p. 296 (1910).

mention of the lateral line in which, as explained above, the specific character is to be found.

Quite a number of specimens have recently been brought back from several places in the Kashmir Valley by the members of the Zoological Survey of India.

Nemachilus yasinensi Alcock.

1898. *Nemachilus yasinensis*, Alcock, *Rep. Nat. Hist. Res. Pamir Bound. Comm.*, p. 38, pl. ii, figs. 2, 2*a*.

This species has hitherto been known from a single male specimen procured by Col. Alcock in the Yasin River. The specimen is now preserved in our collection. A large number of specimens have recently been obtained from a small stream flowing into the Sind River, a tributary of the Jhelum River. Among these there are three female specimens which differ considerably from the males. The following are some of the chief points of difference:—

Male.	*Female.*
The dorsal fin commences midway between the tip of the snout and the base of the caudal fin.	The dorsal fin commences somewhat nearer to the base of the caudal than to the tip of the snout.
The snout is slightly longer than the postorbital part of the head.	The snout is shorter than the postorbital part of head.
The lateral line is continued to the base of the caudal fin.	The lateral line ends in front of the base of the ventral fins.
The caudal fin is forked.	The caudal fin is either rounded or truncate.

Besides these the female specimens possess short paired fins, small eyes and a deep caudal peduncle as compared with the males. The males possess well-marked secondary sexual characters such as are described towards the end of this paper.

The eggs are small.

The species is now known from the head-waters of the Indus and Jhelum Rivers.

Nemachilus lhasae Regan

(Text-figs. 3*a–c*.)

1905. *Nemachilus lhasae*, Regan, *Ann. Mag. Nat. Hist.* (7) XV, p. 301.
1908. *Nemachilus stoliczkae*, Lloyd (in part), *Rec. Ind. Mus.*, II, p. 341.
1911. *Nemachilus stoliczkae*, Stewart (in part), *Rec. Ind. Mus.* VI, p. 70
1920. *Nemachilus lhasae*, Annandale and Hora (in part), *Rec. Ind. Mus.* XVIII, p. 179.

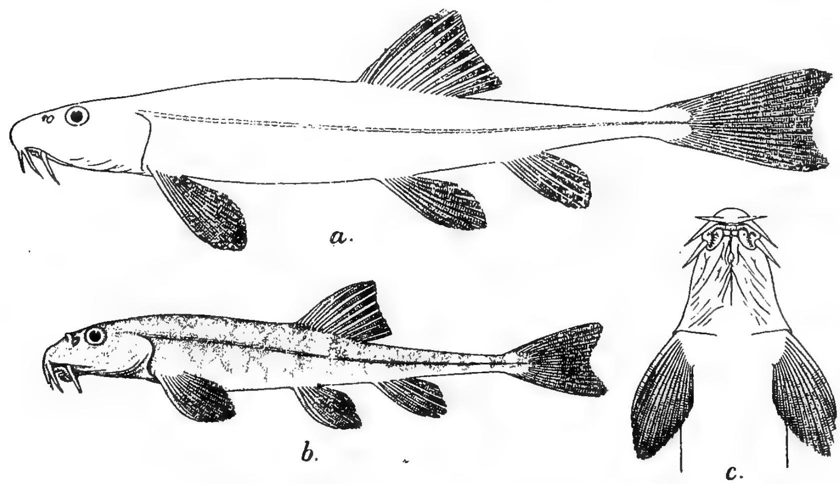
There are several young and half-grown specimens of this species before me, which have been referred to *Nemachilus stoliczkae* by Lloyd. They were collected by Capt. Kennedy and Capt. Stewart in Rhamtso, Nyang-chu, Langma-thang-chu, Phari and to the S.W. of Dochen, all in Eastern Tibet. My specimens agree with Regan's description of the species. The young individuals, however, possess black blotches along the lateral line besides short cross-bars on the back.

The species exhibits well-marked sexual dimorphism.

Nemachilus kashmirensis, sp. nov.

1876. *Nemachilus rupicola*, Day, *Proc. Zool. Soc. London*, p. 799.
1878. *Nemachilus rupicola*, Day, *Sci. Res. 2nd Yarkand Mission-Ichthyol.*, p. 17.

To this new species I assign several specimens recently collected in Verinag, Kukarnag and in a small stream flowing from the Kashmir waterworks reservoir to the trout farm at Harwan. The species is characterized by an emarginate caudal fin and by the presence of broad, black bands across the back. Probably these characters led Day to refer some of his Kashmir examples to *Nemachilus rupicola* (McClell.)[1] I have recently visited the



TEXT-FIG. 3.—*Nemachilus lhasae*, Regan.

a. Lateral view of adult specimen.
b. Same of young specimen.
c. Under surface of head and chest of adult specimen.

Simla Hills and have obtained some specimens of *N. rupicola*, which differ from *N. kashmirensis* in the following points :—

N. kashmirensis.	*N. rupicola.*
The ventrals extend beyond the anal opening and almost reach to the base of the anal fin.	The ventrals do not reach the anal opening and are separated from the anal fin by a considerable distance.
The pectorals are shorter than the head.	The pectorals are longer than the head.
There are no definite black bands on the sides of the body.	There are several black bands on the sides of the body.
The body is absolutely devoid of a scaly covering.	There are minute scales covering at least the posterior three-fourths of the body.

I propose to give a detailed description with figures of this species in my paper on the Indian species of the genus to be published in this journal at some future date.

[1] McClelland, *Journ. As. Soc. Bengal* VII, p. 948, pl. 55, fig. 3.

Nemachilus tenuis Day.

1876. *Nemachilus tenuis*, Day. *Proc. Zool. Soc. London*, p. 796.
1878. *Nemachilus tenuis*, Day, *Sci. Res. 2nd Yarkand Mission, Ichthyol.*, p. 15, pl. v, fig. 4.
1898. *Nemachilus tenuis*, Alcock, *Rep. Nat. Hist. Res. Pamir Bound. Comm.*, p. 14.
1906. *Nemachilus stenurus*, editorial note to Regan, *Journ. As. Soc. Bengal*, II, p. 8.
1920. *Nemachilus stoliczkae*, Annandale and Hora (in part), *Rec. Ind. Mus.* XVIII, p. 178.

The specimens from which Day drew up his description of *Nemachilus tenuis*, came from two sources, from " Aktash, where the waters of the Ak-su Pass to the Oxus " and from " Yankihissar, where the rivers go to the Yarkand River." Day's specimens from the latter locality are not to be found in our collection, though there are several specimens of other species of the genus from the same place. The record, therefore, requires confirmation as I think it improbable that the species really extends to the Tarim river-system. Several specimens from the Great Pamir, whence the waters pass to the Oxus system, were correctly referred to this species by Alcock.

Quite recently Annandale and I (*op. cit.*) identified the Seistan examples as *N. stoliczkae*, but I now believe that they represent *N. tenuis*. The Seistan specimens were collected in the Helmand River which may once have formed a part of the once-extensive Oxus system. Regan (*op. cit.*) referred these specimens to *N. stenurus* on account of their long and narrow caudal peduncle, but this is also a character of *N. tenuis*. The two species differ in the following points:—

N. stenurus Herz.	*N. tenuis* Day.
The commencement of the dorsal fin is nearer to the tip of the snout than to the base of the caudal fin.	The commencement of dorsal fin is either equidistant from the base of the caudal fin and the tip of the snout or it is slightly nearer to the former than to the latter.
The lower lip is continuous and entire.	The lower lip is widely interrupted in the middle and is greatly pliated.

N. stenurus was described from Dy-tschu, the sources of the Yang-tse-kiang River; while *N. tenuis* is known from the Oxus system.

Vinciguerra[1] on the authority of Regan referred his examples from Skardu in the Indus System to *N. stenurus* for he writes, " nel riferire questi individui al *N. stenurus* sono confortato dall' avviso di Tate Regan, al quale li ho comunicati." The specimens require re-examination.

It is evident from the above discussion that the character of a long and narrow caudal peduncle is shared by a number of species. Such species are *N. stenurus* from the sources of the Yang-tse-kiang, *N. tenuis* from the Oxus system and *N. lhasae*

[1] Vinciguera, *Ann. Mus. Stor. Nat. Genova* XLVII, p. 148 (1916).

from Eastern Tibet. The Skardu specimens probably represent another form in the same series.

Nemachilus ladacensis Günther.

1868. *Nemachilus ladacensis*, Günther, *Cat. Brit. Mus. Fish.* VII, p. 356.

The Indian Museum possesses only one specimen of this species six and a half inches in length, from Kashmir; it agrees closely with Günther's description but had been referred to *N. stoliczkae* by Day. Day's[1] *N. ladacensis* differs from Günther's account in several respects and probably represents a different species. The descriptions differ in the following points:—

N. ladacensis Günther.	*N. ladacensis* Day.
"The origin of the dorsal fin is nearer to end of snout than to the root of the caudal."	"Dorsal commences midway between the front edge of the eye and the base of the caudal fin."
"The free portion of tail is very low, its depth being nearly one fourth of its length."	"Free portion of the tail twice as high as long at its base."
The caudal fin is rounded?	The caudal fin is emarginate.

The proportions are also different in the two species.

Unfortunately the specimen from which Day drew up his description and which he "deposited in the Indian Museum" is not now to be found.

Day's specimen was said to have been collected by von Schlagintweit at Gnari Khorsum, Tibet. *N. ladacensis* is known from Ladak and Kashmir.

Nemachilus stoliczkae (Steind.).

1866. *Cobitis stoliczkae*, Steindachner, *Verh. Zool-bot. Ges. Wien*, p. 793. pl. xiv, fig. 2.

1868. *Nemachilus stoliczkae*, Günther, *Cat. Brit. Mus. Fish.* VII, p. 360.

A very wide interpretation has been given to this species by Day,[2] Herzenstein,[3] Günther,[4] and several other ichthyologists. I have examined a large number of specimens in our collection from Lukong stream, Chagra, Yarkand, Sirikol and Aktash which were referred to this species by Day but find that several distinct forms are represented among them. There are only six specimens which I can definitely refer to this species, one from Rupshu, the type-locality, three from Lukong Stream, one from Chagra and one from Kashmir. The waters from these places pass to the Indus River.

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[1] Day, *Proc. Zool. Soc. London*, p. 797 (1876); *Sci. Res. 2nd Yarkand Mission, Ichthyol.*, p. 15, pl. iv, fig. 4.

[2] Day, *Proc. Zool. Soc. London*, p. 795 (1876); *Sci. Res. 2nd Yarkand Mission, Ichthyol.*, p. 14, pl. v, fig. 2 (1878).

[3] Herzenstein, *Wiss. Res. Przewalski Central As. Reis., Zool.* III (2), p. 14 (1888).

[4] Günther, in Pratt's "*Snows of Tibet*", p. 249 (1892).

Herzenstein (*op. cit.*) has recognised several varieties of this species, most of which so far as I can judge from the figures represent different species. My specimens agree with the typical form, of which I have examined one specimen from Rupshu.

Vinciguerra[1] has recorded the species from Skardu, but it appears from his description that he has grouped several distinct forms under one name. In identifying his specimens as *N. stoliczkae* he has followed Day and Herzenstein for he observes that, "questa determinazione é basata non tanto sulla descrizione e figura originale, quanto su quelle di Day, di Günther e specialmente di Herzenstein."

Lloyd[2] referred some specimens from Eastern Tibet to this species. I have been able to recognize at least three different forms among the material he examined, two of them belonging to the genus *Nemachilus*, viz. *N. lhasae* Regan and *N. tibetanus* Regan,[3] while the third belongs to the genus *Diplophysa* and is described here as new.

Day[4] in his later works regarded *Nemachilus griffithii*, Günther,[5] as synonymous with this species. I have not examined any specimen of Günther's species, but it appears from the description that the two are different. In *N. griffithii* "the origin of the dorsal fin is midway between the root of the caudal and the end of the snout," while in *N. stoliczkae* "the origin ot the dorsal fin is conspicuously nearer to the root of the caudal than to the end of the snout."

Nemachilus tenuicauda (Steind.).

1866. *Cobitis tenuicauda*, Steindachner, *Verh. Zool.-bot. Ges. Wien* XVI, p. 792, pl. 17, fig. 3.

1868. *Nemachilus tenuicauda*, Günther, *Cat. Brit. Mus. Fish.* VII, p. 357.

This species closely resembles *N. stoliczkae*, from which it is distinguished by its elongate and narrow caudal peduncle and by its colouration.

Nemachilus tenuicauda is represented in our collection by two specimens from Leh.

Nemachilus marmoratus (Heckel).

1838. *Cobitis marmorata*, Heckel, *Fish. Kaschm.*, p. 76, pl. xii, figs. 1 and 2.

1844. *Cobitis marmorata*, Heckel, in Hügel's *Kaschmir* IV, p. 380, fig.

This is apparently a rare species and is represented in our collection by a few specimens recently obtained in Kashmir. The specimens were obtained from Kukarnag Spring and from ponds on the road between Martand and Ichabal.

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[1] Vinciguerra, *Ann. Mus. Stor. Nat. Genova* XLVII, p. 146 (1916).
[2] Lloyd, *Rec. Ind. Mus.* II, p. 341 (1908).
[3] Regan, *Ann. Mag. Nat. Hist.* (7) XV, pp. 187 and 301 (1905)
[4] Day, *Fish. India* II, p. 620 (1878).
[5] Günther, *Cat. Brit. Mus. Fish.* VII, p. 360 (1868).

I am unable to say whether Zugmayer's (*op. cit.*) specimens represent this species or *N. vittatus*, but the latter is undoubtedly more common in the Kashmir lakes.

For the reasons already given under *N. vittatus* I have not included references by Günther and Day under the title of this species.

Nemachilus microps (Steind.).

1866. *Cobitis microps*, Steindachner, *Verh. Zool.-bot. Ges. Wien* XVI, p. 794, pl. 13, fig. 3.
1868. *Nemachilus microps*, Günther, *Cat. Brit. Mus. Fish.* VII, p. 357.

This species is readily distinguished by its small eyes. We have two specimens in our collection from Mecma [1] (Yarkand Mission, Dr. Stoliczka's collection) which agree with Steindachner's description of the species. These specimens had previously been referred to *Nemachilus stoliczkae*. The male possesses well-marked secondary sexual characters below the eyes.

The species was originally described from Leh and in all probability the waters from Mecma pass to the Indus River.

Nemachilus tibetanus Regan.

(Text-figs. 2*a*, 2*b*.)

1905. *Nemachilus tibetanus*, Regan, *Ann. Mag. Nat. Hist.* (7) XV, p. 187.
1908. *Nemachilus stoliczkae*, Lloyd (in part), *Rec. Ind. Mus.* II, p. 341.
1911. *Nemachilus stoliczkae*, Stewart (in part), *Rec. Ind. Mus.* VI, p. 70.

The specimens before me of this species were collected by Capt. Kennedy in Nyang-chu at Kangmar and by Capt. Stewart in Gyang-tse. These had been referred to *Nemachilus stoliczkae* by Lloyd and Stewart. The species differs from *N. lhasae*, which is known from the adjacent region, by the greater depth of its caudal peduncle, by the position of the dorsal fin, whose commencement is situated nearer to the root of the caudal than to the tip of the snout, and by the position of the eye, which is nearer to the tip of the snout than to the posterior margin of the head.

Nemachilus tibetanus exhibits a well-marked sexual dimorphism.

Nemachilus sp.

There are several specimens in our collection from Sirikol, which have been referred to *Nemachilus stoliczkae* by Day with the following remark, "in specimens from Sirikol the snout is rather more pointed." I am unable to refer these specimens to any of the known species of the genus, but on account of their bad state of preservation I do not propose to describe them as a new species.

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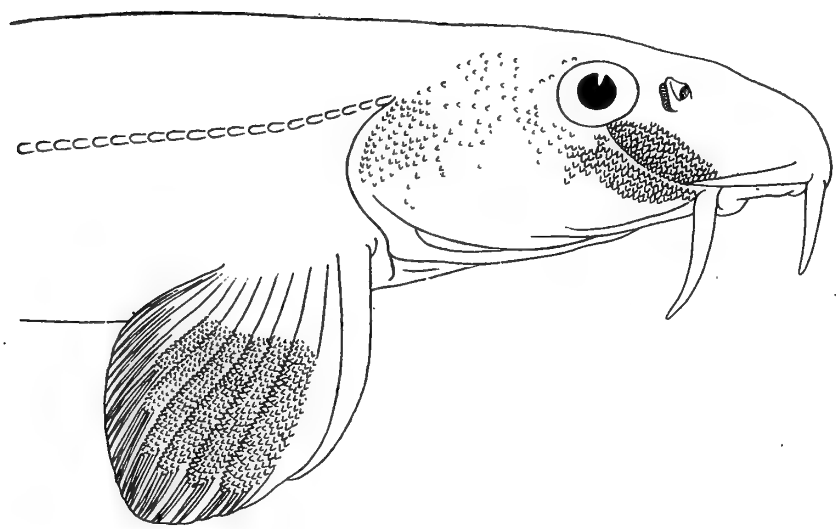
[1] The Yarkand Mission made collections in several places outside Yarkand. I have not been able to determine the exact locality of Mecma, but I suppose waters from this place flow into the Indus river-system.

Among the specimens from this locality two forms are represented, one in which the caudal peduncle is very low and the commencement of the dorsal fin is situated at an equal distance from the tip of the snout and the base of the caudal fin; while in the other the caudal peduncle is fairly deep and the origin of the dorsal fin is distinctly nearer to the base of the caudal than to the tip of the snout. Most of the females, which are about 54 mm. in length, are full of eggs. The snout is long and pointed and the eyes are situated in the middle of the head.

NOTE ON THE SECONDARY SEXUAL CHARACTERS OF CERTAIN SPECIES OF COBITID FISHES FROM HIGH ALTITUDES IN CENTRAL ASIA.

In the Indian species of the genus *Nemachilus* which exhibit sexual dimorphism the male is provided with "a slit-like



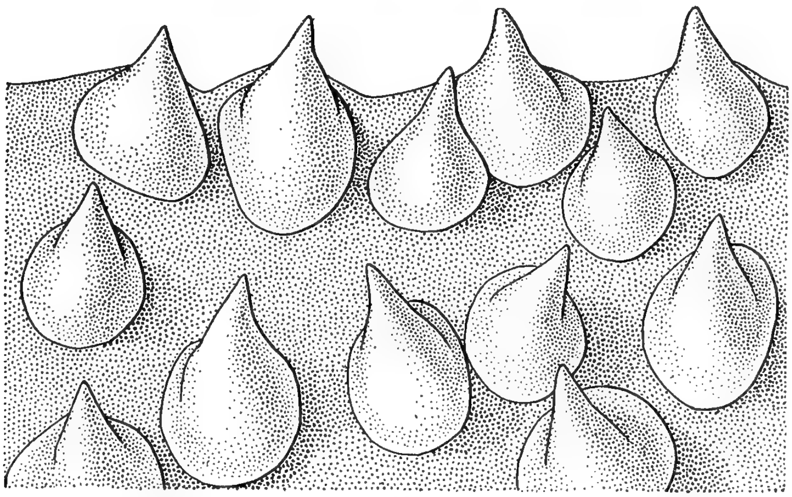
TEXT-FIG. 4.—Lateral view of head and upper surface of pectoral fin in a male specimen of *Nemachilus tibetanus* Regan, showing secondary sexual characters.

deep groove in front of the eye which bends round a small knob-like rounded flap of skin protruding below the anterior one-third of the orbit, the ridge above the groove appearing slightly swollen and cushion-like." The pectoral fins are also modified where "there is a kind of padding and thickening on the upper surface" and "on the padding, minute hooked denticular outgrowths are noticed." These secondary sexual characters were described by Chaudhuri in *Nemachilus mackenziei*[1] and *N. manipurensis*[2] and

[1] Chaudhuri, *Rec. Ind. Mus.* V, p. 183.

[2] Chaudhuri, *Rec. Ind. Mus.* VII, p. 443, pl. xl, figs. 4, 4*a*, 4*b*; pl. xli, figs. 1, 1*a*, 1*b*.

I have noticed similar modifications in mature males of several other Indian species of the genus. In the Central Asiatic forms, however, the secondary characters of the male are more marked and somewhat complicated. Of the thirteen species of the genus *Nemachilus* referred to in this paper, seven show marked sexual dimorphism. The male in these is usually provided with a raised tuberculate area below the nares, separated ventrally by a groove from the adjacent parts of the skin. The area is almost rectangular, commencing at the corner of the lips and extending posteriorly below the anterior third of the orbit. In certain species such as *N. tenuis*, *N. yasinensis* and *N. tibetanus* (fig. 4), there is another tuberculate area immediately behind the first one. Sometimes the tubercles are irregularly scattered on the operculum and the sides of the head behind the eyes. In all species that exhibit



TEXT-FIG. 5.—Tubercles covering secondary sexual pads of male of *N. tibetanus* (highly magnified).

sexual dimorphism, the pectoral fin-rays are provided with thickened tuberculate pads on their dorsal aspect. These tubercles on the fin-rays are not to be confused with encysted glochidia, which are sometimes found in this position, though they resemble them closely. A few scattered tubercles are sometimes found on the under surface of the pectoral fin-rays.

In both the species of the genus *Diplophysa* in our collection, the male is modified on exactly the same lines as has already been described for the genus *Nemachilus*.

The structure of the tuberculate areas is somewhat interesting. Each of the tubercles is provided with a short, stout spine-like outgrowth (fig. 5) which is sharp and slightly curved towards the end. The spine rests on a broad cushion-like rounded base.

Recently I have collected an interesting specimen of *Nemachilus* from the Simla Hills. It possesses a groove and a small knob-like rounded flap of skin below the eye, but on dissection was found to be full of eggs. There is no padding on the dorsal aspect of the pectoral fin-rays and even the sexual character below the eye is not so well marked. I have examined a large number of specimens of the species to which I think this example probably belongs, *N. rupicola* (McClelland), and have not been able to find any other specimen with secondary sexual characters.

A NOTE ON BEES OF THE GENERA *XYLOCOPA* AND *BOMBUS* IN THE INDIAN MUSEUM.

By CEDRIC DOVER, *F.E.S.*

The accumulation of a large amount of unnamed carpenter- and bumble-bees in the collection of the Zoological Survey of India has led me to attempt their identification; and, as, though no novelties were among them, my results are not quite without interest, I have drawn up the following short note in the hope that it will prove useful.

Subfamily *XYLOCOPINAE*.[1]

Xylocopa tenuiscapa Westw.

1921. *Xylocopa tenuiscapa*, Dover, *Rec. Ind. Mus.* XXII, p. 389.

In the paper quoted I have given references to works which give characters by which the female of *X. latipes* and *X. tenuiscapa* may be readily separated, and I have also quoted Maidl, who regards Sichel's *albofasciata* as the female of this species. "In Bingham's description of the male for tibiae read basitarsi" (*Cockerell*).

The Indian Museum possesses a specimen from Tenasserim which is probably a *latipes* ♀ but differs from it in being much larger (about 37 mm.) and there are two deep dents on either side of the disc of the mesonotum, which is smooth and brightly polished.

Xylocopa acutipennis Smith.

The Indian Museum has examples from the following localities unnoticed by Bingham: Darjiling District, above Tura in the Garo Hills of Assam, 3500 ft., and the Dawna Hills in Lower Burma, 2000–3000 ft.

Xylocopa attenuata Perez.

1852. *Xylocopa pictifrons*, Smith, *Trans. Ent. Soc.* (2) XI, p. 42, ♀ *nec* ♂.
1897. *Xylocopa pictifrons*, Bingham, *Faun. Brit. Ind. Hym.* I, p. 538, ♂.
1901. *Xylocopa attenuata*, Perez, *Act. Soc. Linn. Bordeaux* LXXV (6) VI, p. 46, ♀.
1912. *Xylocopa attenuata*, Maidl, *Ann. Nat. Hofmus. Wien* XXVI, p. 287.
1921. *Xylocopa attenuata*, Dover, *Journ. Bomb. Nat. Hist. Soc.* XXVII, p. 961,

The species is found sparingly in the Indian plains, and commonly in Sikkim and Kumaon. It is found also in China,

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[1] I have thought it best in this note not to recognise the genus *Mesotrichia*.

Java, Formosa and the Malay Peninsula. Some confusion has existed as to the sexes of the species described by Smith and Bingham as *pictifrons*, but this has been admirably cleared up by Maidl in his paper. He regards the male described by Smith as typical *pictifrons*, while Bingham's male and Smith's female are a separate species for which he has adopted the name *attenuata* of Perez.

Xylocopa auripennis Lepel.

In addition to the localities noticed by Bingham, the Indian Museum also possesses specimens from the Darjiling District, the Naga Hills and Sibsagar in Assam, South India and Nepal. The species is supposed to be mimicked by a Sphingid moth (*Sataspes hauxwelli*), which according to De Niceville (*Journ. Bomb. Nat. Hist. Soc.* XIII, p. 174) was "a beautiful mimic of the very common large blue carpenter-bee *Xylocopa auripennis*, Lepeletier." The wings of the moth are a deep indigo-blue with bronze markings, which scarcely resembles the wings of the bee, and in the cabinet the whole insect seems entirely different.

De Niceville does not say that the bee and the moth were taken together, and in the absence of definite field-observations, the moth has little claims to being a mimic of the *Xylocopa*.

Xylocopa dissimilis Lepel.

The Museum has specimens from Bangalore, Bandra in the Bombay Presidency, Mong-Wan in Yunnan (W. China) and Southern China.

Xylocopa fenestrata Fabr.

? *Xylocopa bombayensis*, Cam. ? *M. S.*
1921. *Xylocopa fenestrata*, Dover, *Rec. Ind. Mus.* XXII, p. 390.

In the paper cited, I have noticed what appears to be an aberration of *X. fenestrata* from Barkuda Island in the Chilka Lake, with a comparatively large, and a small, almost reniform, hyaline marking on each of the hindwings. The Indian Museum possesses another specimen from Hamirpur Road in the United Provinces (*Caunter*, x·11), which has the lower halves of the wings semi-hyaline. The fact that King described an example with semi-lunate, hyaline markings on the hindwings under the name *lunata*, makes me now think that aberrations of this species, with hyaline markings of some sort on the wings are perhaps not uncommon. It might be of interest to note here that I remember to have seen a specimen of the closely allied African *X. carinata* with an irregular hyaline patch on the right forewing. Can it be that these markings are caused by injuries sustained in the early stages? *X. fenestrata* is a common Indian species, extending as far Celebes on the south-east and probably into Australia, and Madagascar on the south-west. It does not penetrate into South Africa, but is replaced there by

X. carinata. Meade-Waldo has shown[1] that Cameron's *X. bombayensis* is a synonym of this species.

Xylocopa amethystina Fabr.

Bengal, Chota Nagpur, Bihar and Sind are not recorded by Bingham. This is an apparently widely distributed species in India.

Xlyocopa bryorum Fabr.

The Museum has specimens from Assam and the Andamans.

Xylocopa collaris Lepel.

This species is found in most parts of India, Burma and Ceylon and is known from Borneo, Sumatra, Java, the Philippines, Celebes and Malacca and from the Palaearctic Region.

Xylocopa tranquebarica Fabr.

1804. *Bombus tranquebaricus*, Fabr., *Syst. Piez.*, p. 343.
1917. *Xylocopa tranquebarica*, Cockerell, *Philipp. Journ. Sci.* XII, p. 346.
1921. *Xylocopa rufescens*, Dover, *Rec. Ind. Mus.* XXII, p. 390.

Found in Sikkim, Bengal, South India, Burma, Andamans, Java, Sumatra, Borneo and the Philippines. There are three examples in the Indian Museum under the name *ferruginea* which I think really belong to this species. Prof. Cockerell has shown that the more generally used name *rufescens* will have to be sunk in favour of *tranquebarica*. He has also noted its crepuscular habits.

Xylocopa caerulea Fabr.

This beautiful species has been found in Sikkim, Burma, Ceylon, Annam, Sumatra, Borneo, Java and New Caledonia.

Xylocopa flavonigrescens Smith.

1918. *Xylocopa flavonigrescens*, Cockerell, *Entomologist*, LI, p. 104.

The Zoological Survey possesses examples from Sikkim, Sylhet, Tenasserim, Ton-Kin and Malacca. Meade-Waldo, basing his opinion on the male, thought Cameron's *malayana* (*Proc. Zool. Soc. Lond.* 1901, p. 32) to be the same as this species, but Prof. Cockerell notes that a female from the island of Penang is the same as *X. malayana*.

Xylocopa nitidiventris, X. dubiosa and **X. convexa** Smith.

1878. Smith, *Scient. Res. 2nd. Yark. Miss.* (*Hym.*) pp. 7 and 8.

The types of these species, described from the neighbourhood of Yangihissar in Yarkand, are in the collection of the Indian

[1] *Ann. Mag. Nat. Hist.* XIV, p. 404, 1914.

Museum. The U.S. National Museum has specimens of *X niti-diventris* from Kukier, Eastern Turkestan.

Subfamily *BOMBINAE*.[1]

Bombus montivagus Smith.

The Indian Museum has examples from Upper Tenasserim and Take-pum Mt. on the Chinese Frontier in N E. Burma.

A form has also been taken in Onari in British Garwhal, 11,000 ft., which has the colour of the pubescence on the apical three segments of the abdomen almost snow-white and not fulvous red.

Bombus lapidarius var. tunicatus Smith.

1897. *Bombus tunicatus*, Bingham, *Faun. Brit. Ind. Hym.* I, p. 549.
1910. *Bombus tunicatus*, Cockerell, *Ann. Mag. Nat. Hist.* V, p. 417.
1916. *Bombus lapidarius* var. *tunicatus*, Meade-Waldo, *Ann. Mag. Nat. Hist.* XVII, p. 467.

Following Meade-Waldo I consider *tunicatus* and Cockerell's *gilgitensis* to be varieties of the European *B. lapidarius* Linn. The Museum possesses specimens of the former variety from Garwhal, Simla Hills, Mussoorie, Nepal, and two examples from Calcutta. In *Nature* for May 19th, 1921, I recorded the capture of the two Calcutta examples and mentioned having seen what was probably a species of *Bombus* at the base of the Eastern Himalayas, as "bumble bees" are supposed never to descend below 3,000 ft. Burkill (*Journ. As. Soc. Beng.* (*n. s.*) II, p. 521, 1906) found *B. haemorrhoidalis* common in the N.W. Himalayas at 1,600 ft., but the capture of *Bombus* actually in the plains is astonishing, and it is probable that such an incident may never occur again, though I originally mentioned that these bees probably occur, very rarely, in the plains. There is an old record of *B. orientalis* in Calcutta which I think must be authentic; but as to how these strictly hill-species have been found here I can offer no explanation other than that these species of *Bombus* probably nest in the ground and have been conveyed here through the agency of man.

A fly, *Criorhina imitator* of the family Syrphidae, closely resembles this species and the case appears to be one of real mimicry. Brunetti in his original description (*Rec. Ind. Mus.* XI, p. 237, 1915) stated that it was a mimic of the bee *Bombus trifasciatus* (as understood by Bingham), but I think it will be admitted that it resembles *tunicatus* more closely in the light pubescence on the anterior parts of the thorax, on the scutellum, on the basal abdominal segments, and in the colour of its wings and legs. The pubescence on the apical abdominal segments is also reddish, but unfortunately, it is not quite so dense as in the bee it resembles. Hingston in *A Naturalist in Himalaya* (Witherby: 1920, p. 184) notices the resemblance of *Bombylius* to *Bombus* and of a species

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[1] As the use of the term *Bremus* for *Bombus* is dependent on the validity of the "Erlangen" list, and this is still a debatable point I have preferred to use the more generally known name.

of *Bombylius* to *B. lapidarius* var. *tunicatus*. I have never noticed this myself and judging from his description I think it just probable that his *Bombylius* is really a *Criorhina*.

Bombus eximius Smith.

The Darjiling District, Khasi Hills, Shillong, and Mong-wan in W. China may be added to the localities given by Bingham.

Bombus flavescens Smith.

The Darjiling District, Nepal and Kumaon may be added to the localities given by Bingham.

Bombus funerarius Smith.

There are specimens in the Indian Museum from the Western Himalayas. Col. Bingham remarks that individuals with the pubescence on the apical three segments bright orange-red instead of greyish have only been found in Sikkim, but I have seen an example from the W. Himalayas.

Bombus alienus Smith.

1897. *Bombus? vallestris*, Bingham, *Faun. Brit. Ind. Hym.* I, p. 553.
1916. *Bombus alienus*, Meade-Waldo, *Ann. Mag. Nat. Hist.* XVII, p. 467.

This species (omitted from the "Fauna") was taken in October, 1903, by Mr. R. E. Turner in Shillong. *B. vallestris* agrees fairly well with the description of *alienus*, but as Smith's type of the latter species is not available in Calcutta, and his type and? cotypes of *vallestris* in the Indian Museum are almost unrecognisable, I can offer no definite opinion. Meade-Waldo says that it is probable that *vallestris* is synonymous with *alienus*.

Bombus Bhaemorrhoidalis Smith.

The Museum possesses specimens from several localities in the Eastern and Western Himalayas.

Bombus orientalis Smith.

To Mr. Paiva's list of the specimens in the Indian Museum (*Rec. Ind. Mus.* VIII, p. 80, 1912) I may add Yokohama and? Calcutta.

Bombus longiceps Smith.

1910. *Bombus longiceps*, Cockerell, *Ann. Mag. Nat. Hist.* V, p. 505.
1916. *Bombus longiceps*, Meade-Waldo, *Ann. Mag. Nat. Hist.* XVII, p. 468.

The Museum possesses a worn specimen which is, I think, the type of this species from Leh in Ladak. It has also been taken by Captain Hingston in Kashmir. I agree with the authors cited that *longiceps* cannot be a variety of *hortorum*.

A REVISION OF THE BURMESE UNIONIDAE.

By B. PRASHAD, *D.Sc., Assistant Superintendent, Zoological Survey of India.*

(Plate II.)

In spite of various eminent malacologists having paid considerable attention to the Burmese Unionidae from early times, our knowledge of these forms was hitherto in a very confused state. Of the earlier authors, references to whose works are embodied in this paper, Benson Gould, Blanford, Theobald and Nevill deserve special mention; all of them with the exception of Blanford, who in 1866 [1] tried to summarize all that was known to date, described numbers of species at various times from collections made in various parts of Burma. The most comprehensive collection of Burmese Unionidae was made by Leonardo Fea in the years 1885–1887 for the Genoa Museum and a detailed paper [2] on these collections was published by Tapparone-Canefri. In the part dealing with the Unionidae thirteen new species and varieties were described and notes were included on twenty-two of the already known species and varieties. A small part of the collection, however, which was probably received after the report was written, was not included in it. Apparently Tapparone-Canefri had to base his work to a very great extent, if not entirely, on the incomplete published descriptions of the earlier authors and on the illustrations in the *Conchologia Indica* of Hanley and Theobald, for most of his identifications are incorrect, this would not have happened if he had had authentically named material for comparison. He referred all his new species to the composite genus *Unio*, and gave elaborate descriptions but did not publish any figures; his work, therefore, has been a great stumbling block in the way of all later work. Simpson [3] tried to remedy this by an examination of the named duplicates of some of these species which the United States National Museum had received by exchange, but did not succeed in many cases owing probably to the small amount of material available. Haas [4] also has tried to deal with some of the species, but the results of his work on the predominent Indo-Burmese genera have not been published as yet.

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[1] Blanford, *Journ. As. Soc. Bengal,* XXXV, pt. i, pp. 134–155 (1866).

[2] Tapparone-Canefri, *Ann. Mus. Civ. Stor. Nat. Genova,* XXVII, pp. 339–355 (1889).

[3] Simpson, *Desc. Cat. Naiades* (Detroit, 1914).

[4] Haas, in Martini and Chemn. *Conch.-Cab. Unio* (in the course of publication).

The author whose work is most open to criticism, however, is Preston, who in two of his works [1] dealt with the Indo-Burmese Unionidae. He had for the basis of these works the entire collection belonging to the Indian Museum, which besides being very rich in specimens of various species, is specially valuable because of the many type-specimens or of specimens from type-localities, in many cases named or seen by the authors of the species. Another feature of the collection is the existence of labels in the hand-writings of the various specialists, of whom Blanford, Theobald and Nevill deserve special mention. Nevill in particular had rearranged the whole collection and given provisional names to species and varieties which he considered as new. Preston without any further work accepted Nevill's identifications and under his manuscript names described these species or varieties as new. He did not even attempt to sort out the specimens of different species where Nevill had left large series mixed up, but labelled all the specimens in one lot according to Nevill's label which he found with it. In attempting to revise Preston's work I found that it was quite impossible adequately to work out the Burmese forms without an examination of Tapparone-Canefri's type-specimens, and I applied to Dr. R. Gestro of the Genoa Museum. He was not only kind enough sent me the whole of Fea's Burmese collection on loan, but also generously presented to the Indian Museum specimens of a number of the species, duplicates of which were still available. This kindness on Dr. Gestro's part, for which I am greatly indebted to him, has made it possible for me to assign T.-Canefri's species to their proper generic and specific position. I have besides carefully gone through the large collections of Indo-Burmese Unionidae already in the Indian Museum.

The results of the work may be briefly summarized here. Most of the forms described by T.-Canefri and Preston were found to be referrable to already known species and I have not come across any new forms. Notes are given on the generic position, relationships, structure and geographical distribution of the twenty-six species and varieties (excluding *M. woodthorpi*, Godwin-Austen) which I am now able to recognize as being endemic in Burma. They belong to the following genera, *Margaritanopsis*, Haas ; *Indonaia*, Prashad ; *Oxynaia*, Haas ; *Physunio*, Simpson ; *Pseudodon*, Gould ; *Trigonodon*, Conrad ; *Indopseudodon*, Prashad ; *Parreyssia*, Conrad ; *Lamellidens*, Simpson and *Trapezoideus*, Simpson.

Genus **Margaritanopsis** Haas.

1913. *Margaritanopsis*, Haas, *Nachr. Deutsch. Malakozool. Ges.* LXV, p. 33.
1913. *Margaritanopsis*, Haas, in Martini and Chemnitz *Conch. Cab. Unio*, p. 121.
1914. *Margaritana* (in part) Simpson, *Descr. Cat. Naiades*, p. 511.

[1] Preston, *Rec. Ind. Mus.* VII, pp. 279–308, pl. viii (1912) and *Faun. Brit. Ind. Freshw.-Moll.* pp. 134-195 (1915).

Haas erected this genus for *Unio laosensis* Lea in 1913, but Simpson considers that the species is an undoubted *Margaritana* and that the new genus is not justified. The genus, however, appears to be well characterized and I agree with Haas in separating *M. laosensis*, with its peculiar distribution in Cambodia, Siam and Burma, from the other species of the genus *Margaritana*. Godwin-Austen has recently described another species from the Shan States under the name *M. woodthorpi* [1], but of this I have seen no specimens.

Margaritanopsis laosensis (Lea).

Pl. II, figs. 1–4.

1863. *Unio laosenis*, Lea, *Proc. Acad. Nat. Sci. Philadelphia* VII, p. 190.
1913. *Margaritanopsis laosensis*, Haas, *op. cit.*, p. 33.
1913. *Margaritanopsis laosensis*, Haas, *op. cit.*, pp. 122, 123, pl. vii, figs. 1, 2.
1914. *Margaritanopsis laosensis*, Simpson, *op. cit.*, pp. 520, 521.

My reasons for agreeing with Haas in keeping this species in his new genus *Margaritanopsis* are based on an examination of four specimens collected by Fea in the Karin Hills, Burma, at an altitude of 1000–1200 feet and labelled *Unio sella* T. Canefri, a manuscript name only as the species was never described as such. These specimens, as was rightly considered by Haas, are referrable to this species and are of special interest because they beautifully illustrate the changes that take place in the structure of the hinge during the growth of the young into the adult shell, changes which appear to be characteristic of the genus.

The young shells are somewhat rhomboidal and only show a beginning of the arcuate outline of the ventral margin of the adult shells. They are thin and not at all solid. The pseudocardinals in the right valves of the young shells are lamellar, thin, and lie one above the other; in the adult shell the upper or anterior becomes very thick, somewhat knob-like and lies just next to the scar of the anterior adductor muscle, the lower (or now the posterior) comes to be more or less in line with the anterior and is separated from it by a fairly deep groove, it now takes the form of an elongated ridge with its anterior edge raised into a trigonal tooth-like structure. In the left valve there is a single lamellar pseudocardinal in the young shells, but in the adult it becomes very thick and divided into two parts—an anterior smaller and somewhat trigonal and a posterior much larger and conical, for interlocking with the teeth of the other valve. I have nothing further to add to Lea's original description of the species and to Haas' elaborate notes on it.

The species described as *Unio rectangularis* by Tapparone, Canefri (*loc. cit.*, pp. 354, 355) is based on a single very young shell. It is undoubtedly to be referred to the genus *Margaritanop-*

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[1] Godwin-Austen, *Rec. Ind. Mus.* XVI, pp. 202–204, pl. xv. (1919).

sis and probably represents another species of the genus. Owing, however, to a single young shell being available I do not feel disposed to consider it as a distinct species but a figure of the unique specimen (pl. II, fig. 5) is published for future reference.

Genus **Indonaia** Prashad.

1918. *Indonaia*, Prashad, *Rec. Ind. Mus.* XV, pp. 148–148, fig. 2.
1921. *Indonaia*, *id.*, *ib.*, XXII, p. 602.

Six species of this genus are known to occur in Burma. Of these *I. caerulea* has a wide distribution throughout India and Burma, *I. bonneaudi* and *I. pachysoma* occur in Assam and Burma, *I. crispisulcata* and *I. chaudhurii* are only known from Burma, while *I. crispata* has a wide range in Burma, Siam and Cambodia.

Indonaia caerulea (Lea).

1889. *Unio leioma*, Tapparone-Canefri, *op. cit.*, p. 344.
1914. *Nodularia caerulea*, Simpson, *op. cit.*, pp. 978–980.
1915. *Nodularia caeruleus*, Preston, *op. cit.*, pp. 136, 137.

As a result of my examination of the large series of specimens of this species in the Indian Museum, I am able to confirm Simpson's conclusion that *Unio gerbidoni* Eydoux, *Unio humilis* Lea, *Unio corrianus* Küster, *Unio leioma* Benson, *Unio pilatus* Lea, *Unio evitatus* Lea, *Unio trirostris* Sowerby and *Unio andersonianus* Nevill (part only) are synonyms of this species.

This is the commonest species of the genus throughout India and Burma and it is represented by a large series of specimens in the Indian Museum.

Indonaia bonneaudi (Eydoux).

1889. *Unio Bonneaudi*, Tapparone-Canefri, *op. cit.*, p. 343.
1914. *Nodularia bonneaudi*, Simpson, *op. cit*, pp. 988, 989.
1915. *Nodularia bonneaudi*, Preston, *op. cit.*, pp. 140, 141.

I have not seen the specimens referred to this species by Tapparone-Canefri, but have no doubt as to his identification.

The species is widely distributed in Assam and Burma and is represented by a large series of shells in the Indian Museum. The specimens show great variation both as regards shape and colour. Normally they are oval or ovate but some are distinctly rostrate posteriorly; in colour they vary from yellowish green to dull brown or even black.

Indonaia chaudhurii (Preston).

1912. *Nodularia chaudhurii*, Preston, *Rec. Ind. Mus.* VII, p. 290.
1914. *Nodularia chaudhurii*, Simpson, *op. cit.*, p. 988.
1915. *Nodularia chaudhurii*, Preston, *op. cit.*, p. 140, fig. 7 (1, 2).

I am not quite certain as to the validity of this species. The only specimens I have seen are the type-series of Preston. They come very near *I. bonneaudi*, but the shells are shorter, more ovate, less inflated and have the sculpture more pronounced. For the present I propose considering this species as distinct, but believe that it will only turn out to be a form of *I. bonneaudi* when more material is collected.

Indonaia pachysoma (Benson).

1914. *Nodularia pachysoma*, Simpson, *op. cit.*, p. 987.
1915. *Nodularia pachysoma*, Preston, *op. cit.*, pp. 139, 140.

I. pachysoma is nearly related to *I. bonneaudi* and *I. caerulea*. From the former it is distinguished by its more elongate, more inflated, but less deep shells, more pronounced umbones and much stronger hinge, while from the latter it differs in having much brighter and more inflated shells and in the entire absence of the radial sculpture on the sides.

The species has practically the same distribution as *I. bonneaudi* and is represented in the Indian Museum by a large series of specimens from the Brahmaputra River, Assam, and the Irrawadi River, Burma.

Indonaia crispata (Gould).

1914. *Nodularia crispata*, Simpson, *op. cit.*, pp. 994, 995.
1915. *Nodularia crispata*, Preston, *op. cit.*, p. 142.

Gould's original description is very short but Simpson has recently given an elaborate description. It is a very characteristic form and is easily distinguished from all other Burmese species of the genus by its sculpture, which consists of green zigzag radial lines interspersed here and there with thicker nodules on a yellowish to brownish ground; the ridges run transversely in the anterior region and vertically in the posterior part of the shell.

In the Indian Museum collection the species is represented by specimens from Bhamo (Burma), Siam and Cambodia.

Indonaia crispisulcata (Benson).

1914. *Nodularia crispisulcata*, Simpson, *op. cit.*, p. 1017.
1915. *Nodularia* (*Radiatula*) *crispisulcata*, Preston, *op. cit.*, pp. 146, 147.

Simpson in 1900 separated this species along with his *N. lima* to form a new section, *Radiatula*, of the genus *Nodularia*; but as I have recently [1] shown there is no justification for separating *I. lima* from species like *I. caerulea* and *I. bonneaudi*. Nothing is known about the anatomy of *I. crispisulcata* and I do not consider the shell characters alone as being sufficient for the separation of this species into a distinct section.

The species, as represented by a large series of shells from Bongong River, Burma, in the Indian Museum, is remarkably constant in the sculpture of the shell.

[1] Prashad, *Rec. Ind. Mus.* XXII, p. 604 (1921).

Genus **Oxynaia** Haas.

1913. *Oxynaia*, Haas, *op. cit.*, p. 34.
1913. *Oxynaia*, Haas, *op. cit.*, p. 152.
1914. *Nodularia* (in part), Simpson, *op. cit.*, p. 115.

Haas established this genus for the species *N. jourdyi*, *N. diespiter*, *N. micheloti* and *N. pugio* of Simpson's composite genus *Nodularia*. Of these I have only seen specimens of *Oxynaia pugio*, but the descriptions of the other species and my examination of the specimens of *O. pugio* justifies Haas' separation of these species into a distinct genus.

Oxynaia pugio (Benson).

1862. *Unio pugio*, Benson, *Ann. Mag. Nat. Hist.* (3) X, p. 193.
1889. *Unio pugio*, Tapparone-Canefri, *op. cit.* p. 344.
1913. *Oxynaia pugio*, Haas, *op. cit.*, pp. 158, 159, pl. xiv, figs. 6, 7.
1914. *Nodularia pugio*, Simpson, *op. cit.*, p. 990.
1915. *Nodularia pugio*, Preston, *op. cit.*, p. 141.

This species has a strongly marked and angled posterior ridge running to the cuneate posterior margin; the shell region lying internal to the ridge between the two valves is nearly flat, but is divided in some specimens by the line of union of the two valves rising in the middle; both the anterior and posterior margins are very short, the posterior being much the shorter of the two and distinctly cuneate owing to the ventral margin sharply rising up to meet the point of union of the posterior ridge; the beaks are elevated but not very full. The hinge is characteristic in that the pseudocardinals in the right valve are double, but the anterior is reduced to a thin, lamellar structure only, while the posterior is thickened into a triangular, conical and more or less canine-shaped tooth; in the left valve also there are two pseudocardinals placed in line with one another, the anterior is small and somewhat conical, the posterior is elongate, ridge-like or triangular and the two are separated from one another by a fairly deep concavity in which the tooth of the corresponding valve fits. Nothing is known about the anatomy of any of the species of the genus *Oxynaia*.

In the Indian Museum the species is represented by a large series of shells from Tenasserim, Pegu, Sawaddy River and from Myadong in Burma.

A single specimen from Arrakan appears to belong to a distinct variety, but with this scanty material I do not feel justified in describing it as such.

Genus **Physunio** Simpson.

1918. *Physunio*, Annandale, *Rec. Ind. Mus.* XIV, p. 138.

In the paper cited above Annandale described two interesting species of this genus from the Inlé Basin. The soft-parts of these were described by Ghosh [1] and further notes on the anatomy were

[1] Ghosh, *Rec. Ind. Mus.* XV, pp. 109–122, pl. xvi (1918).

added by me[1] later. I have nothing further to add regarding these two species (*P. micropteroides* Annandale and *P. ferrugineus* Annandale).

Genus Pseudodon Gould.

1844. *Pseudodon*, Gould, *Proc. Boston Soc. Nat. Hist.* I, p. 161.
1853. *Monodontina*, Conrad, *Proc. Acad. Nat. Sci. Philadelphia*, VI, p. 269.
1914. *Pseudodon* (in part), Simpson, *op. cit.*, p. 1079.
1915. *Pseudodon s. s.* (in part), Preston, *op. cit.*, p. 152.
1919. *Monodontina*, Prashad, *Rec. Ind. Mus.* XVI, pp. 403–408.
1920. *Pseudodon* (subgen. *Monodontina*), Haas, *op cit.*, p. 318.

I am afraid I am responsible for introducing some confusion in the already confused state of affairs regarding this genus. In the paper cited above I revived the generic name *Monodontina* for species like *P. vondembuschiana*, since the animal of *P. chaperi*, which I consider as one of the varieties of this species, was very different from that of *P. salwenianus* (wrongly spelt *salvenianus*) described by me in a previous paper.[2] In the genus *Monodontina* I also included the species *P. inoscularis* as a variety of *P. vondembuschianus*, having through oversight considered *P. salwenianus*, instead of *P. inoscularis*, as the type of the genus *Pseudodon*. Since the genus *Monodontina*, with *P. vondembuschiana* as its type-species, is synonymous with *Pseudodon* with *P. inoscularis* as its type, the former name must give way to the latter, it having been described about nine years after *Pseudodon*. The genus *Pseudodon* as now restricted will include the species or varieties *orbicularis*, *cambodjensis*, *ovalis*, *ellipticus*, *zollingeri*, *vondembuschianus*, *chaperi*, *ponderosus* and *inoscularis*. The specimen which I doubtfully assigned to *cumingii* (*loc. cit.*, p. 408) is not the true *cumingii* and cannot be included here.

Pseudodon vondembuschiana var. inoscularis (Gould).

1919. *Monodontina vondembuschiana* var. *inoscularis*, Prashad, *op. cit.*, p. 408.
1921. *Pseudodon* (*Pseudodon*) *inoscularis*, Haas, *op. cit.*, p. 341, pl. xlii, fig. 7.

In the paper cited above I have given reasons for considering this species as a variety of Lea's *vondembuschiana*, but as I have stated above I made a mistake in adopting the generic name *Monodontina*.

In the Indian Museum collection this variety is represented by two specimens from Tenasserim.

Genus Trigonodon Conrad.

1865. *Trigonodon*, Conrad, *Amer. Journ. Conch.* I, p. 233

In view of the differences in hinge and other shell characters of the species that now have to be assigned to the genus *Pseudodon*,

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[1] Prashad, *Rec. Ind. Mus.* XIV, pp. 183–185, pl. xxii (1918) and XVI, p. 294, fig. 5 (1919). [2] Prashad, *Rec. Ind. Mus* XVI, p. 295, fig. 6 (1919).

the species *peguensis* with its two varieties must now be separated from it. The arrangement, however, is only provisional till the soft parts of these forms are investigated.

Trigonodon peguensis (Anthony).

1900. *Pseudodon crebristriatus* var. *peguensis*, Simpson, *op. cit.* p., 835.
1914. *Pseudodon peguensis*, Simpson, *op. cit.*, pp. 1083, 1084.
1915. *Pseudodon peguensis*, Preston, *op. cit.*, p. 150.

As stated in the notes on the genus above, I have been obliged to revive Conrad's generic name *Trigonodon* for this species and its varieties. The type-species of the genus is *Monocondylaea crebristriatus* Anthony, which I think is no more than a variety of *T. peguensis.*

Simpson in his first work treated this species as a variety of *M. crebristriatus*, but in his Descriptive Catalogue he was doubtful whether the two were distinct. His first course was not correct since, if the two forms are varieties of the same species, the name of the species should be *T. peguensis*, this being the first of the two species described by Anthony.

As a result of my examination of a fair series of specimens of this species and of the form *crebristriatus* from Pegu I am unable to consider the two as distinct species. The latter, however, owing to the shells being more compressed and the sculpture more strongly marked, with the umbones a little more inflated, may be regarded as a distinct variety.

var. crebristriatus (Anthony).

1914. *Pseudodon crebristriatus*, Simpson, *op. cit.*, pp, 1082, 1083.
1915. *Pseudodon crebristriatus*, Preston, *op. cit.*, pp. 150, 151.

There are only two specimens of this form in the Indian Museum collection, from Pegu, the type-locality. They resemble the original description very closely and only differ from typical *T. peguensis* in the points already noted.

var. curvata (Preston).

1915. *Pseudodon peguensis* var. *curvata*, Preston, *op. cit.*, p. 152, fig. 9 (1, 2, 3).

This form, of which I have seen a large series from Pegu, differs from the *forma typica* and the var. *crebristriatus* in having a less ovate shape, distinctly curved ventral margin, hardly projecting umbones and in having only very faint sculpture on the posterior wing.

Genus Indopseudodon, nov.

I have very reluctantly adopted the course of introducing a new generic name for the species *P. salwenianus* and *P. ava*, as the anatomy of the related forms is not known and as so many new subgeneric names have recently been introduced by Haas. Probably my new name may have to be dropped when the exact generic positions of the various subgenera of Haas can be decided by examination of the animals of these species.

The soft parts of this genus were described by me in 1919[1] as those of *Pseudodon*, *s.s.*, based on an examination of the animal of *P. salwenianus*.

Indopseudodon salwenianus (Gould).

1844. *Anodon salwenianus*, Gould, *op cit.*, p. 160.
1914. *Pseudodon salwenianus*, Simpson, *op. cit.*, pp. 1093, 1094.
1915. *Pseudodon salwenianus*, Preston, *op. cit.*, p. 152.
1919. *Pseudodon salwenianus*, Prashad, *op. cit.*, pp. 295, 296, fig. 6 (animal).
1920. *Pseudodon salwenianus*, Haas, *op. cit.*, pp. 341, 342, pl. xliii, fig. 4.

I. salwenianus, as Simpson pointed out in his description of the species, is distinguished from the allied species by its considerable length and by the strong plicated sculpture on the posterior wing.

In the Indian Museum collection it is represented by a fair series of specimens from the Tenasserim River and a shell with the label "Burma," exact locality not stated. No specimens of this species were obtained by Fea.

Indopseudodon ava (Theobald).

1873. *Monocondylaea avae*, Theobald, *Journ. As. Soc. Bengal*, XLII, pt. ii, p. 209, pl. xvii, fig. 15.
1900. *Pseudodon ava*, Simpson, *op. cit.*, p. 839.
1914. *Pseudodon ava*, Simpson, *op. cit.*, p. 1098.
1915. *Pseudodon ava*, Preston, *op. cit.* pp. 153, 154.
1920. *Pseudodon avae*, Haas, *op. cit.*, p. 343, pl. xliii, figs. 5, 6.

Simpson in his first work included this species in his section *Binereus* of the genus *Pseudodon*, but in his recent 'Catalogue' was doubtful as to its exact position though he still retained it in this section. Haas, however, from an examination of an authentic Burmese specimen was able to assign the species to its exact position near *I. salwenianus*. I have before me one of Theobald's specimens from Mandalay and can confirm Haas' conclusions. Theobald's comparison of this species with *cumingi* and *inoscularis* in the remarks at the end of his description is rather unfortunate as the species is not related to either of them.

Genus Parreyssia Conrad.

1914. *Parreysia*, Simpson, *op. cit.*, pp. 1103, 1104.
1919. *Parreysia*, Prashad, *op. cit.*, p. 292, fig. 3.

Eight species of this genus are now known from Burma. Of these only *P. smaragdites* occurs in Assam as well, all the others

[1] Prashad, *Rec. Ind. Mus.* XVI, pp. 295, 296, fig. 6 (1919).

being confined to Burma. Most of these Burmese species, though they show near relationships with the other Indian species of the genus, form a definite group among themselves.

Parreyssia bhamoensis (Theobald).

1873. *Unio bhamoensis*, Theobald, *Journ. As. Soc. Bengal* XLII, pp. 207, 208, pl. xvii, fig. 1.
1876. *Unio bhamoensis*, Hanley and Theobald, *Conch. Ind.* p. 62, pl. clv, fig. 2.
1878. *Unio bhamoensis* (in part), Nevill, in Anderson's *Zool. Res. Yunnan Exped.* p. 900.
1890. *Unio bhamoensis*, Paetel, *Conch Sam.* III, p. 146.
1899. *Unio bhamoensis*, von Martens, *Arch. Naturgesch.* LXV, pp. 38, 39, pl. v, figs. 2, 4.
1900. *Parreysia bhamoensis* (in part), Simpson, *Proc. U.S. Nat. Mus.* XXII, p. 483.
1914. *Parreysia bhamoensis*, Simpson, *Descr. Cat. Naiades*, pp. 1111, 1112.
1915. *Parreysia* (*Parreysia*) *bhamoensis*, Preston, *Faun. Brit. Ind. Freshw. Moll.* p. 163.

The type-specimen of this species from Bhamo, with the label "*U. Bhamoensis* n. sp." written in Theobald's hand, is preserved in the Indian Museum collection. The species was stated to be a rare one, and Theobald considered it and *U. mandelayensis*, the species described next to it, to form "a natural little subgroup of osculent species," which, however, he did not feel "justified in separating from the great Indian *corrugatus* group." Nevill, while working out the Yunnan collections, did not agree with Theobald's conclusions and united the two species *U. bhamoensis* and *U. mandelayensis* under the former name. Tapparone-Canefri,[1] in his paper on the Burmese molluscs collected by Fea, agreed with Nevill in his interpretation of Theobald's two forms, but wrongly selected the name *U. mandelayensis* for the species. I have examined one of Tapparone-Canefri's specimens and find that it is a true *mandelayensis*. Von Martens, who published good figures of this species, considered the species *U. bhamoensis* as distinct from *U. mandelayensis*. Simpson in his first work united the two species under the name *P. bhamoensis*, and in this was followed by Preston; in his later work, however, having examined more specimens, he rightly regarded the two species as distinct.

I have examined the types of the two species besides a large series of specimens in the Indian Museum and find the following differences between the two species:—(i) The shell of *P. bhamoensis* is only sub-triangular as opposed to the distinctly triangular shell of *P. mandelayensis*, (ii) the beaks in *P. bhamoensis* are high but not placed well forwards, (iii) in young shells of *P. bhamoensis* the beaks and the umbonal region have only a faintly marked zigzag radial sculpture which extends over the posterior wing and a little on the anterior side, but no tubercles

[1] Tapparone-Canefri, *Ann. Mus. Civ. Stor. Nat. Genova*, XXVII, p. 342 (1889).

are ever developed; in *P. mandelayensis* on the other hand the tubercles are always distinctly developed and the sculpture is much coarser, and (iv) the hinge of *P. bhamoensis* has lamellar pseudocardinals which are not very thick, not at like tooth-like and only slightly ragged.

In the Indian Museum collection the species is represented by the type-specimen from Bhamo and a fair series of specimens of all ages from Sagaing, Zayleyman and Tavoy in Burma.

Parreyssia mandelayensis (Theobald).

1873. *Unio mandelayensis*, Theobald, *op. cit.*, p. 208, pl. xvii, fig. 2.
1876. *Unio mandelayanus*, Hanley and Theobald, *op. cit.*, p. 62, pl. cliv, fig. 4.
1878. *Unio bhamoensis* (in part), Nevill, *op. cit.*, p. 900.
1889. *Unio mandelayensis*, Tapparone-Canefri, *op. cit.*, p. 342.
1890. *Unio mandelayensis*, Paetel, *op cit.*, p. 158.
1899. *Unio mandelayensis*, von Martens, *op. cit.*, p. 38.
1900. *Parreysia bhamoensis* (in part), Simpson, *op. cit.*, p. 843.
1914. *Parreysia mandelayensis*, Simpson, *op. cit.*, pp. 1112, 1113.
1915. *Parreysia* (*Parreysia*) *bhamoensis* (in part), Preston, *op. cit.*, pp. 163, 164.

The question of the validity of this species as distinct from *P. bhamoensis* has been discussed already in the account of the latter species, and I would only note here the distinguishing features of the species.

The shell is triangular with a very high and forwardly placed beak, the beak and the umbonal region are both very strongly sculptured and often have distinct tubercles or even spines developed in this region. The hinge is very strong, with compact, thick and distinctly tooth-like pseudocardinals.

I have examined a specimen from Theobald's collection, which is the one figured by him in the paper cited above and is probably the type of the species. Besides I have examined one of the specimens named by Tapparone-Canefri, and other specimens in the Indian Museum collection from Bhamo, Sheinmagah, Maydong and Pegu in Burma.

Parreyssia houngdaranicus (Tapparone-Canefri).

Pl. II, fig. 6.

1889. *Unio houngdaranicus*, Tapparone-Canefri, *op. cit.*, p. 341.
1900. *Parreysia tavoyensis* var. *triembolus* (in part), Simpson, *op. cit.*, p. 844.
1914. *Parreysia tavoyensis* var. *triembolus* (in part), Simpson, *op. cit.*, pp. 1115, 1116.
1915. *Parreysia tavoyensis* var. *triembolus* (in part), Preston, *op. cit.*, p. 167.

Simpson, on the basis of a specimen labelled *U. houngdaranicus* from Fea's collection in the U.S. National Museum, placed *U. houngdaranicus* in the synonymy of what he called *Parreysia tavoyensis* var. *triembolus*, but from his remarks it appears that he was not quite certain as to the correctness of his conclusions.

As a result of a careful examination of Tapperone-Canefri's type-specimen of the species and the forms with which Simpson included it, I am of opinion that Simpson's conclusions are quite untenable. Not only is the species quite distinct from Benson's *Unio triembolus*, but it also has no relationship whatsoever with Gould's *Unio tavoyensis.* It is on the other hand to be grouped with species like *U. bhamoensis* and *U. mandelayensis*, forms in which the anterior margin is greatly shortened, the beak placed far forwards and the posterior side drawn out into a cuneate or elliptical lobe. The species may be redescribed as follows:—

Shell subrhomboidal to subovate, moderately inflated, subsolid, inequilateral; beaks high and full, very forwardly placed and recurved outwards and downwards, with a fairly deep cavity, sculptured irregularly with low zigzag transverse bars extending over a little more than the depth of the shell; posterior ridge only feebly marked; dorsal margin slightly arched, somewhat truncate; anterior margin very short, rapidly curving inwards between the umbones in the lunule region and regularly curving below over the podium to meet the nearly straight or slightly arcuate ventral margin; posterior margin longer than the anterior, sharply truncate and rather slanting; epidermis dark brown to black, somewhat shining; ligament prominent, of an amber to chocolate brown colour; hinge-teeth moderately strong; pseudocardinals slightly ragged, three in the right valve, of which the middle is the largest, and three in the left valve, of which the posteriormost is the best developed; laterals slightly arched, single in the right and two in the left valve; anterior muscle scar deeply impressed, posterior quite shallow; nacre shining white in the umbonal region but with a light bluish tinge below.

The type-series was collected by Fea in the Houngdaran River, Meetan, Tenasserim, Lower Burma.

Parreyssia smaragdites (Benson).

1862. *Unio smaragdites*, Benson, *Ann. Mag. Nat. Hist.*, (3) X, p. 190.
1866. *Unio smaragdites*, Blanford, *Journ. As. Soc. Bengal* XXXV, p. 147.
1876. *Unio smaragdites*, Hanley and Theobald, *op. cit.*, p. 5, pl. x, fig. 5.
1877. *Unio andersoniana* (in part), Nevill, *Journ. As. Soc. Bengal*, XLVI, p. 40.
1878. *Unio andersoniana* (in part), Nevill, *op. cit.*, pp. 901, 902, pl. lxxx, figs. 9, 9*a*, 9*b*.
1889. *Unio smaragdites*, Tapparone-Canefri, *op. cit.*, p. 343.
1890. *Unio smaragdites*, Paetel, *op. cit.*, p. 167.
1899. *Unio smaragdites*, von Martens, *op. cit.*, p. 39.
1900. *Parreysia smaragdites*, Simpson, *op. cit.*, p. 843.
1914. *Parreysia favidens* (in part), Simpson, *op. cit.*, pp. 1109, 1110.
1915. *Parreysia (Parreysia) smaragdites*, Preston, *op. cit.*, p. 163.

Simpson recently regarded *P. smaragdites* as only a synonym of *P. favidens*, but the former species, as is clear from the large series of specimens in the Indian Museum, is quite distinct from the latter. Nevill's large series of *Unio andersoniana* from Burma mostly consists of this species, the remainder being young shells of *Indonaia caerulea.*

P. smaragdites, as was noted by Benson, is characterized by the shells being of a beautiful green colour interspersed with lemon-yellow in the middle, the beaks being submedian and greatly deflected forwards, with deep cavities and a well-marked lunule.

Benson's specimens were taken in the Berhampooter (Brahmaputra) River, Assam, but the species is now known to have a wide range in Burma and Assam.

Parreyssia burmanus (Blanford).

1869. *Unio burmanus*, Blanford, *Proc. Zool. Soc. London*, p. 449.
1875. *Unio vulcanus*, Hanley, *Proc. Zool. Soc. London*, p. 606.
1876. *Unio burmanus* and *Unio vulcanus*, Hanley and Theobald, *op. cit.*, p. 19, pl. xlii, fig. 7 and p. 62, pl. clv, fig. 3.
1878. *Unio burmanus*, Nevill, *op. cit.*, p. 900.
1879. *Unio burmanus*, Tapparone-Canefri, *op. cit.*, p. 343.
1890. *Unio burmanus* and *Unio vulcanus*, Paetel, *op. cit.*, pp. 146 and 172.
? 1899. *Unio burmanus*, von Martens, *op. cit.*, p. 38, pl. v, fig. 5.
1900. *Parreysia burmanus* and *P. vulcanus*, Simpson, *op. cit.*, p. 845 and p. 844.
1912. *Parreysia pernodulosa*, Preston, *Rec. Ind. Mus.* VII, p. 300.
1914. *Parreysia burmanus*, Simpson, *op. cit.*, p. 1120.
1915. *Parreysia burmanus*, *P. pernodulosa*, and *P. vulcanus*, Preston, *op. cit.*, pp. 170, 164, 168.

The only specimen of this species which I have seen from Fea's collection is a half-grown individual. It is decidedly longer in proportion to the height and is abnormal so far as the sculpture is concerned. The nodular sculpture which is a characteristic of the umbones of the young and half-grown shells of this species is quite obsolete and the radial sculpture over the rest of the beak is also feebly developed.

The specimens figured by von Martens (*loc. cit.*) are, in my opinion, not referrable to this species and I have therefore included a reference to his notes on this species with a reservation only. Hanley's *Unio vulcanus*, which was described from a single specimen and later figured by Hanley and Theobald in the *Conchologia Indica*, is undoubtedly based on a young specimen of this species. Some of the half-grown shells from Bhamo in the Indian Museum collection answer to Hanley's description and are quite like the figure of the type-shell in the *Conchologia Indica.* According to von Martens (*loc. cit.*, p. 38), however, the young shells of *Unio tavoyensis* resemble the figure of the type of *U. vulcanus.* Preston's *P. pernodulosa* is based on very young shells of this species.

The types of this species along with a large series of specimens from the type-locality, the Irrawadi River near Bhamo, are preserved in the Indian Museum. The types of Preston's *P. pernodulosa* were collected by Dr. Anderson at Zaleyman in Upper Burma; Fea's specimens were taken at Teinzo in the Mule Stream, north-east of Bhamo.

Parreyssia tavoyensis (Gould).

1843. *Unio tavoyensis*, Gould, *Proc. Boston Soc. Nat. Hist.* I, pp. 140, 141.
1856. *Unio tavoyensis*, Küster, in Martini and Chemnitz, *Conch.-Cab.*, *Unio*, p. 166, pl. xlviii, fig. 2.
1862. *Unio tavoyensis*, Gould, *Otia Conch.* p. 190.
1864. *Unio tavoyensis*, Reeve, *Conch. Icon.* XVI, pl. xiii, fig. 49.
1866. *Unio tavoyensis*, Blanford, *Journ. As. Soc. Bengal* XXXV, p. 148.
1868. *Unio parma*, Benson, Sowerby in *Conch. Icon.* XVI, pl. xclviii, fig. 514.
1870. *Margaron (Unio) tavoyensis*, Lea, *Synonyms*, p. 31.
1876. *Unio parma* and *U. tavoyensis*, Hanley and Theobald, *op. cit.*, p. 61, pl. cliv, fig. 1 and p. 62, pl cliv, figs. 6, 7.
1889. *Unio parma*, Tapparone-Canefri, *op. cit.*, p. 239.
1890. *Unio parma*, *U. savoyensis* and *U. tavoyensis*, Paetel, *op. cit.*, pp. 164, 166, 169.
1899. *Unio tavoyensis*, von Martens, *op. cit.*, pp. 37, 38.
1900. *Parreysia tavoyensis*, Simpson, *op. cit.*, p. 843.
1914. *Parreysia tavoyensis*, Simpson, *op. cit.*, pp. 1114, 1115.
1915. *Parreysia tavoyensis*, Preston, *op. cit.*, pp. 167, 168.

Unio parma Benson, was doubtfully included by Simpson and Preston in the synonymy of this species; having before me, however, one of Benson's original specimens, probably a cotype of the species, I am now able to confirm Simpson's conclusions. Tapparone-Canefri's specimen from Bhamo, referred to in his paper cited above as *U. parma* and another from Tenasserim labelled *Unio sp.* also belong to this species. Simpson considered Benson's *Unio triembolus* as a variety of *P. tavoyensis*, but an examination of one of Benson's type-series of specimens shows that *U. triembolus* is quite a distinct species.

The umbones and a considerable part of the valves in the young shells are covered with a beautiful zigzag sculpture; this however, becomes obsolete with age and hardly a trace of it is left in full-grown individuals.

P. tavoyensis is represented in the collection of the Indian Museum by a large series of shells from Pegu, Tenasserim, Tavoy and Arrakan.

Parreyssia feddeni (Theobald).

1874. *Unio feddeni*, Theobald, *Journ. As. Soc. Bengal* XLII, pt. ii, p. 208, pl. xvii, fig. 3.
1877. *Unio feddeni*, Nevill, *Journ. As. Soc. Bengal* XLVI, pt. ii, p. 38.
1878. *Unio feddeni*, Nevill, *op. cit.*, p. 900.
1900. *Parreysia feddeni*, Simpson, *p. cit.*, p. 165.
1914. *Parreysia feddeni*, Simpson, *p. cit.*, pp. 1113, 1114.
1915. *Parreysia (Parreysia) feddeni*, Preston, *op. cit.*, p. 165.

This species was described by Theobald from shells collected by Mr. F. Fedden and said to have been obtained from the Peemgunga River in Central India. Later Nevill, when reporting on Dr. Anderson's Yunnan collections, stated that the species is tolerably abundant in the rice-fields at Pegu and also at Yaylaymaw in Burma. He also doubted Central India as the provenance of this species from the fact that in the "carefully kept collections of Mr. H. F. Blanford" specimens of *U. feddeni* obtained from Fedden were labelled as from Burma. Since Fedden had collected in both localities the probabilities were that Theobald had mixed up the labels of his specimens. The only specimen of this species now in the Indian Museum collection is from Burma and none of the Central Indian specimens in the collection are referrable to this species It is probable, therefore, that Nevill was correct in considering this species as a true Burmese form.

Theobald's description of the shell of this species, except for the inaccuracy in his description of the hinge pointed out by me in a recent paper [1], is quite complete and needs no amplification.

The species is not represented in Fea's Burmese collections.

Parreyssia feae (Tapparone-Canefri).

Pl. II, figs. 7, 8.

1889. *Unio feae*, Tapparone-Canefri, *op. cit.*, p. 340.
1900. *Parreysia feae*, Simpson, *op. cit.*, p. 814.
1914. *Parreysia feae*, Simpson, *op. cit.*, pp. 1116, 1117.
1915. *Parreysia (Parreysia) feae*, Preston, *op. cit.*, p. 168.

This species, which was described from specimens collected at Meetan in the Houngdaran River, Burma, has never been figured and was hitherto known only from the author's original description and the short notes added recently by Simpson from an examination of some of Fea's specimens. The following additional notes are based on three specimens one labelled "Type" and the other two "Co-types," which have been presented to the Indian Museum by Dr. R. Gestro of the Genoa Museum.

The shells of this species vary in outline. In the young they are subrhomboidal but become more elongate as growth proceeds. The zigzag radial sculpture of the young shells becomes obsolete with age and in fully grown shells is just faintly indicated. The umbones are high, recurved forwards and inwards but not meeting in the middle line; they are often weathered even in half-grown individuals. The young shells are dirty yellow, interspersed with green in the region with raised zigzag sculpture, older shells are yellowish-brown, while the full-grown type is dark chocolate-brown. The nacre is bluish white.

Genus **Lammellidens** Simpson.

1914. *Lamellidens*, Simpson, *op. cit.*, p. 1165.
1919. *Lamellidens*, Prashad, *op. cit.*, p. 293, fig. 4.

A large number of specific and varietal names have been given by previous authors to ordinary variations of the commoner Indo-Burmese forms of this genus, and it has been found necessary on examination of the large collections of Unionids now available, to drop most of these names. I am now able to recognize only six definite species and varieties as occurring within the

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[1] Prashad, *Rec. Ind. Mus.* XIX, p. 713 (1920).

limits of Burma. Three of these *L. generosus*, *L. lamellatus* and *L. scutum* are confined to Burma, while the other three have a much wider distribution.

Lamellidens marginalis (Lamarck).

1876. ? *Unio marginalis* var. *zonata*, Hanley and Theobald, *op. cit.*, p. 20, pl. xliv, fig. 2.
1889. *Unio marginalis* with vars. *subflabellatta*, *cylindrica* (*nec* Hanley and Theobald) and *obesa* (*nec* Hanley and Theobald), *U. protensus* var. *obtusatus*, Tapparone-Canefri, *op. cit.*, pp. 345, 346, 350.
1914. *Lamellidens marginalis*, Simpson, *op. cit.*, pp. 1166–1168.
1915. *Lamellidens marginalis*, Preston, *op. cit.*, pp. 175, 176.
1921. *Lamellidens marginalis*, Prashad, *Rec. Ind. Mus.* XXII, p. 606, fig 6A.

In the paper cited above I have recently given the distinctive characters of the species and have figured the hinge of a typical specimen.

Tapparone-Canefri was apparently unaware of the great variation in the shape and form of this species and gave specific and varietal names to shells which are quite typical. As a result of my examination of Tapparone-Canefri's named specimens I find that five of his names, including his true *marginalis*, must be treated as synonyms. Simpson doubtfully included *Unio dolichorhynchus* and *U. gianelli* in the synonymy of *L. marginalis*, but the former on examination of the type was found to be an elongate specimen of *L. corrianus* and the latter a half-grown *L. scutum*. The various Burmese forms included by Preston as varieties and subspecies of this species, are discussed in the notes on the several species.

L. marginalis has a very wide range of distribution, throughout India, Burma and Ceylon.

Lamellidens corrianus (Lea).

Pl. II, figs. 9-11.

1889. *Unio corrianus*, *U. dolichorhynchus*, *U. protensus* and var. *ellipticus*, Tapparone-Canefri, *op. cit.*, pp. 347–350.
1900. *Lamellidens canefrinus*, Simpson, *op. cit.*, p. 857.
1914. *Lamellidens canefrinus*, Simpson, *op. cit.*, p. 1176.
1915. *Lamellidens canefrinus*, Preston, *op. cit.*, p. 187.
1921. *Lamellidens corrianus*, Prashad, *op. cit.*, p. 609, fig. 29C.

In the paper cited above I have given reasons for considering *L. corrianus* as a species distinct from *L. marginalis*. As a result of my examination of Tapparone-Canefri's types of *U. protensus* and its var. *ellipticus* I find, that both of them should be referred to this species, Simpson's new name *canefricus* must, therefore, be sunk in the synonymy of *L. corrianus*. The type specimen of *L. dolichorhynchus* differs from typical shells of *L. corrianus* in being a little more elongate and the cuneation of the posterior margin is therefore more pronounced, but these differences in the shape of the shell in the case of a variable species such as *L. corrianus* are not enough to warrant the erection of a distinct variety, much less a separate species.

L. corrianus like *L. marginalis*, is widely distributed throughout India and Burma.

Lamellidens jenkinsianus subsp. obesa (Hanley and Theobald).

1920. *Lamellidens jenkinsianus* subsp. *obesa*, Prashad, *Rec. Ind. Mus.* XIX, pp. 170–172, pl. ix, figs. 1, 2.

In the paper cited above I have recently discussed the question of the various forms of *L. jenkinsianus*. In Fea's collection from Burma there is a young specimen of the form *obesa* from Tonghoo. This specimen is one of the few unnamed specimens of Fea's collection and only had the name '*Unio*' on the label. The specimen is from the same locality from which Theobald's specimens, now in the Indian Museum, were collected.

It may also be noted here that the specimens referred to as *Unio marginalis* var. *obesus* by Tapparone-Canefri (*loc. cit.*, p. 346) are, as has been pointed out already, only typical specimens of *L. marginalis*.

Lamellidens generosus (Gould).

Pl. II, figs. 12-17.

1847. *Unio generosus*, Gould, *op. cit.*, p. 220.
1870. *Margaron* (*Unio*) *generosus*, Lea, *Synonyms*, p. 20.
1876. *Unio generosus* and var. *angustior*, *id.*, *ib.*, p. 22, pl. xlvi, figs. 4, 7.
1876. *Unio lamellatus*, var. (*nec* Lea), Hanley and Theobald, *op. cit.*, p. 5, pl. ix, fig. 6.
1889. *Unio marginalis* var. *sonata* (*nec* Hanley and Theobald),[1] var. *tricolor* (*nec* Küster), *U. pulcher* and var. *lamellatiformis*, *U. generosus* and var. *delapsus*, Tapparone-Canefri, *op. cit.*, pp. 346, 347, 350, 351, 352.
1899. *Unio generosus*, von Martens, *op. cit.*, p. 46.
1900. *Lamellidens generosus*, Simpson, *op. cit.*, p. 857.
1912. *Lamellidens marginalis* subsp. *sawaddyensis*, Preston, *Rec. Ind. Mus.* VII, p. 305.
1914. *Lamellidens marginalis* var. *tricolor* and subsp. *sawaddyensis*, *L. Burmanus*[2] and *L. generosus*, Simpson, *op. cit.*, pp. 1168, 1169. 1170, 1175.
1915. *Lamellidens marginalis* var. *tricolor* and subsp. *sawaddyensis*, and *L. pulcher* with var. *lamellatiformis*, Preston, *op. cit.*, pp. 176, 177, 185.

The above elaborate synonymy is based on a careful examination of the type-specimens of Tapparone-Canefri's and Preston's new species and also of authentic specimens of others in the Indian Museum collection.

The specimens identified by both Tapparone-Canefri and Preston as belonging to the var. *tricolor* Küster are undoubtedly

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[1] Hanley and Theobald, *Conch. Ind.* p. 20, pl. xliv, fig. 2. The shell figured is apparently a young specimen of *L. marginalis*.

[2] The second name, *Lamellidens Burmanus*, on the same page (1170) certainly a *lapsus calami* for *L. thwaitesi*.

the young of this species and I have little doubt that Küster's types also belonged to it.

Simpson has recently described this species very fully and I have nothing more to add to his description beyond noting the changes that take place in the colour of the shell during growth. The young shells are fulvous or chocolate-brown in the umbonal region and the greater part of the shell is bordered by a broad band of deep yellow on the inner side, while the dorsal slope together with the posterior wing and the rest of the shell are shining green. As the shell grows the green and yellow gradually disappear and the shells as a whole become dark chestnut to black; the umbonal region, however, is always much lighter. A certain amount of variation is also exhibited by the posterior wing and the posterior margin; in young shells the wing is usually much broader proportionately and more marked, but as the shells increase in size it becomes much narrower; the posterior margin shows much greater variation, it may be only somewhat narrowed or may even take on a distinct cuneate appearance.

In the Indian Museum collection this species is represented by a large series of specimens of all ages from various localities in Burma.

Lamellidens lamellatus (Lea).

1838. *Unio lamellatus*, Lea, *Trans. Amer. Phil. Soc.* VI, p. 19, pl. vi, fig. 16.
1889. *Unio pulcher* var. *ponderosulus*, Tapparone-Canefri, *op. cit.*, pp. 351, 352.
1914. *Lamellidens lamellatus*, Simpson, *op. cit.*, pp. 1172, 1173.

Both Simpson and Preston have wrongly included Lea's *Unio layardi* in the synonymy of *L. lamellatus*. *Lamellidens layardi* has no relationship whatsoever with such Burmese species as *L. generosus*, *L. lamellatus* and *L. scutum*, but is closely allied to *L. marginalis*.

L. lamellatus, as has been noted above, is allied to *L. generosus*, but is distinguished by its general shape, thinner shell, less well developed post-dorsal wing and more delicate hinge-teeth.

I have examined a large series of this species from various localities in Burma, in the Indian Museum collection.

Lamellidens scutum (Sowerby).

1868. *Unio scutum*, Sowerby, *Conch. Icon.* XVI, pl. xciv, fig. 510.
1876. *Unio scutum*, Hanley and Theobald, *Conch. Ind.* p. 22, pl. xlvi, fig. 1.
1889. *Unio gianelli* with var. *degener*, Tapparone-Canefri, *op. cit.*, pp. 353, 354.
1899. *Unio scutum*, with var. *humilior*, von Martens, *op. cit.*, pp. 45, 46.
1912. *Lamellidens marginalis* var. *sublamellata*, Preston, *op. cit.*, p. 305.
1914. *Lamellidens scutum*, Simpson, *op. cit.*, pp. 1173, 1174.
1915. *Lamellidens marginalis* vars. *zonata* (*nec* Hanley and Theobald), *sublamellata*, *scutum* and *humilior*, Preston, *op. cit.*, pp. 177, 181, fig. 19 (1–3).

An examination of the types of *Unio giannelli*, its var. *degener*, *L. marginalis* var. *sublamellata* and shells identified as var. *zonata*, has shown that they are all referrable to this species. The shells of var. *humilior* von Martens also gradually fade into those of the typical form and it is impossible, therefore, to distinguish this variety.

L. scutum has a comparatively less broad, less tumid, but more elongate type of shell than that of either *L. generosus* or *L. lamellatus*—the other two species of this interesting group. The group, so far as is known at present, is confined to Burma.

Genus **Trapezoideus** Simpson.

1921. *Trapezoideus*, Prashad, *Rec. Ind. Mus.* XXII, p. 609.

In the paper cited above I have described the anatomy of this interesting genus. In Burma it is represented by five species, all of which, with the exception of *T. foliaceus*, are endemic in Burma.

Trapezoideus exolescens (Gould).

1843. *Unio exolescens*, Gould, *op. cit.*, p. 141.
1852. *Margaron* (*Unio*) *exolescens*, Lea, *Synoyms*, p. 32.
1862. *Unio exolescens*, Gould, *Otia Conch.*, p. 191.
1866. *Unio exolescens*, Blanford, *Journ. As. Soc. Bengal*, XXXV, pt. i, p. 149.
1876. *Unio exolescens*, Hanley and Theobald, *op. cit.*, p. 43, pl. cvii, fig. 5.
1877. *Unio fragilis*, Nevill, *Journ. As. Soc. Bengal*, XLVI, p. 39.
1878. *Unio foliaceus* var. *fragilis*, Nevill, *op. cit.*, p. 400, pl. lxxx, fig. 8.
1889. *Unio exolescens*, Tapparone-Canefri, *op, cit.*, p. 349.
1899. *Unio exolescens*, von Martens, *op. cit.*, p. 42.
1900. *Trapezoideus exolescens*, Simpson, *op. cit.*, p. 859.
1914. *Trapezoideus exolescens*, Simpson, *op. cit.*, p. 1185.
1915. *Trapezoideus exolescens*, Preston, *op. cit*, p. 195.
1920. *Trapezoideus exolescens*, Haas, *op. cit.*, p. 272.

An examination of Nevill's type of *Unio fragilis* has shown that the species should be referred to *T. exolescens* rather than to var. *comptus* of *T. foliaceus* as Simpson thought (*loc. cit.*, p. 1182) or to *T. misellus* as Haas has done. One of the specimens in Fea's collection is labelled '*Unio microsomus*, T. Canefri, n. sp.,' but this is not referred to in his paper; the specimen is only a young example of *T. exolescens*; the other shells referred by T. Canefri to *T. exolescens* are correctly identified.

The locality of the type-specimens was not certain, but von Martens' specimens were obtained at Mandalay and the Indian Museum specimens are from Bhamo.

Trapezoideus foliaceus (Gould).

1843. *Unio foliacea*, Gould, *op. cit.*, p. 141.
1852. *Margaron* (*Unio*) *foliacea*, Lea, *op. cit.*, p. 39.
1862. *Unio foliacea*, Gould, *op. cit.*, p. 191.
1865. *Unio Peguensis*, Anthony, *Amer. Journ. Conch.* I, p. 351, pl xxv, fig. 2.

1866. *Unio foliaceus* and *Unio peguensis*, *op. cit.*, pp. 148, 154.
1868. *Unio peguensis*, Reeve, *Conch. Icon.* XVI, pl. xcv, fig. 519.
1876. *Unio foliaceus*, Hanley and Theobald, *op. cit.*, p. 19, pl. xlii, fig. 3.
1889. *Unio foliaceus*, Tapparone-Canefri, *op. cit.*, p. 345.
1900. *Trapezoideus foliaceus*, Simpson, *op. cit.*, p. 858.
1912. *Trapezoideus foliaceus*, Preston, *op. cit.*, p. 307.
1914. *Trapezoideus foliaceus*, Simpson, *op. cit.*, pp. 1181, 1182.
1915. *Trapezoideus foliaceus*, Preston, *op. cit.*, p. 193.
1919. *Trapezoideus foliaceus*, Haas, *op. cit.*, pp. 261, 262, pl. xxxii, fig. 3.

Anthony's *Unio peguensis* is synonymous with this species and is not referrable to the genus *Pseudodon* as Simpson believed. Deshayes and Julien's *Unio comptus* is *T. misellus*, and the type of *Unio fragilis*, Nevill, is a specimen of *T. exolescens* (*vide* p. 109). Preston's new variety *zaleymanensis* is not a variety of this species, but is based on young and half-grown shells of *T. misellus.*

T. foliaceus is represented in the Indian Musuem collection by specimens from Bhamo and Zaleyman, Burma.

Trapezoideus dallianus (Frierson).

1899. *Unio foliaceus*, von Martens, *op. cit.*, p. 42.
1913. *Parreysia dalliana*, Frierson, *Nautilus*, XXVI, p. 142.
1919. *Trapezoideus dallianus*, Haas, *op. cit.*, p. 263, pl. xxxii, fig. 4.

Frierson's species, as Haas has pointed out, is a *Trapezoideus* and not a *Parreyssia* as the author of it thought. Haas has also, I think, rightly referred von Martens' specimens of *T. foliaceus* to this species.

In the Indian Museum there is a single right valve from Burma, exact locality not stated, which belongs to this species.

Trapezoideus misellus (Morelet).

1912. *Trapezoideus foliaceus* var. *zaleymanensis*, Preston, *op. cit.*, p. 307.
1915. *Trapezoideus foliaceus* var. *zaleymanensis*, Preston, *op. cit.*, p. 194.
1919. *Trapezoideus misellus*, Haas, *op. cit.*, pp. 266–270, pl. xxxii, figs, 6–9, pl. xxxiii, figs. 1–5.

Haas has given the complete synonymy of this species quite recently. However, he wrongly included in it Nevill's *Unio fragilis,* the type of which, as I have stated already, is *T. misellus*, and he did not include in the synonymy Preston's var. *Zaleymanensis* of *T. foliaceus*, which was described from young and half-grown shells of this species.

The species is represented in the Indian Museum collection by a fair series of specimens of all ages from Tenasserim, the Irrawadi River, Zaleyman and Bhamo.

Trapezoideus subclathratus (v. Martens).

1919. *Trapezoideus subclathratus,* Haas, *op. cit.*, pp. 270–272, pl. xxiii, fig. 6.

Careful examination of a single specimen of this form taken at Sheinpagali, Burma, leaves no doubt in my mind that, as Haas correctly states, this species is distinct from *T. misellus*, of which von Martens considered it to be a variety.

EXPLANATION OF PLATE II.

All figures are direct photographs of dry shells.

Margaritanopsis laosensis (Lea).

FIGS. 1–4.—Shells of various ages, forming the type-series of *Unio sella*, Tapparone-Canefri : ×½.

Margaritanopsis sp.

FIG. 5.—Type-shell of *Unio rectangularis*, Tapparone-Canefri : ×½.

Parreyssia houngdaranicus (Tapparone-Canefri).

FIG. 6.—Type-shell from Houngdaran River, Burma : natural size.

Parreyssia feae (Tapparone-Canefri).

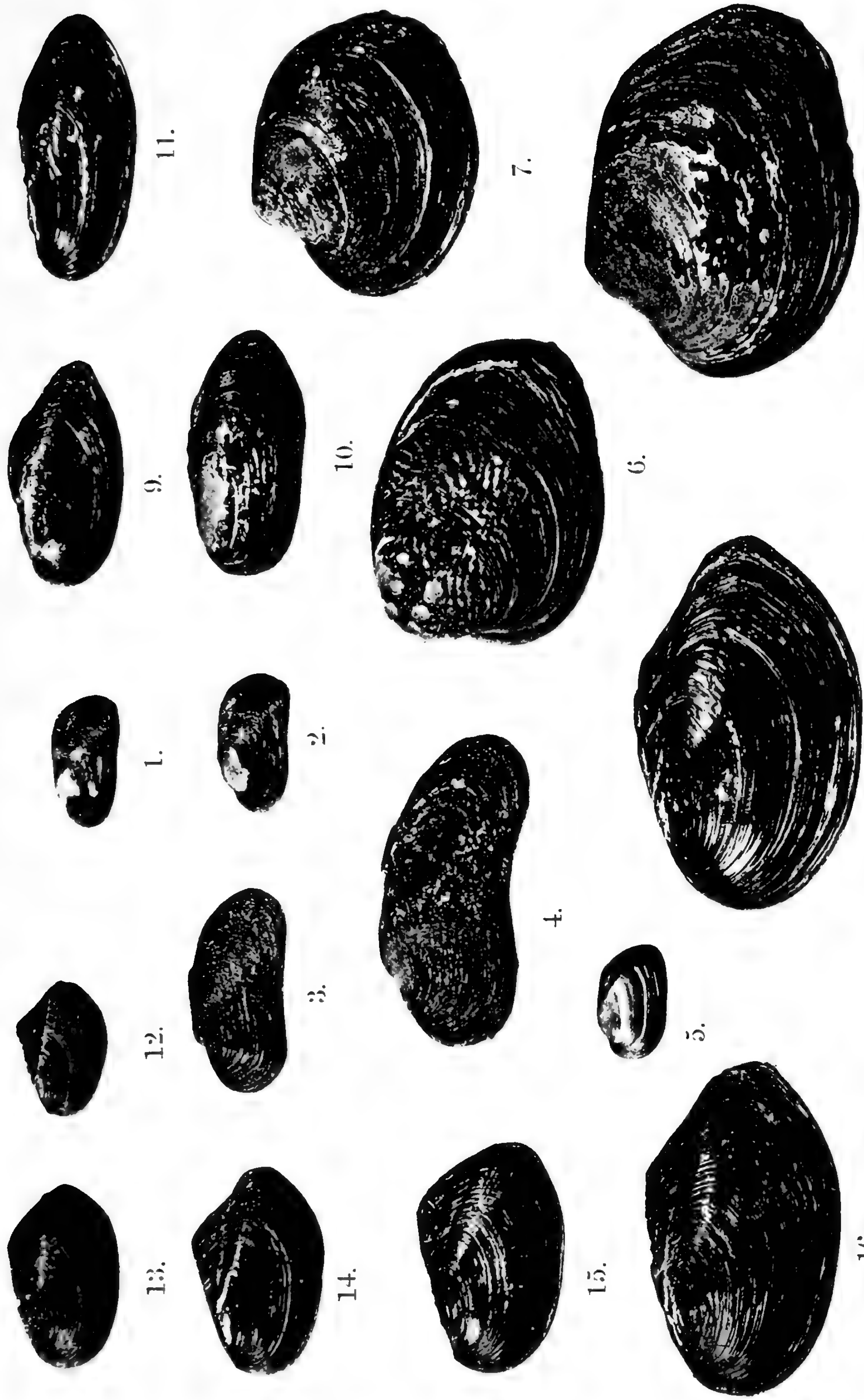
FIG. 7.—Adult shell from Meetan, Burma: natural size.
,, 8.—Type shell from the same locality : natural size.

Lamellidens corrianus (Lea).

FIG. 9.—Type-shell of *Unio protensus*, Tapparone-Canefri : ×½.
,, 10.—Type-shell of *Unio protensus* var. *ellipticus*, Tapparone-Canefri : ×½.
,, 11.—Type-shell of *Unio dolichorhynchus*, Tapparone-Canefri : ×½.

Lamellidens generosus (Gould).

FIG. 12.—Young shell of *L. marginalis* subsp. *sawaddyensis*, Preston : ×½.
,, 13.—Specimen identified as *Unio marginalis* var. *tricolor* by Tapparone-Canefri : ×½.
,, 14.—Half-grown specimen of *L. marginalis* subsp. *sawaddyensis*, Preston : ×½.
,, 15.—Type-shell of *Unio pulcher*, Tapparone-Canefri : ×½.
,, 16.—A shell identified by Preston as *L. marginalis* var. *sublamellata* : ×½.
,, 17.—Type-shell of *L. marginalis* subsp. *sawaddayensis*, Preston : ×½.



BURMESE UNIONIDÆ.

S. C. Mondul, photo.

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NOTES ON CRUSTACEA DECAPODA IN THE INDIAN MUSEUM.

XV. PONTONIINAE.

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The Pontoniinae form one of the four subfamilies into which the Caridean family Palaemonidae is divided; the other three are the Palaemoninae, the Desmocaridinae and the Typhlocaridinae. Of the very numerous species known in the family all except three belong to the Palaemoninae and Pontoniinae. The Desmocaridinae comprise only a single species, *Desmocaris trispinosus* (Aurivillius), found in freshwater streams in West Africa, and Sollaud[1] who first drew attention to its peculiar characters regards it as the most primitive known Palaemonid. The Typhlocaridinae include two remarkable blind species, both belonging to the genus *Typhlocaris* Calman,[2] which inhabit waters of subterranean origin in Palestine and Cyrenaica. *Typhlocaris* differs from all other Palaemonidae in the presence of a longitudinal suture in the carapace, resembling that found in certain Penaeidae and in the Thalassinidea.

The Palaemoninae and Pontoniinae are closely related subfamilies, distinguished from the other two by a number of important characters.[3] They differ from one another in two respects. The pleurobranch found in the Palaemoninae above the base of the third maxilliped is invariably absent in the Pontoniinae, with the result that six *large* branchiae are found in the former subfamily as against five in the latter. The telson-tip in the Palaemoninae is usually armed with two pairs of spines and a varying number of plumose setae, whereas in the Pontoniinae there are always three pairs of spines.[4] This character is not an invariable one. There appears to be no real morphological distinction between spines and setae as found at the apex of the telson; in the Pontoniinae the median spines are frequently plumose and I have seen one species of Palaemoninae[5] in which there are three pairs of spines, almost precisely as in the related subfamily.

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[1] Sollaud, *Comptes rendus Acad. Sci. Paris* CLII, p. 913 (1911).

[2] Calman, *Trans. Linn. Soc.* (2) *Zool.* XI, p. 93 (1909); Annandale and Kemp, *Journ. Asiat. Soc. Bengal* (n.s.) IX, p. 245 (1913); Parisi, *Atti Soc. Ital. Sci. nat. Milano* LIX, p. 241 (1920).

[3] The characters of the four subfamilies are summarized by Borradaile, *Trans. Linn. Soc.* (2) *Zool.* XVII, p. 326 (1917).

[4] *Coutierea* is said to possess merely a single pair, but the genus is only known from one specimen. It may prove not to belong to the Pontoniinae.

[5] A remarkable species from South India, allied to *Palaemonetes* and hitherto undescribed.

In working through the large collection of Pontoniinae in the Indian Museum I have derived much assistance from the memoir which Borradaile has recently published [1]; his full lists of references to the species have been most useful to me. On a large number of taxonomic questions, however, I have formed conclusions which differ very widely from those which he has expressed, particularly in regard to the generic subdivision of the group. The latter question, as Borradaile has pointed out, is one of great difficulty. In the course of my work I have repeatedly been struck by the very homogeneous nature of the subfamily as a whole, and it is to this fact that we must turn for an explanation of the apparently trivial characters on which many of the genera have been founded.

The characters used for the generic subdivision of the Pontoniinae contrast very strongly with those employed for the same purpose in certain other families and subfamilies of Caridea. In the Hippolytidae, for example, we find that the genera can be separated by trenchant morphological characters based for the most part on the branchial formula, on the structure of the mandible and on the carpal segmentation of the second peraeopods. We are thus able, in this family, to devise a scheme of classification which should satisfy even the most earnest seeker after phylogenetic truth; we have confidence that our genera form natural groups and that they can be arranged in a manner which will demonstrate their true affinities.

The Pontoniinae present a far more difficult problem. We search almost in vain for important morphological features which will serve to separate the large assemblage of species into natural groups. We are obliged to define our genera on characters of a much inferior order of magnitude and we are often far from certain that they are phylogenetically valid.

This radical difference between two not distantly related groups of Caridea is perhaps to be explained by supposing that the Pontoniinae have succeeded in evolving a structural type that can be adapted without any deep-seated modifications to all needful kinds of environment; whereas the Hippolytidae, with a less useful stock-pattern, must needs undergo drastic change, sometimes assuming the most bizarre forms, in order to equip themselves for particular conditions of life. In this connection it is to be remarked that the Pontoniinae have proved themselves far superior to the Hippolytidae in their ability to accommodate themselves to unusual surroundings.

In subdividing such a homogeneous group as the Pontoniinae it is, I believe, of first importance that the genera should be established on a broad basis and that the characters used in separating them should so far as possible be unequivocal. That the classification of the family has hitherto been greatly lacking in this respect is clear from a study of the literature. As evidence of the confu-

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[1] Borradaile, *Trans. Linn. Soc.* (2) *Zool.* XVII, p. 323 (1917).

sion that has prevailed, it may be mentioned that Balss has recently redescribed the type species of *Periclimenes* as a new form of *Urocaris* and that a single species has been described by Schenkel, Nobili, Lenz and Miss Rathbun—all writers of experience—under the names *Ancylocaris brevicarpalis*, *Palaemonella aberrans*, *Harpilius latirostris* and *Periclimenes hermitensis* respectively.

Borradaile's recent system of classification does little to remove the sources of error. The primary divisions in his synoptic key to the genera depend almost wholly upon habit of body. This character appears to me to possess little generic importance and, inasmuch as the subfamily comprises species with every imaginable gradation of form, between the most slender and the stoutest, it is frequently quite impossible to decide on the section to which any particular form should be allocated.

I have attempted in this paper to devise a more workable arrangement. In so doing I have been led to discard *Urocaris*, *Ancylocaris* and *Periclimenaeus* as distinct genera and to merge all the species belonging to them, together with those of Borradaile's subgenera *Falciger*, *Cristiger*, *Corniger* and *Hamiger* under the single name *Periclimenes*. The large assemblage of species thus constituted is divided into three subgenera, *Periclimenes*, *Periclimenaeus* and *Ancylocaris*, which together comprise the majority of known species of the subfamily. Except for *Harpiliopsis*, which is no doubt identical with *Harpilius*, the remaining genera retain their rank; several, however, are inadequately described and one or two may even prove not to belong to the subfamily.

Whether the new grouping in the *Periclimenes* section demonstrates the real affinities of the species better than the old one is a question on which it is difficult to express a decided opinion. It is clear from the manner in which they are combined that many of the characters which are used in the distinction of species must necessarily be convergent in origin and it is impossible to be certain that this is not also the case with some of those to which I have attached generic or subgeneric significance. The new grouping, however, removes some of the obvious anomalies that have hitherto existed and will, I believe, be found convenient in practice. In proposing this new scheme of classification it will be understood that I disagree with much that Borradaile has said regarding the phylogeny of the group and that my views on the way in which the different genera have originated differ very widely from those which he has illustrated in the form of a phylogenetic tree.

The Pontoniinae are for the most part Indo-Pacific in distribution and the subfamily is almost exclusively marine. The only exceptions to the latter statement are *Periclimenes indicus*, *P. demani* and *P. obscurus*, which frequent lagoons of variable salinity on the eastern side of the Indian Peninsula. The two former species are capable of enduring extreme alterations in salinity and both have been found in water that is quite fresh as well as in pure sea-water. *Periclimenes obscurus* has been found both in the sea and in brackish water. The members of the subfamily occur for the most part in sheltered portions of the littoral zone and are especially abundant in the vicinity of coral-reefs. A small proportion occur in moderate depths, up to 50 fathoms, and a few live in deeper water. The greatest depth from which any Pontoniine is known is 703 fathoms.[1]

The most remarkable feature of the subfamily is the ability its members have shown in forming associations with other animals. In the variety of these associations they excel all other Caridea. Some are found on Sponges, others on Actinians, Alcyonaria and Madrepore corals, a few are to be met with on Asteroids and Echinoids and many live on Crinoids. A considerable number of species occur in the mantle-cavity of Lamellibranch molluscs and some are known from the branchial sac of Ascidians. Many species are, of course, free-living, but the association between a prawn and some other animal can usually be detected only by the collector and unless the facts are carefully noted on the label they are liable to escape notice. I have little doubt that many more species possess these associations than we now realize.

As to the nature of the association we are at present very ignorant. The species that live in Lamellibranchs and in Ascidians find a safe retreat from the perils they would meet outside and through the activities of their hosts are, no doubt, well supplied with food. They are commensals in the strict application of the term and, in so far as they deprive their hosts of a portion of their nutriment, may also be regarded as parasites. In the absence of any evidence that their presence is of advantage to the host, they cannot be called symbiotic in the sense in which the word is generally applied.

The species that live on the giant sea-anemone, *Discosoma*, are probably protected by their host and those that live on Sponges, Alcyonaria, Madreporaria and Echinoderms doubtless obtain the benefit of shelter. The species on *Discosoma* perhaps share the food of their host, but it is not unlikely that those on Alcyonaria feed directly on the polyps and are thus true parasites.

Dr. Asajiro Oka found two remarkable species of *Pontonia* when examining the Indian Museum collection of Tunicates and has pointed out that the size of the prawns indicates that they must have entered the Ascidian in the larval state and grown up to maturity in the branchial sac. In a specimen of *Polycarpa annandalei* Oka, in which the external measurements of the test were 33 mm. × 23 mm. × 19 mm., a male and female of *Pontonia anachoreta*, sp. nov., were found, the prawns being 6·5 and 10·5 mm. in length. From *Ascidia willeyi* Oka, with test 35 mm. × 20 mm. a pair of *Pontonia okai*, sp. nov., 8 and 8·5 mm. in length, was obtained. When it is considered that these Pontoniids are heavily built forms, with one of the chelate legs of the second pair extremely large, it is evident that they could not possibly

[1] A specimen of *Periclimenes laccadivensis* collected by the R.I.M.S. 'Investigator.'

pass through the small apertures in the test of the Ascidian. They are thus, like *Spongicola venusta* in *Euplectella*, perpetual prisoners.

In the course of an extremely interesting note on sex-phenomena in *Pinnotheres*, Orton[1] has pointed out that female crabs are frequently found alone in a mollusc and that males are scarce. This corresponds with my own observations on this and other genera of Pinnotherid crabs in India: single specimens, usually females, are of common occurrence and it is quite exceptional to find two crabs in one mollusc. It is probable, as Orton has pointed out, that the male crabs wander freely and visit the molluscs from time to time in search of females.

Conditions are different with the Pontoniids that live in Lamellibranchs, for in practically every instance a male and female prawn are found together in the same mollusc. From this fact it is perhaps legitimate to infer that, as with the species in Ascidians, the prawns after they are once established in their host never leave it throughout the whole course of their existence.

The animal associations recorded in the Pontoniinae are the following:—

On PORIFERA.

? *Periclimenes impar*, sp. nov.
Pontonia tyrrhena (Petagna).[2]
Typton spongicola Costa.

On COELENTERATA.

On Actiniaria.

Periclimenes brevicarpalis (Schenkel), on *Discosoma*.
,, *inornatus*, sp. nov., on *Discosoma*.

On Madreporaria.

Periclimenes spiniferus de Man.
,, *diversipes*, sp. nov.
Harpilius, probably all species.
Coralliocaris, probably all species.

On Alcyonaria.

Periclimenes investigatoris, sp. nov.
,, *diversipes*, sp. nov.
Dasycaris symbiotes, gen. et sp. nov., on *Pteroeides*
Pontonides beaufortensis (Borr.), on a Gorgonian.
Balssia gasti (Balss), on *Corallium rubrum*.

On ECHINODERMATA.

On Asteroidea.

Periclimenes parasiticus Borr., on *Linckia*.

On Echinoidea.

Periclimenes brocki de Man.
Stegopontonia commensalis Nobili, on *Echinothrix*.

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[1] Orton, *Nature* CVI, p. 533 (1920).

[2] *Fide* Heller. The species usually lives in *Pinna* and it seems to me a little unlikely that it should also occur on sponges.

On Crinoidea.

Palaemonella pottsi (Borr.), on *Comanthus*.
,, *affinis* Zehntner, on *Actinometra*.
"*Palaemonella orientalis* Dana," de Man.
Periclimenes brocketti Borr.
,, *ceratophthalmus* Borr.
,, *cornutus* Borr.
,, *commensalis* Borr., on *Comanthus*.
Pontoniopsis comanthi Borr., on *Comanthus*

In MOLLUSCA LAMELLIBRANCHIATA.

In *Pinna*.
Anchistus inermis (Miers).
,, *miersi* (de Man).
Pontonia tyrrhena (Petagna).
,, *pinnae* Lockington.
Conchodytes biunguiculatus (Paulson).
,, *domestica* (Gibbes).

In *Tridacna*.
Anchistus miersi (de Man).
,, *biunguiculatus* Borr.
,, *spinuliferus* (Miers).
,, *mirabilis* (Pesta).
,, *demani*, sp. nov.
Conchodytes tridacnae Peters.
,, *meleagrinae* Peters.

In *Meleagrina*.
Anchistus miersi (de Man).
Conchodytes meleagrinae Peters.

In *Margaritophora*.
Pontonia margarita Smith.

In *Pecten*.
Conchodytes domestica (Gibbes).

In *Spondylus*.
Anchistus miersi (de Man).

In "clamp-shells."
Pontonia brevirostris Miers.

In ASCIDIACEA.

Pontonia flavomaculata Heller, in *Phallusia*, *Diazona* and *Ascidia*.
,, *ascidicola* Borr.
,, *okai*, sp. nov., in *Ascidia*.
,, *anachoreta*, sp. nov., in *Polycarpa*.

I have been able to include in this paper brief colour descriptions of a number of species which I have observed in the living state. Most of these are based on notes made at Port Blair in the Andaman Is., where the Pontoniid fauna is one of unparalleled richness. Though the colour pattern cannot as a rule be used in taxonomic work, there is no doubt that it is often of specific value and even when the actual tints are variable the distribution of the pigment is frequently constant. A colour description of *Coralliocaris superba* made at Port Blair agrees in a wonderfully exact manner with the coloured figure published by Dana in 1852; had there been any doubts as to the identity of the species the evidence of colour would have been most helpful.

The colouration of many species of Pontoniinae is very striking and there can be little doubt that in some cases it is protective. Potts[1] has observed that the rather strikingly coloured species which live on Crinoids usually harmonize well with their hosts and a remarkable correspondence with the host in both pigment and pattern was noticed by Col. Alcock[2] in a Pontoniid associated with *Pteroeides*.

But protection will not always supply an explanation. Of the two Pontoniids associated with *Discosoma*, one, *P. inornatus*, is protectively coloured; it is semitransparent, without any pigmentation whatever, and can only be detected with difficulty as it crawls among the short tentacles of the Actinian. The other species, *P. brevicarpalis*, though very closely allied, is pigmented in a most remarkable manner and is probably one of the most gorgeous prawns in existence. By reason of its colour it is always excessively conspicuous. *Periclimenes rex*, another species with very brilliant colouration, is perhaps associated with a red and white sponge and it is possible that the colour, though very bright, is protective.

In addition to the rich collection of the Zoological Survey of India, I have been able, thanks to the courtesy of Prof. Ch. Gravier, to examine a number of undetermined specimens belonging to the Paris Museum. Among other interesting species this collection contains a very remarkable prawn for which I have proposed the new genus *Thaumastocaris*. To Dr. W. T. Calman I am indebted for much assistance while working at the British Museum and to Dr. C. Forster Cooper for the opportunity of examining some of the species described by Borradaile.

The types of the new species, unless otherwise noted, are in the collection of the Zoological Survey of India.

Key to the genera of Pontoniinae.

A. Mandibular palp present, usually composed of two segments [rostrum laterally compressed with conspicuous teeth; dactylus of last three legs (? always) simple].
  B. Second maxilliped with podobranch; first pleopod of male with appendix interna [free-living] ... *Urocaridella*, p. 122.
  B'. Second maxilliped without podobranch; first pleopod without appendix interna [free-living or associated with crinoids] ... ... *Palaemonella*, p. 122.
A'. Mandibular palp absent.
  B. Antennal scale well developed.

[1] Potts, *Public. Carnegie Inst. Washington*, no. 212, p. 81 (1915).

[2] Alcock, *A Naturalist in Indian Seas*, p. 14 (1902). The species on which this observation was made is *Dasycaris symbiotes*, gen. et sp. nov.

C. Dactylus of last three legs simple or biunguiculate,[1] but without basal protuberance.
  D. All three maxillipeds with exopods.
    E. Inner lacinia of maxillula narrow; free-living or epizootic on coelenterates or echinoderms.
      F. Carpus of first leg not segmented.
        G. Carapace not areolated; basal antennular segment normal in form; abdominal pleura usually rounded inferiorly.[2]
          H. Rostrum laterally compressed, with conspicuous teeth.
            J. Carapace not depressed [free-living or associated with coelenterates or echinoderms] ... ... *Periclimenes*, p. 134.
            J'. Carapace depressed, often very strongly [associated with corals] ... *Harpilius*, p. 226.
          H'. Rostrum depressed and toothless [associated with crinoids] ... *Pontoniopsis*, p. 239.
        G'. Carapace areolated; basal antennular segment greatly attenuated anteriorly; third to fifth abdominal pleura sharply pointed inferiorly [rostrum laterally compressed, with dorsal teeth; associated with alcyonaria] ... ... *Dasycaris*, p. 240.
      F. Carpus of first leg segmented [rostrum laterally compressed, with teeth; carapace not areolated; ? free-living] ... *Thaumastocaris*, p. 244.
    E'. Inner lacinia of maxillula very broad; endozootic in lamellibranchs or ascidians.
      F. Rostrum laterally compressed in distal half, toothless or with small teeth at apex only; dorsal spines of telson very small [living in lamellibranchs] ... ... *Anchistus*, p. 247.
      F'. Rostrum depressed, toothless; dorsal spines of telson usually large [living in lamellibranchs or ascidians] ... ... *Pontonia*, p. 259.
  D'. Exopods absent from some or all maxillipeds.
    E. Rostrum toothless; carapace not sculptured, without supra-orbital crest; no tooth on first abdominal somite; free-living (?), or associated with gorgonians ... ... *Pontonides*, p. 266.
    E'. Rostrum with teeth; carapace deeply sculptured, with supra-orbital crest on either side armed with teeth; a mid-dorsal tooth on first abdominal somite; associated with red coral ... ... *Balssia*, p. 267.
C'. Dactylus of last three legs simple or biunguiculate[3] and with a large basal protuberance.
  D. Rostrum very long; carapace areolated, with huge antennal and supraorbital spines and with pterygostomian spine; abdominal pleura sharply pointed inferiorly [? free-living] ... *Coutierea*, p. 267.
  D'. Rostrum little if at all longer than scale; carapace not areolated, without supraorbital or pterygostomian spines; antennal spine when present short; abdominal pleura inferiorly rounded

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[1] Biunguiculate in *Periclimenes s. str.*, in *Thaumastocaris* and in some species of *Anchistus* and *Pontonia*.

[2] The only exceptions are found in the genus *Harpilius*

[3] Biunguiculate only in *Conchodytes*.

E. Dactylus of last three legs with basal protuberance double [rostrum toothless, concave above; associated with echinoids] ... *Stegopontonia*, p. 268.

E'. Dactylus of last three legs with basal protuberance single.

F. Rostrum laterally compressed, frequently with teeth; inner lacinia of maxillula narrow; dactylus of last three legs with a single claw and a hoof-shaped basal protuberance; living on corals ... ... *Coralliocaris*,[1] p. 268.

F'. Rostrum depressed, toothless; inner lacinia of maxillula very broad; dactylus of last three legs with two claws and flat basal protuberance; living in lamellibranchs ... ... *Conchodytes*, p. 279.

B'. Antennal scale rudimentary.

C. Rostrum present, with or without teeth; distal lacinia of maxilla well developed; all maxillipeds with exopods; dactylus of last three legs biunguiculate [associated (? always) with sponges] ... *Typton*, p. 286,

C'. Rostrum absent; distal lacinia of maxilla rudimentary; second and third maxillipeds without exopods; dactylus of last three legs simple .. *Paratypton*, p. 286.

In this key Nobili's *Onycocaris*, originally proposed as a subgenus of *Coralliocaris*, is not included (see p. 278). I am not convinced that the two species for which it was founded are related to *Coralliocaris*, and as I have not seen either I prefer to leave their position undetermined for the present. The generic position of a number of other species is doubtful[2]; when they are better known it is probable that some modification will be necessary in the generic arrangement here adopted.

Balss' *Bathypalaemonella*[3] evidently does not belong to the subfamily, as it possesses a series of arthrobranchs in addition to five pleurobranchs.

Of the seventeen genera which I recognise *Periclimenes* comprises by far the largest number of species. No less than eight genera are monotypic and the majority of these are known from single specimens only.

In the keys to the species I have followed Borradaile's example and have in each instance inserted the rostral formula. An expression such as R. 11–14 : 2–3 indicates that the teeth on the upper border of the rostrum vary from 11 to 14 and that there are 2 or 3 teeth on the lower border. The length of a specimen, as given in the descriptive parts, represents the distance between the tip of the rostrum and the tip of the telson with the animal extended as nearly as possible in a straight line. The figures in the text, even when forming part of a single text-block, are not necessarily drawn to the same scale.

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[1] Not including *Onycocaris* Nobili.

[2] In my attempts to readjust the generic classification of the subfamily I have found myself greatly handicapped by our inadequate knowledge of a number of species. It is important that we should have fuller knowledge of *Onycocaris*, of the two species from Japan which Balss referred to *Periclimenes* (see p. 138) and of the three forms attributed to *Coralliocaris* by Miss Rathbun (see p. 268).

[3] Balss, *Zool. Anz.* XLIV, p. 598 (1914).

Genus **Urocaridella** Borradaile.

1915. *Urocaridella*, Borradaile, *Ann. Mag. Nat. Hist.* (8) XV, p. 207.
1917. *Urocaridella*, Borradaile, *Trans. Linn. Soc.* (2) *Zool.* XVII, p. 352.

The presence of the appendix interna on the first pair of pleopods is a very remarkable character of this genus and one in which it differs, I believe, from all other known Caridea. It should be noted, however, that the appendix is to be found on the first pleopods in males only, not in both sexes as implied by Borradaile.

Urocaridella gracilis Borradaile.

1915. *Urocaridella gracilis*, Borradaile, *Ann. Mag. Nat. Hist.* (8) XV, p. 210.
1917. *Urocaridella gracilis*, Borradaile, *Trans. Linn. Soc.* (2) *Zool.* XVII, p. 352, pl. liii, fig. 2.

This species was described by Borradaile from Suvadiva, Kolumadulu and Haddumati Atolls in the Maldives. It is here recorded from the Orissa Coast, the Andaman Is. and the Mergui Archipelago.

Specimens from the Andamans were transparent when alive with brown speckling and with narrow transverse brown bands at the end of the carapace and on the second and third abdominal somites. There were brown patches in the middle and at the tip of the rostrum, on each side of the first abdominal somite, at the tips of the telson and uropods and at the base of the uropods. The antennules, antennae and all the legs were broadly banded with red.

The largest specimens in the collection are ovigerous females about 30 mm. in length.

2183/7.	Off Chilka Lake, Orissa Coast, 11 fms.	'Investigator,' Jan., 1890.	One.
C 342/1.	Port Blair, Andamans, 2–8 fms.	S. Kemp, Feb., 1915; Feb., March, 1921.	Many.
C 343/1.	Mergui Archipelago, 10 fms., 12°40′ N., 98°26′30″E.	'Investigator,' Oct., 1913.	Many.
C 344/1.	Mergui Archipelago, 6 fms., 11°17′20″ N., 98°29′40″ E.	'Investigator,' March, 1914.	Three.

The specimens from Port Blair were caught in bottom nets hauled in Ross Channel and at the mouth of Brigade Creek; those from the Mergui Archipelago, none of which are fully adult, were obtained at night in surface nets.

Genus **Palaemonella** Dana.

1852. *Palaemonella*, Dana, *U. S. Explor. Exped., Crust.* I, p. 582.
1917. *Palaemonella*, Borradaile, *Trans. Linn. Soc.* (2) *Zool.* XVII, p. 356.

Borradaile includes twelve species in this genus, but except for the two originally described by Dana and the three that Borradaile himself named, all require re-examination. In general appearance the species of *Palaemonella* bear an exceedingly close resemblance to those of *Periclimenes*. The only valid distinction between the two lies in the presence of a mandibular palp in the former genus and its absence in the latter. Unfortunately this character is one to which attention is seldom paid, with the result that the generic position of a number of species is doubtful.

Palaemonella laccadivensis Alcock and Anderson does not possess a mandibular palp and is transferred to the genus *Periclimenes*; in *Periclimenes pottsi* on the other hand this appendage is present and the species is in consequence removed to *Palaemonella*. Borradaile's *Palaemonella tridentata* is in my opinion a synonym of Dana's *P. tenuipes* and Zehntner's *Palaemonella amboinensis* is perhaps synonymous with *Periclimenes brevicarpalis* (Schenkel).

Several species with the dactyli of the last three legs biunguiculate have been referred to *Palaemonella*, but the position of all is uncertain.[1]

The five species that I have myself examined may be distinguished thus:—

- *A*. Hepatic spine present.
  - *B*. Distal margin of carpus of second leg toothed or angulate on its inner aspect, but without a large *subterminal* spine.
    - *C*. Antennal scale strongly narrowed distally, with spine extending far beyond apex; a spine at distal end of merus of second leg.
      - *D*. A vestigial supra-orbital spine; propodus of third leg at most 4·5 times length of dactylus; R. 6–8 : 1–3 ... ... *vestigialis*, sp. nov.
      - *D'*. No vestige of supra-orbital spine; propodus of third leg more than 5 times length of dactylus; R. 7 : 2 ... ... *pottsi* (Borr.).
    - *C'*. Antennal scale not narrowed distally, with spine scarcely extending beyond apex; no spine at distal end of merus of second leg; R. 8 : 3 ... *lata*, sp. nov.
  - *B'*. A large subterminal spine on carpus of second leg [antennal scale narrowed distally, with spine extending much beyond apex; a spine at distal end of merus of second leg]; R. 6–8 : 1–3 ... *tenuipes* Dana.
- *A'*. Hepatic spine absent [no spine at distal end of merus of second leg]; R. 6–7 : 1 ... ... *orientalis* Dana.

Palaemonella vestigialis, sp. nov.

(Plate III, fig. 2.)

The rostrum extends beyond the end of the antennular peduncle and reaches about to the apex of the antennal scale. It varies somewhat in depth and is straight for the greater part of its length with the terminal portion sometimes turned a little upwards. On the upper border it bears from 6 to 8 teeth,[2] usually 7; the pos-

[1] A specimen from Australia which Balss (*K. Svenska Vet.-Akad. Handl.* LXI, no. 10, p. 13, 1921) has doubtfully attributed to Nobili's *Palaemonella biunguiculata* bears only four spines at the apex of the telson and probably belongs to the subfamily Palaemoninae.

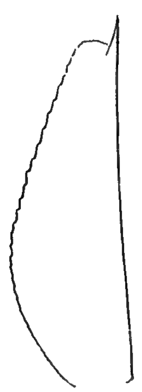
[2] Of thirteen specimens four have 6 dorsal teeth, six have 7 and three have 8.

terior tooth is placed in front of the middle of the carapace, the second is behind the orbit, while the foremost is small and is not far removed from the apex. On the lower border there are from 1 to 3 teeth,[1] usually 2, which are large and placed in the anterior half of the rostral length.

In the position usually occupied in other genera by the supra-orbital spine a small angular prominence or tubercle may be detected and extending downwards from this tubercle to the base of the antennal spine there is a well-defined curved ridge parallel with the orbit. From this ridge the carapace slopes obliquely inwards to the orbital margin, the orbit thus having a broadly bevelled edge. The antennal spine is strong; the hepatic spine is placed behind it, but on a lower level.

The eyes are stout with short, thick stalks. The cornea is a little wider than the stalk and frequently, as in some species of *Periclimenes*, shows two concentric bands of dark pigment. The ocular spot touches the cornea.

The basal segment of the antennular peduncle (text-fig. 2*a*) is broad; the lateral process does not reach the middle of the segment; the terminal spine is rather short and the margin between this spine and the articulation of the second segment is nearly straight. The two distal segments are stout. The free portion of the shorter ramus of the outer flagellum is half or rather less than half the length of the fused basal part, the latter consisting of 8 to 10 segments. The total length of the shorter ramus is equal to or rather less than that of the peduncle. The antennal scale (text-fig. 1) is from 3·3 to 4 times as long as wide, proportionately longest in males, and is strongly narrowed apically. The outer margin is straight or very slightly concave and terminates in a spine which reaches far beyond the end of the lamella.



TEXT-FIG. 1.—*Palaemonella vestigialis*, sp. nov.
Antennal scale of female.

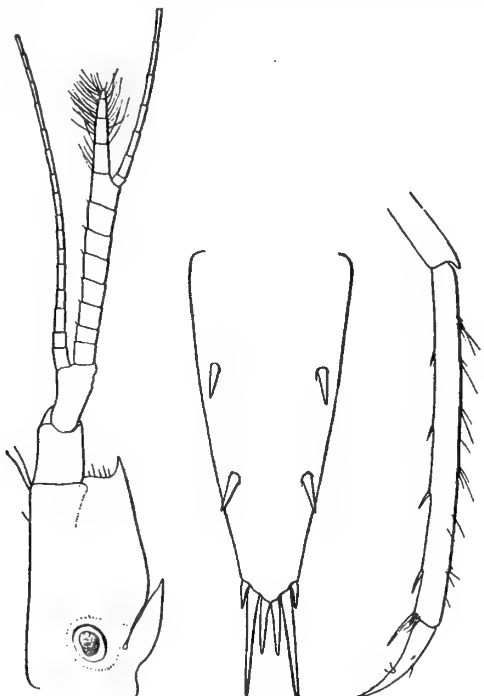
There is a minute arthrobranch at the base of the third maxilliped. The exopod almost reaches the end of the antepenultimate segment and the ultimate segment, excluding the terminal spine, is about three quarters the length of the antepenultimate.

The first peraeopods reach beyond the apex of the antennal scale by considerably more than the length of the chela. The carpus is about equal in length with the merus and is from 1·0 to 1·25 times as long as the chela. The fingers are longer than the palm and are unarmed.

The second peraeopods in adults of both sexes reach beyond the antennal scale by the whole of the chela and carpus. The

[1] Of thirteen specimens two have 1 ventral tooth, ten have 2 teeth and one has 3.

merus bears a strong spine close behind the distal end of the lower margin and is from 5·5 to 6 times as long as wide and from 1·25 to 1·4 times[1] as long as the carpus. The carpus is conical, from 2·8 to 3·2 times as long as its distal breadth, most slender in females. From the distal margin on the inner side there project two small acute processes or teeth, the upper the most conspicuous; the strong subterminal spine found in *Palaemonella tenuipes* is com-



TEXT-FIG. 2.—*Palaemonella vestigialis*, sp. nov.
a. Antennule. *c*. Telson.
b. Last two segments of third peraeopod.

pletely absent (*cf.* text-figs. *7a* and *7b*). Behind the distal edge, especially on the upper side, the carpus exhibits a transverse furrow, while the distal edge itself is somewhat dilated. The chela is from 2·3 to 2·65 times as long as the carpus and is proportionately longest in males. The palm is a little swollen, wider than the distal end of the carpus, 3 times as long as its greatest breadth and from 1·3 to 1·5 times as long as the fingers. The fingers have inturned tips, their cutting edges are unarmed distally, but in the proximal half each bears two teeth, those on the dactylus in advance of those on the fixed finger.

The last three pairs of peraeopods are slender; the fifth reach a little beyond the end of the antennal scale. In the third pair

[1] About equal to the carpus in a female from Mahé.

the merus is from 9 to 10 times as long as broad. The propodite bears spinules on its posterior border (text-fig. 2*b*) and is from 3·5 to 4·5 times as long as the dactylus.

The sixth abdominal somite is about 1·5 times the length of the fifth. The spinules on the dorsum of the telson (text-fig. 2*c*) are so arranged as to divide its length into three equal parts.

Large specimens are about 18 mm. in length.

C 394–5/1.	Port Blair, Andamans.	S. Kemp, March, 1915; Feb., 1921.	Four, including TYPES.
C 396/1.	Cheval Paar, Ceylon.	T. Southwell, Nov., 1910.	Five.
7717/6.	Kabusa I., Mergui.	'Investigator,' March, 1887.	One.
398–9/1.	Tor and Ain Musa, Gulf of Suez.	R. B. S. Sewell, 1916.	Three.

I have also seen three specimens from Mahé, Seychelles, belonging to the Paris Museum (Alluaud coll.).

The specimens from Port Blair were found at low water in rock-pools at Aberdeen and in North Bay. The type-specimens are from the former locality.

A male and female from Port Blair, found on a muddy shore near the mouth of Brigade Creek, differ from the specimens described above in the absence of the vestige of the supra-orbital spine and in the longer dactyli of the last three legs. In the third pair the propodite is only from 2·6 to 3 times as long as the dactylus. In the male the merus of the second peraeopod is about 4·5 times as long as wide and the carpus about 2·5 times as long as its distal width. The male possesses three pairs of spines on the back of the telson; but this is no doubt an abnormality as the teeth are not arranged symmetrically.

C 400/1.	Port Blair, Andamans.	S. Kemp, March, 1921.	Two.

The specimens were found among lumps of dead coral on muddy ground.

Palaemonella pottsi (Borradaile).

1915. *Periclimenes (Falciger) pottsi*, Borradaile, *Ann. Mag. Nat. Hist.* (8) XV, p. 213.

1915. *Periclimenes pottsi*, Potts, *Publ. Carnegie Inst. Washington*, no. 212, p. 82.

1917. *Periclimenes (Falciger) pottsi*, Borradaile, *Trans. Linn. Soc.* (2) *Zool.* XVII, p. 374.

I have examined two specimens, both unfortunately in poor condition, brought by Mr. F. A. Potts from the Torres Straits and find that Borradaile was mistaken in referring the species to the genus *Periclimenes*. The mandibular palp is present and is composed of two segments.

The species is very closely allied to *P. vestigialis*, differing as far as I am able to discover only in the following characters :—

(i) There is no vestige of the supra-orbital spine, though the orbit has a bevelled edge as in the allied species.

(ii) The spine at the end of the merus of the second peraeopod is quite terminal in position.

(iii) The dactylus of the last three peraeopods is much shorter, the propodite being from 5·3 to 5·5 times its length.

These characters are not very convincing. It is possible that other distinctive features will be found in the second peraeopods of the male, for I have only seen one detached leg of the second pair in *P. pottsi* and this appears to belong to a female.

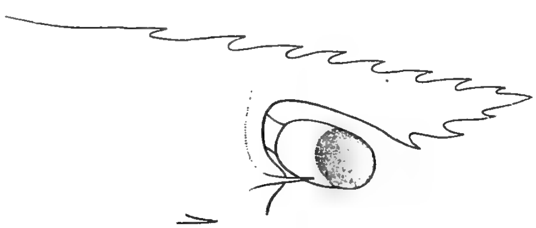
Palaemonella pottsi is purple in colour when alive and is associated with crinoids, whereas *P. vestigialis* is not conspicuously coloured in life and is free-living. There were no crinoids in the localities where the latter species was collected at Port Blair.

The species is known only from the Murray Is. in the Torres Straits.

Palaemonella lata, sp. nov.

This species, which is represented by a single adult male, is closely allied to *P. vestigialis* and *P. pottsi* but differs in the following characters:—

(i) There is no vestige of the supra-orbital spine (text-fig. 3).



TEXT-FIG. 3.—*Palaemonella lata*, sp. nov. Anterior part of carapace.

(ii) The lateral process of the antennular peduncle is longer, extending beyond the middle of the segment and the terminal spine of the basal segment is also longer, reaching much beyond the middle of the second segment (text-fig. 4*a*).

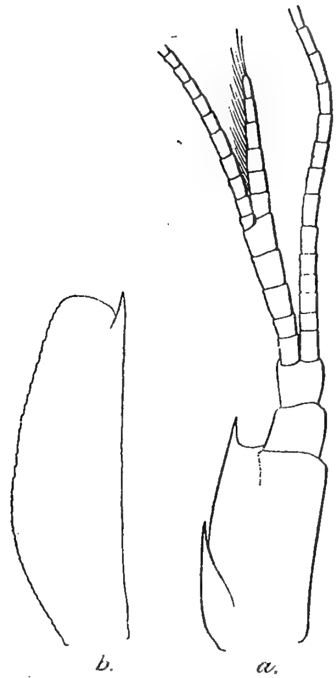
(iii) The outer antennular flagellum is more deeply cleft. The free portion of the stouter ramus is as long as the fused basal part, the latter comprising only 5 segments (text-fig. 4*a*).

(iv) The distal end of the antennal scale is very much broader and the terminal spine reaches scarcely at all beyond the apex of the lamella (text-fig. 4*b*).

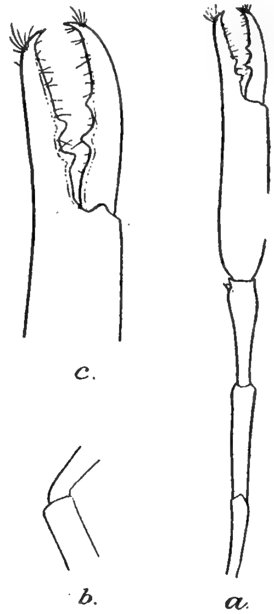
(v) The fingers of the first peraeopod are equal in length with the palm.

(vi) There is no spine at the distal end of the merus of the second peraeopods (text-fig. 5*b*).

In other respects there is little difference. The rostrum reaches beyond the end of the antennular peduncle and is rather



TEXT-FIG. 4.—*Palaemonella lata*, sp. nov.
a. Antennule. *b*. Antennal scale.



TEXT-FIG. 5.—*Palaemonella lata*, sp. nov.

Second peraeopod.
a. In dorsal view.
b. Mero-carpal articulation in lateral view.
c. Fingers.

deep in lateral view. It bears 8 teeth above and 3 below, two of the former being situated on the carapace. The antennal scale is a little more than 3 times as long as wide. The carpus of the first peraeopod is about 1·2 times the length of the chela. In the second peraeopods the merus is a little more than 5 times as long as wide. The carpus bears two conspicuous teeth on the inner side of its distal margin and is slightly less than 4 times as long as its distal breadth. The chela is about 2·5 times as long as the carpus and the palm is nearly 4 times as long as broad. There are two teeth in the proximal half of each finger as in *P. vestigialis*. The last three peraeopods are slender, the fifth reaching well beyond the antennal scale. In the third pair the merus is 10 times as long as wide and the propodus, which bears spinules on its posterior edge, is 3·3 times as long as the dactylus. The telson spines are arranged as in the preceding species.

TEXT-FIG. 6.—*Palaemonella lata*, sp. nov.
Last three segments of third peraeopod.

As in the two preceding species the mandibular palp is composed of two segments, but it differs in that the distal segment is very much shorter than the proximal. This is perhaps merely an abnormality and only one mandible was examined.

The single specimen is about 15 mm. in length. In life it was perfectly transparent except for a few small red chromatophores on the carpus and chela of the second legs.

P. lata is readily distinguished from related species by the broad apex and short terminal spine of the antennal scale and by the absence of the spine at the distal end of the merus of the second peraeopods.

C 401 1. Port Blair, Andamans. S. Kemp, Feb., 1921. One, TYPE.

The specimen was found in a rock-pool at Aberdeen at low water.

Palaemonella tenuipes Dana.

1852. *Palaemonella tenuipes*, Dana, *U. S. Explor. Exped., Crust.* I, p. 582 pl. xxxviii, figs. 3*a–d*.
1898. *Palaemonella tridentata*, Borradaile, *Proc. Zool. Soc. London*, p. 1007, pl. lxiv, figs. 8*a–c*.
1899. *Palaemonella tridentata*, Nobili, *Ann. Mus. civ. Genova* (2) XX, p. 235.
1906. *Palaemonella tenuipes* var. (ann. sp. ?), Nobili, *Ann. Sci. nat., Zool.* (9) IV, p. 70.
1917. *Palaemonella tenuipes* and *tridentata*, Borradaile, *Trans. Linn. Soc.* (2) *Zool.* XVII, pp. 323, 358.
1921. *Palaemonella tenuipes*, Tattersall, *Journ. Linn. Soc., Zool.* XXXIV, p. 383.
? 1921. *Palaemonella tenuipes*, Balss, *K. Svenska Vet.-Akad. Handl.* LXI, no. 10, p. 14.

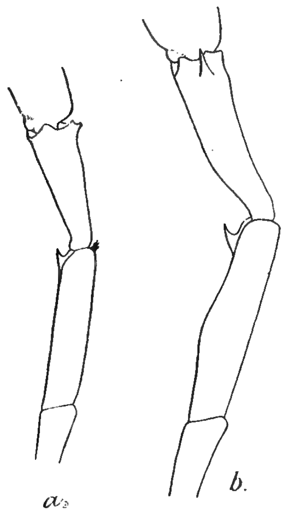
I have examined a single example of this species obtained at Peros Banhos in the Chagos Archipelago. It differs conspicuously form all other species of the genus that I have seen in the possession of a large *subterminal* spine on the upper and inner aspect of the carpus of the second peraeopod in addition to one or two small angular projections on the actual distal margin of the segment. The subterminal spine is clearly shown in Dana's figure.

In determining the specimen in the collection I have derived much assistance from the notes which Tattersall has recently published. I have no doubt that my specimen is specifically identical with those that he examined and I accept his view that they should be referred to Dana's *P. tenuipes*. The identification presupposes a considerable amount of error in Dana's figures, but we have ample evidence that these are not to be trusted in the finer detail now necessary for systematic work on the Macrura.

Tattersall remarks that Borradaile's *P. tridentata* is closely allied to *P. tenuipes* and is doubtfully distinct. I go further and regard the former as a synonym of the latter.

The specimen examined was obtained by Prof. Stanley Gardiner's expedition and was determined by Borradaile as *P.*

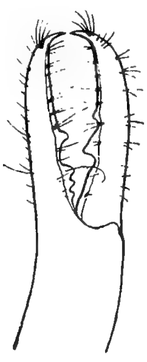
tridentata.' Apart from the fact that it possesses only a single tooth on the lower border of the rostrum, it differs conspicuously from Borradaile's figure in the proportions of the segments of the second peraeopods. The merus is longer than the carpus and much longer than the fingers and the carpus is stouter, only about 3·5 times as long as its distal breadth. Tattersall has given a tabular statement of the proportionate lengths of the segments of the second peraeopod, the figures being derived from his own specimens, from Nobili's measurements and from the illustrations by Dana and Borradaile. The corresponding values for my specimen are merus 1·2, carpus 1·0, palm 1·6 and fingers 0·8. In these proportions the specimen agrees fairly well with those that Tattersall and Nobili examined. The shorter palm in Dana's figure may be due to the less well-developed condition of his specimen; the very short merus in Borradaile's figure is, I believe, an error in drawing. In my specimen, which is a male, the lower border of the merus is sinuous, conspicuously convex in the middle; this character is shown in Borradaile's figure and is probably found only in males. The dentition of the fingers is shown in text-fig. 8.



TEXT FIG. 7.—Merus and carpus of second peraeopod viewed laterally from inner side.

a. Palaemonella vestigialis, sp. nov.
b. Palaemonella tenuipes Dana.

Tattersall's notes and the evidence of my specimen, identified as *P. tridentata* by Borradaile himself, all point to the conclusion that only one species of *Palaemonella* with subterminal carpal spine is at present known.



TEXT-FIG. 8.—*Palaemonella tenuipes* Dana.
Fingers of second peraeopod.

Dana's specimen came from the Sooloo Sea. Borradaile's original example of *P. tridentata* was obtained at Funafuti in the Ellice Is. and he has since recorded the species under the same name from various localities in the Maldives and the Chagos Archipelago. Nobili has recorded a specimen under the name *P. tridentata* from Beagle Bay in British New Guinea. Nobili and Tattersall have examined specimens from the Red Sea, the former from Djibouti and other undetermined localities, the latter from Khor Dongonab and Suakin Harbour.

I look on most other records of *P. tenuipes*[1] with suspicion, but those of Stimpson from Ousima in the Loo-Choo Is., of Miss Rathbun from the Hawaiian Is. and of Balss from N. W. Australia are perhaps trustworthy. No reliance can be placed on de Man's record from Amboina as his specimen did not possess either of the second legs and the identity of Ortmann's specimens from Japan and the Maldives appears to me to be extremely doubtful. Zehntner in recording a specimen from Amboina remarks that the colour is entirely black, a fact not noted elsewhere and possibly not true of real *P. tenuipes*. Heilprin's record from the Bermudas cannot be accepted without corroboration.

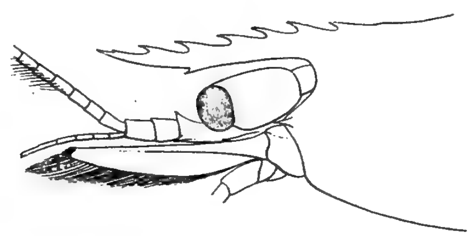
Palaemonella orientalis Dana.

1852. *Palaemonella orientalis*, Dana, *U. S. Explor. Exped., Crust.* I, p. 583, pl. xxxviii, figs. 4*a–d*.

? 1887. *Palaemonella orientalis*, de Man, *Arch. Naturgesch.* LIII, i, p. 552.

The single specimen which I refer to this species exhibits the following characters:—

The rostrum (text-fig. 9) is slender, straight at the base and a little upturned at the tip; it reaches almost to the end of the antennal scale. On the upper border it bears 7 equidistant teeth, the hindmost placed on the carapace, the next a little in advance of the posterior limit of the orbit, and the foremost small and



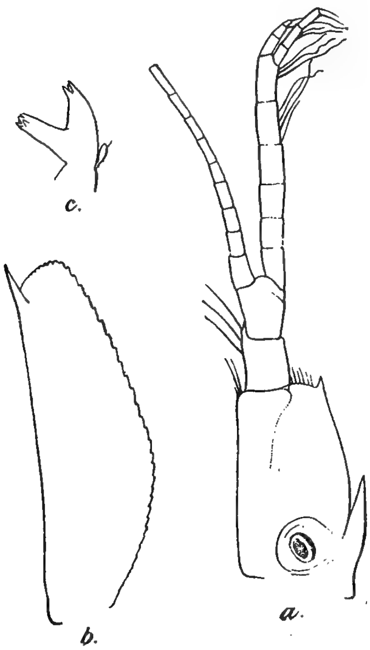
TEXT-FIG. 9.—*Palaemonella orientalis* Dana.
Anterior part of carapace, etc., in lateral view.

situated close to the apex. On the lower border there is a single tooth, placed beneath the fifth of those on the upper edge.

The antennal spine is present, but both the supra-orbital and the hepatic are missing. The eyestalks are swollen and, in the middle, are distinctly wider than the hemispherical cornea. The ocular spot is not visible.

[1] For references see Borradaile, *loc. cit.*, 1917, p. 358.

The lateral process of the antennular peduncle (text-fig. 10*a*) reaches about to the middle of the basal segment. The spine at the outer distal angle of the same segment is short and the margin between this spine and the articulation of the second segment is gently convex. The free portion of the shorter ramus of the outer antennular flagellum is only about one quarter the length of the fused basal part, the latter comprising 6 elongate segments. The antennal scale (text-fig. 10*b*) is narrow at the distal end and widest in the middle; its greatest breadth is a little less than one-third the total length. The outer margin is very slightly concave and terminates in a strong spine which reaches a little beyond the end of the lamella.



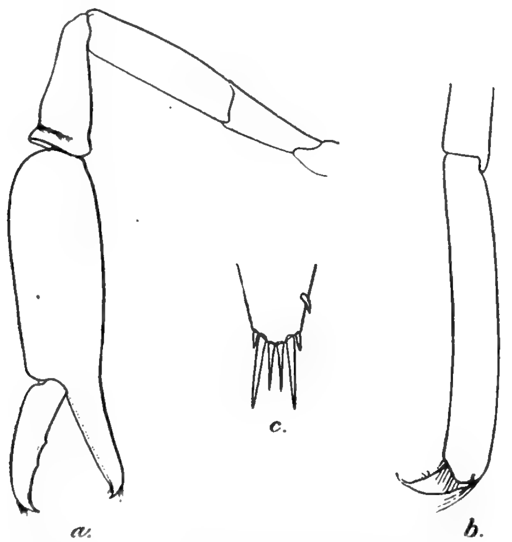
TEXT-FIG. 10.—*Palaemonella orientalis* Dana.
a. Antennule. *b*. Antennal scale.
c. Mandible.

The mandible (text-fig. 10*c*) resembles Dana's figure, but the palp consists only of a single segment, bearing a seta near the apex. The exopod of the third maxilliped reaches only a little beyond the end of the antepenultimate segment. The terminal segment is two-thirds the length of the penultimate. The first peraeopods reach about to the end of the antennal scale. The merus is equal in length with the carpus and about 1·2 times as long as the chela; the palm is a little swollen, and is fully 1·5 times as long as the fingers.

The second peraeopods (text-fig. 11*a*) are equal and reach beyond the scale by rather more than the entire length of the chela. The merus is stout, not more than 3·5 times as long as broad, about one-fifth longer than the carpus; it does not possess a spine at its distal end. The carpus is conical, less than 2·5 times as long as its distal breadth. Anteriorly, on the dorsal side, the carpus is feebly furrowed transversely and the distal margin is reflected outwards. The carpus is a little longer than the fingers and is rather less than two-thirds the length of the palm. The chela is massive; the palm is about 2·5 times as long as broad and is 1·75 times the length of the fingers. The tips of the latter are inturned and their inner margins have blade-like cutting edges; on the dactylus there are two small and obscure teeth.

The last three peraeopods are rather stout. The propodites (text-fig. 11*b*) are unarmed except for a spinule at the distal end of the posterior margin; they are from 4·5 to 5 times the length of the dactyli. The dactylus is broad at the base, simple, strongly curved and is partially concealed by long setae springing from the end of the propodus.

The appendix masculina on the endopod of the second pair of pleopods is fully formed; the specimen thus appears to be an adult male. The sixth abdominal somite is less than 1·5 times the length of the fifth. The telson has the usual three pairs of apical spines, but is unarmed on the dorsal surface except for a single spine on the right hand side placed quite close to the apex (text-fig. 11*c*).



TEXT-FIG. 11.—*Palaemonella orientalis* Dana.
a. Second peraeopod. *c*. Tip of telson.
b. Last two segments of third peraeopod.

The single specimen is about 9 mm. in total length. In life it was completely transparent.

The specimen agrees almost exactly with Dana's description and differs but slightly from his figures. The principal discrepancies are that in the Indian specimen the mandibular palp is one-segmented, that the exopod of the third maxilliped does not reach so far beyond the end of the antepenultimate segment and that the second peraeopods are rather longer and a little more slender.

The specimens recorded by de Man differ more considerably. According to his description the first legs are much longer, with the carpus longer in relation to the chela. The second peraeopods are also much longer and the fingers bear teeth and are only half the length of the palm. The dactyli of the last three peraeopods are one-third the length of the propodus.

Dana gives the length of the adult female as 8 lines, while a male examined by de Man was 13 mm. in length; the Indian specimen is thus much smaller than any previously referred to the species.

C 353/1. Port Blair, Andamans. S. Kemp, March, 1915. One.

The specimen was obtained at low water on the reef at the northern end of Ross Island and was not associated with a crinoid.

Dana described *P. orientalis* from the Sooloo Sea. The specimens described by de Man were obtained on a crinoid at Amboina.

Genus **Periclimenes** Costa.

1831. *Pelias*, Roux, *Mém. sur les Salicoques*, p. 25 (*nom. praeocc.*).
1846. *Periclimenes*, Costa, *Cat. Crost. Napoli* (unpaged).
1852. *Anchistia*, Dana, *U. S. Explor. Exped., Crust.* I, p. 577.
1860. *Urocaris*, Stimpson, *Proc. Acad. Sci. Philadelphia*, p. 39.
1861. *Dennisia*, Norman, *Ann. Mag. Nat. Hist*, (3), VIII, p. 278.
1902. *Ancylocaris*, Schenkel, *Verhandl. naturf. Ges. Basel* XIII, p. 563.
1915. *Periclimenaeus* and *Periclimenes* with subgenera *Corniger*, *Cristiger* and *Falciger*, Borradaile, *Ann. Mag. Nat. Hist.* (8) XV, p. 207.
1916. *Periclimenes* subgenus *Hamiger*, Borradaile, *Brit. Antarct. Exped.* 1910, *Zool.* III, p. 87.
1917. *Urocaris*, *Ancyclocaris*, *Periclimenes* and subgenera, *Periclimenaeus*, Borradaile, *Trans. Linn. Soc.* (2) *Zool.* XVII, pp. 353 *et seq.*
1919. *Periclimenes*, subgenera *Laomenes* and *Cuapetes*, Clark, *Proc. Biol. Soc. Washington*, XXXII, p. 199.

In working through the collection of Pontoniinae in the Indian Museum I have reached conclusions regarding the limits of this genus which, as the above references show, differ widely from those expressed by Borradaile in his recent memoir. That *Anchistia* and *Dennisia* are synonymous with *Periclimenes* has long been well established, but the inclusion of other names in the same category requires explanation.

Almost at the beginning of my work I found the greatest difficulty in distinguishing the three genera *Urocaris*, *Ancylocaris* and *Periclimenes*, and it is evident from the literature that others have found themselves in the same position. In Borradaile's key (*loc. cit.*, 1917, p. 346) the three are placed under primary headings, distinguished for the most part by habit of body. Thus in *Urocaris*: "Body very slender and compressed. Sixth abdominal segment much elongate"; in *Ancylocaris*: "Body moderately stout, not compressed. Sixth abdominal segment short"; in *Periclimenes*: "Body never very slender, or much compressed. Sixth abdominal segment never much elongate." The large assemblage of species which these three genera comprise exhibits a very great range of variation in the form of the body and between the most slender and the stoutest every degree of transition can be found. On these grounds it is quite impossible to distinguish separate genera with any certainty. Borradaile himself is inconsistent, for in *P. parasiticus*, which he retains in the genus *Periclimenes*, the habit of body is extremely slender and the sixth abdominal somite is decidedly longer than in nearly all the species referred to *Urocaris*.

It remains to be seen whether there are any other characters which will justify the retention of *Urocaris* and *Ancylocaris* as separate genera. The type of Stimpson's *Urocaris* is *U. longicaudatus*, from the West Indies. In this species, as in *P scriptus* (Risso), the type of Costa's *Periclimenes*, the last three peraeopods have biunguiculate dactyli. Several Indo-Pacific species are closely allied to *U. longicaudatus*, but the latter does not possess the antennal spine of the carapace which is present without exception in all other species hitherto referred to *Urocaris*, *Ancylocaris* and *Periclimenes*. On the closest examination and comparison it does not seem possible to separate a group of species to which the name *Urocaris* can be applied and, if the genus is to be retained, it must be monotypic and characterized solely by the absence of the antennal spine of the carapace. It is very difficult to assess the value of a unique character of this kind; but in view of the clear affinity which exists between *U. longicaudatus* and various other species I am of the opinion that *Urocaris* should be regarded as a synonym of *Periclimenes*. An illustration of the impossibility of distinguishing between *Urocaris* and *Periclimenes*, as usually applied, is to be found in a recent paper by Balss, in which the type of the latter genus is redescribed as a new species of the former.

Ancylocaris was erected by Schenkel for a species, *A. brevicarpalis*, which is now known to be commensal with giant anemones of the genus *Discosoma*. The same species has since been described under a variety of specific names; it was referred to the genus *Palaemonella* by Nobili, to *Harpilius* by Lenz, and to *Periclimenes* by Miss Rathbun. It will be seen from Borradaile's key that *Ancylocaris* in reality differs from *Periclimenes* in only one character —that the carapace of the female is strongly swollen dorsally. This feature is well developed only in large females and a slight swelling of the carapace is not infrequently seen in normal *Periclimenes*. Moreover, in a species described in this paper which is also commensal with *Discosoma*, the carapace is not at all swollen, though in all other respects it shows an extremely close affinity wih *A. brevicarpalis*. There is thus clear proof that the swollen carapace of the female in *A. brevicarpalis* is not a character of generic value. As will be seen further on, the name *Ancylocaris* may be employed in a new sense for a subgenus of *Periclimenes*.

It may here be pointed out that the extent to which the outer antennular flagellum is cleft—a character to which Borradaile attributes importance—cannot be used, at any rate in the *Periclimenes* group, for the separation of genera. In *Periclimenes* there is a small and rather clearly defined group of species inhabiting water of moderate or great depth and the four known representatives of this group agree among themselves even in a peculiar disposition of teeth in the second pair of chelae. In two of them (*P. latipollex* and *P. laccadivensis*) the outer antennular flagellum is deeply cleft, with the free portion of the shorter ramus longer than the fused basal part: in a third (*P. lanipes*) the free portion is slightly shorter than the fused part: in the fourth (*P. alcocki*) the flagellum is scarcely cleft at all, the free portion of the shorter ramus being less than one-third the length of the fused basal part.

Urocaris and *Ancylocaris* are thus, in my opinion, to be regarded as synonyms of *Periclimenes*.

As regards the subdivision of the large assemblage of forms included in the genus, it will be observed that Borradaile in 1915 proposed four subgenera, *Ensiger*, *Corniger*, *Cristiger* and *Falciger* and in 1916 added a fifth, *Hamiger*. Two of these terms are preoccupied as genera, and Mr. Austin H. Clark, who does not seem hitherto to have interested himself in carcinology, has felt it necessary to substitute others.

The subgenus *Ensiger* includes only Dana's *Anchistia aurantiaca*, a species of doubtful affinity which has not been examined since 1852. From the original account it is not even certain that the species belongs to the subfamily Pontoniinae, for the telson is described as "a little hairy at tip, with two short spines." Any decision as to the proper position of *Ensiger* must therefore be postponed until the type-species has been rediscovered.

Borradaile refers the great majority of the species which he includes in *Periclimenes* to the subgenera *Cristiger* and *Falciger*. He separates the two (*loc cit.*, 1917, p. 360) by a number of features, but it will be seen that the only absolute criterion for their discrimination lies in the form of the rostrum, which is stated to be convex in the former and straight or concave in the latter. This character is one of very little value. In determining the specimens in the Indian Museum I have made every endeavour to separate the species on the lines which Borradaile advocates, but have been forced to the conclusion that the division he recommends, even if it were possible in practice, tends only to obscure the real affinities of the species. The two Mediterranean species, *P. amethysteus* and *P. scriptus*, are so far as I am aware distinguished from one another only by colour, yet Borradaile refers the former to the subgenus *Falciger* and the latter to *Cristiger*.

The subgenus *Hamiger* is without doubt synonymous with *Periclimenaeus*, the position of which is discussed below.

To the curious little group of species in which the cornea is conoidal and pointed anteriorly Borradaile has applied the subgeneric name *Corniger*; but the character, though an interesting one, does not in my opinion, possess the importance that he attributes to it. In the collection on which this paper is based I have found one specimen with a conoidal cornea; but though in this respect it resembles the forms that Borradaile refers to *Corniger*, it is otherwise very different, for it possesses neither hepatic nor supra-orbital spines. It is unfortunately impossible to draw up a specific description from this individual, as it is without locality and is much damaged, possessing only the first pair of legs. The existence of such a form seems, however, to indicate that the species with a conoidal cornea do not necessarily form a natural group.

Elsewhere in the genus *Periclimenes* other modifications of the eye are sometimes found. In *P. seychellensis* there is a papilla on the eyestalk and in two of the three species of *Periclimenaeus* the cornea has a circular cup-shaped depression. The evidence we possess at present tends to show that the structure of the eye, when unsupported by other characters, does not afford a valid basis for subgeneric division.

For these reasons I am unable to accept the subgenera proposed by Borradaile. I recommend instead an arrangement in which the primary division is based on the structure of the dactyli of the last three pairs of peraeopods, whether simple or with an accessory lobe or claw. The structure of the dactyli in these limbs is of generic importance in the more highly specialized Pontoniinae and the character is of established value in other Caridea.

Whether the arrangement leads to a natural grouping of the species on a phylogenetic basis, is a question that cannot be answered in the present state of our knowledge. I incline to the view that it does. In some species, however, the additional dactylar claw is reduced to a mere process or lobe,[1] and there is thus a possibility that certain specialized species in which the dactylus is simple may have been derived from forms in which it was once biunguiculate.[2]

In *P. scriptus*, the type-species of *Periclimenes*, the dactyli are biunguiculate, and the subgenus to which this species belongs may thus be termed *Periclimenes s.s.* For the more primitive forms with simple dactylus Schenkel's *Ancylocaris* may be employed, though in a different sense to that in which it has hitherto been used.

Borradaile's *Periclimenaeus*, of which his *Periclimenes* subgen. *Hamiger* is a synonym, is at most a subgenus of *Periclimenes*. In the three known species the dactyli of the hinder peraeopods are biunguiculate, thus resembling *Periclimenes s.s.*, but the hepatic spine of the carapace, which is invariably present in the latter, is here absent. The chelae of the second peraeopods are more massive in *Periclimenaeus* than in *Periclimenes s.s.*, though the species of the latter subgenus exhibit a very great range of variation in this respect.

The characters of the three subgenera that I propose may be summarized thus:—

Dactyli of last three peraeopods biunguiculate or with an accessory process or lobe behind terminal claw.	[139.
Hepatic spine present	*Periclimenes s.s.*, p.
Hepatic spine absent	*Periclimenaeus*, p. 166.
Dactyli of last three peraeopods simple [Hepatic spine usually present]	*Ancylocaris*, p. 167.

[1] e.g., *Periclimenes rex* and *P. noverca*.

[2] Of this *P. frater* is perhaps an example.

Under the subgeneric headings synoptic tables to the majority of the known species will be found. In *Periclimenes s.s.* 20 species are recognised, in *Periclimenaeus* 3 species and in *Ancylocaris* 44 species. The following are omitted from these tables :—

Anchistia aurantiaca Dana, *U. S. Explor. Exped., Crust.* I, p. 581, pl. xxxviii, figs. 2*a–d* (1852).

The generic position of this species is very doubtful and it is not certain that it belongs to the Pontoniinae. The mouth-parts have apparently not been examined and the telson is described as "a little hairy at tip, with two short spinules." Dana's specimens were found at the Fiji Is.

Anchistia danae Stimpson, *Proc. Acad. Sci. Philadelphia,* 1860, p. 108.

This species, from Tahiti, will probably never be recognized with certainty. There is no description of the second peraeopods and it is uncertain whether the posterior dactyli are simple or biunguiculate. The specimens doubtfully referred to this species by Borradaile[1] perhaps belong to the *P. grandis* section of *Ancylocaris*, but the description is insufficient.

Anchistia brachiata Stimpson, *loc. cit. supra*, p. 108.

Found at Port Lloyd in the Bonin Is. There is no description of the last three peraeopods.

Anchistia notata Heller, *Crust. 'Novara' Exped.*, p. 109, pl. x, fig. 3 (1865).

Described from a specimen without the second peraeopods obtained at the Nicobars.

Periclimenes parasiticus Borradaile, *Ann. Mag. Nat. Hist.* (7) II, p. 384 (1898) and in Willey's *Zool Results*, p. 407, pl. xxxvi, fig. 4 (1899); Nobili, *Ann. Mus. civ. Genova* (2) XX, p. 235 (1899).

The description of this species is most inadequate. I examined the type-specimens in the Cambridge Museum, but found that all the legs were missing except those of the first pair. The species was found at New Britain on a black starfish belonging to the genus *Linckia*.

Periclimenes hertwigi and *gorgonidarum* Balss, *Abhandl. math.-phys. Kl. K. bayer. Akad. Wiss.* Suppl. Bd. II, pp. 49-52, text-figs. 28-32 (1914).

Further particulars of these two remarkable species are required before their position can be determined. It is possible, as Borradaile has remarked, that they do not belong to the Pontoniinae.

[1] Borradaile, *Proc. Zool. Soc. London*, 1898, p. 1004, pl. lxiii, figs. 4, 4*a*, *b*.

Periclimenes beaufortensis Borradaile, *Ann. Mag. Nat. Hist.* (9) V, p. 132 (1920).

According to the description this species does not possess exopods on the second and third maxillipeds. It cannot therefore be retained in the genus *Periclimenes*, but belongs in all probability to *Pontonides* (see p. 266).

Periclimenes tenuipes Leach.

Nobili's statement that Leach described a Mediterranean species under this name is erroneous (*v. infra*, p. 223).

Subgenus **Periclimenes**, *sensu stricto*.

The accessory claw or process found on the dactyli of the last three peraeopods in this subgenus is, I presume, to be regarded as a sign of specialization; *Periclimenes s.s.* is thus less primitive than *Ancylocaris*.

The species included in the subgenus exhibit great variation in habit of body. Some, such as *P. longicaudatus* are extremely slender in build, while others, such as *P. lanipes*, are remarkably stout. *P. scriptus*, the type of the subgenus, is intermediate in form, without any strongly marked characters, and it appears to me probable that it is from some such species as this that the remainder have evolved.

P. latipollex, *P. laccadivensis*, *P. alcocki* and *P. lanipes* form a rather distinct section of the subgenus, distinguished by the tooth and socket arrangement in the dentition of the fingers of the second leg. *P. soror* and *P. noverca* differ from all other species of the subgenus in the possession of a series of fine teeth on the edges of the fingers of the first leg. In this they resemble *P. spiniferus*, *P. petitthouarsi* and *P. denticulatus*,[1] which belong to the subgenus *Ancylocaris*. I think it most improbable that there is any real affinity between these two groups of species and regard the similarity in structure of the fingers of the first leg as an instance of convergence.

Certain species possess characters which are unique in the genus: *P. longicaudatus* has no antennal spine, *P. aesopius* has a large compressed tooth on the third abdominal somite and in *P. investigatoris* the lateral process of the antennule is of abnormal length.

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[1] The same character is also found in *P. frater*. Borradaile considers this species to be a close ally of *P. soror*, but the dactylus is said to be simple and I have consequently included it in the subgenus *Ancylocaris*. In *P. noverca* the accessory claw of the dactylus is reduced to a mere lobe and it is easy to understand how this lobe might disappear altogether by further modification along the same lines. If Borradaile's views on the relationships of *P. frater* are correct, the species has presumably been evolved from one with biunguiculate dactyli and has no affinity with the more primitive forms included in the subgenus *Ancylocaris*. The position of the species thus requires further consideration.

Key to the species of the subgenus *Periclimenes*.

A. Supra-orbital spine absent.

B. Antennal spine absent; R. 7–8 : 1–2 ... *longicaudatus* (Stimpson).

B′. Antennal spine present.

C. Third abdominal somite produced backwards over fourth in the form of a large compressed tooth; R. 9–11 : 2 ... ... *aesopius* (Bate).

C′. Third abdominal somite little produced posteriorly.

D. Fingers of chela of first leg unarmed.

E. Lateral process of antennular peduncle of normal length, not reaching beyond middle of basal segment.

F. Second leg with carpus more than one-third length of palm.

G. One or more upper rostral teeth situated on carapace behind posterior limit of orbit.

H. Dactylus of last three legs slender, at least 4 times as long as broad.

J. Posterior dorsal tooth of rostrum separated from next by a wide interval; carpus of second leg much more than half as long as palm.

K. Upper border of rostrum very strongly arched, with ventral teeth placed close to apex below or in advance of foremost dorsal tooth; fingers of second leg as long as palm.

R. 6–8 : 1–2 ... ... *infraspinis* (Rathbun).

R. 9–11 : 1–3 ... ... *indicus* (Kemp).

K′. Upper border of rostrum only a little convex, with ventral teeth placed behind foremost of dorsal series; fingers of second leg usually shorter than palm; R. 7–10 : 1–2 ... ... *obscurus*, sp. nov.

J′. Posterior dorsal tooth of rostrum not separated from second by a wider interval than that between second and third; carpus of second leg about half as long as palm.

K. Abdomen transversely banded and blotched with red; R. 8–10 : 2–4 ... ... *scriptus* (Risso).

K′. Abdomen longitudinally striped with violet; R. 8 : 4 ... *amethysteus* (Risso).

H′. Dactylus of last three legs stout, less than 4 times as long as broad [posterior dorsal tooth of rostrum not separated from second by a wider interval than that between second and third]; R. 9 : 2 ... ... *impar*, sp. nov.

G′. No teeth of upper rostral series situated on carapace behind orbit.

H. Rostrum deep, downcurved; apex of antennal scale broadly rounded; R. 6 : 1 .. .. *parvus* Borr.

H′. Rostrum shallow, straight; apex of antennal scale sharply rounded; R. 6 : 1 ... ... *incertus* Borr.

F'. Second leg with carpus one-third or less than one-third length of palm.
G. Rostrum with at most 10 dorsal teeth.
H. Fingers of second leg more than half as long as palm, ? without teeth on inner margins [merus of second leg with tooth at end of lower border]; R. 6 : 1 ... ... *gracilis* (Dana).
H'. Fingers of second leg half or less than half as long as palm, dactylus with a tooth fitting into a cavity in fixed finger.
J. Rostrum straight or upturned; merus of second leg unarmed; last three legs slender with merus unarmed and without thick hair.
K. Fused portion of outer antennular flagellum short; second legs smooth; two pairs of spines on back of telson.
L. Hepatic spine on a level with antennal; dactylus of second leg flanged externally; R. 7–8 : 2–3 ... ... *latipollex*, sp. nov.
L'. Hepatic spine below level of antennal; dactylus of second leg not flanged externally; R. 10 : 2–3 ... ... *laccadivensis* (Alc. and And.).
K'. Fused portion of outer antennular flagellum very long; second legs minutely tuberculate; four pairs of spines on back of telson; R. 9 : 3 ... .. *alcocki*, sp. nov.
J'. Rostrum downcurved; merus of second leg with tooth at end of lower border; last three legs stout, inferior margin of merus with spinules and distal tooth, propodus densely clothed with hair; R. 8–9 : 0–1 ... ... *lanipes*, sp. nov.
G'. Rostrum with 23 dorsal teeth, lower border unarmed ... .. *rex*, sp. nov.
E'. Lateral process of antennular peduncle abnormally long, reaching distal end of basal segment; R. 9 : 1 ... ... *investigatoris*, sp. nov.
D'. Each finger of chela of first leg with inner margin finely pectinate.
E. Second leg with merus unarmed and fingers one-third length of palm; no tooth at distal end of merus of last three legs; R. 11–13 : 0 ... ... *soror* Nobili.
E'. Second leg with merus armed with a tooth at distal end of lower border and with fingers more than half as long as palm; a tooth at distal end of merus of last three legs; R. 7 : 0 ... ... *noverca*, sp. nov.
A'. Supra-orbital spine present; R. 5 : 2... ... *commensalis* Borr.

Periclimenes (Periclimenes) longicaudatus (Stimpson).

1860. *Urocaris longicaudatus*, Stimpson, *Proc. Acad. Sci. Philadelphia*, p. 39.

1900. *Urocaris longicaudata*, Rathbun, *Proc. Washington Acad. Sci.* II, p. 155.
1902. *Urocaris longicaudata*, Rathbun, *Bull. U. S. Fish Comm.* XX, ii, p. 126.
1918. *Urocaris longicaudata*, Hay and Shore, *Bull. U. S. Bur. Fisheries* XXXV, p. 394.

This species, which is the type of Stimpson's genus *Urocaris*, inhabits the West Indies and the adjacent coasts of America as far south as Brazil. The specimens I have examined are from Punta Rassa in Florida.

The anterior margin of the carapace, immediately below the orbit, projects in the form of a long strap-shaped process with rounded apex. This projection is homologous with the less prominent infra-orbital lobe found in many related species and is imperfectly described by Miss Rathbun (*loc. cit.*, 1902) as a 'rounded extra-orbital tooth.' The antennal spine which usually arises from the vicinity of the lower limit of the infra-orbital lobe is completely absent in *P. longicaudatus*, though it appears to be present in all other known representatives of the subgenus *Periclimenes*.

Periclimenes aesopius (Spence Bate).

1864. *Anchistia aesopia*, Spence Bate, *Proc. Zool. Soc. London*, 1863, p. 502, pl. xli, fig. 5.
1917. *Urocaris aesopius*, Borradaile, *Trans. Linn. Soc.* (2) *Zool.* XVII, p. 354.

Through the kindness of the authorities of the British Museum I have been able to examine the types of this remarkable species which has apparently not been rediscovered during the past fifty years. There are two specimens, one complete and one which has been dissected and is in a fragmentary condition.

The rostrum is slender and straight, with the ventral portion below the midrib greatly reduced. On the upper margin there are 9 or 11 teeth, the three hindmost placed on the carapace behind the orbit. On the lower margin there are two small teeth near the apex and behind these teeth a fringe of very long plumose setae.

The carapace is prominently angled below the orbit. There are antennal and hepatic spines, the latter on a lower level than the former.[1] The eyes are slender, with stalk fully twice the length of the cornea. The lateral process of the antennule is short, not reaching the middle of the basal peduncular segment. The anterior margin of this segment external to the insertion of the second segment is greatly produced, as shown in Bate's figure, reaching the end of the second segment and extending far beyond the spine that terminates the outer margin. The antennal scale is unusually broad distally; it is about two and a half times as long as wide, with the terminal spine not reaching the end of the lamella.

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[1] The position given to these spines in Spence Bate's figure is erroneous.

The first peraeopods reach the end of the scale. The carpus is shorter than the merus and only three-quarters the length of the chela. The fingers are unarmed and are longer than the palm. On the outer edge of the fixed finger there are some tufts of hairs. The second peraeopods reach beyond the scale by almost the entire length of the chela. The merus is unarmed and 1·5 times as long as the carpus. The carpus is conical and about 3 times as long as its distal width. The chela is 2·5 times as long as the carpus and rather more than 4 times as long as wide; the fingers are unarmed, a little shorter than the palm.

TEXT-FIG. 12.—*Periclimenes aesopius* (Sp. Bate).

Dorsal parts of third and fourth abdominal somites in lateral view.

The third peraeopods reach the end of the scale. The propodus in all three pairs is provided with spinules on its posterior border and is about 4 times the length of the dactylus. The dactylus is biunguiculate, with a deep and narrow cleft between the two claws.

The form of the remarkable compressed tooth which projects backwards from the third abdominal somite is shown in text-fig. 12. I know nothing resembling it in any other species of the genus. The sixth abdominal somite is 2·3 times the length of the fifth. The anterior pair of dorsal spinules of the telson are placed in the middle of its length. As usual there are two spines, one of which is movable, at the end of the external margin of the outer uropod.

If the complete specimen were straightened out it would probably be about 24 mm. in length.

The structure of the apex of the telson and of the mandibular palp (found loose in the tube containing the specimens) afford proof that the species belongs to the Pontoniinae. It must certainly be referred to the genus *Periclimenes* in which, however, by reason of the characters of the basal segment of the antennular peduncle and third abdominal somite, it occupies a very isolated position.

The two specimens were found in the Gulf of St. Vincent, S. Australia (Angas coll.).

Periclimenes (Periclimenes) infraspinis (Rathbun).

1902. *Urocaris infraspinis*, Rathbun, *Proc. U. S. Nat. Mus.* XXIV, p. 903.
1904. *Urocaris infraspinis*, Rathbun, *Harriman Alaska Exped.* X, p. 31, text-figs. 10*a*, *b*.
1921. *Urocaris infraspinis*, *Schmitt, Univ. Calif. Publ., Zool.* XXIII, p. 37, fig. 22.

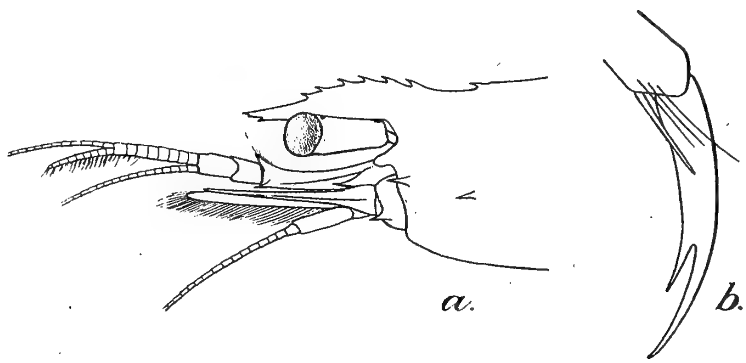
California, Pacific coast of Mexico.

Periclimenes (Periclimenes) indicus (Kemp).

1915. *Urocaris indica*, Kemp, *Mem. Ind. Mus.* V, p. 275, pl. xiii, fig. 9, text-fig. 26.

A comparative statement of the principal differential characters of *P. indicus* and *P. infraspinis* will be found under the above reference (p. 278).

So far as is known at present *P. indicus* is restricted to the coasts of the Indian Peninsula. It is known from the Chilka Lake in Orissa, from Ennur backwater and the Adyar River near Madras and from Pamban and Kilakarai at the upper end of the Gulf of Manaar. The species is estuarine as well as marine and in places like the Chilka Lake, where there are great seasonal changes in salinity, has been found in fresh water.



TEXT-FIG. 13.—*Periclimenes indicus* (Kemp).

a. Anterior part of carapace and rostrum.
b. Dactylus of fifth peraeopod.

I have no additional records of this species, but give further figures of the rostrum and dactylus of the last leg for comparison with *P. obscurus*.

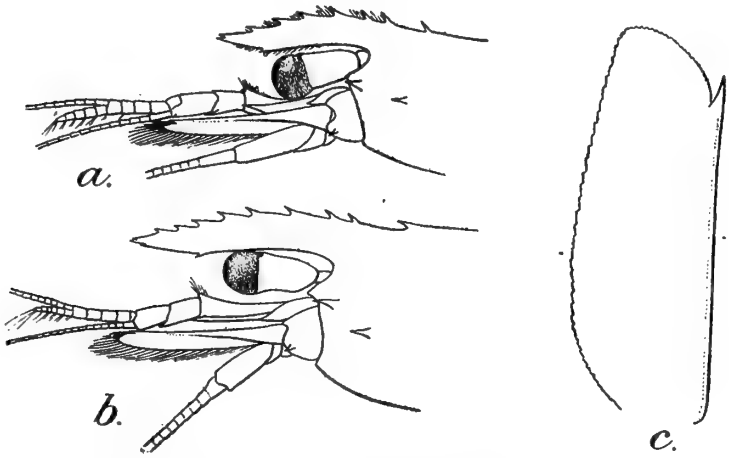
Periclimenes (Periclimenes) obscurus, sp. nov.

The rostrum is longer in females than in males. In the former sex (text-fig. 14*b*) it extends beyond the end of the antennular peduncle, usually reaching the end of the antennal scale, while in the latter (text-fig. 14*a*) it reaches only to the middle or end of the second antennular segment. The upper portion of the blade is convex, but does not take the form of the strongly arched lamella found in *P. indicus*. On the upper border there are from 7 to 10 teeth, usually 8 or 9[1]; the hindmost of these is separated by a considerable interval from the next of the series, but is always situated further forwards than in *P. indicus*. The remaining dorsal teeth are more or less evenly spaced and

[1] Of thirty-three specimens five have 7 dorsal teeth, twelve have 8, twelve have 9 and four have 10.

extend to the tip, the second being above or slightly behind the posterior limit of the orbit. The lower border of the rostrum bears 1, rarely 2 teeth[1] which are rather larger than those of *P. indicus* and occupy a different position. In *P. indicus* there are as a rule 2 very small teeth, the hindmost of which is placed below or in advance of the foremost tooth of the dorsal series, whereas the single tooth usually found in *P. obscurus* is placed much further back, with at least one, often with two or three dorsal teeth in advance of it.

In the antennules and antennae there is little difference between the two species, but in *P. obscurus* the antennal scale (text-fig. 14*c*) is rather less parallel-sided than in *P. indicus* and the



TEXT-FIG. 14.—*Periclimenes obscurus*, sp. nov.

a. Anterior part of carapace of male.
b. The same parts of female.
c. Antennal scale.

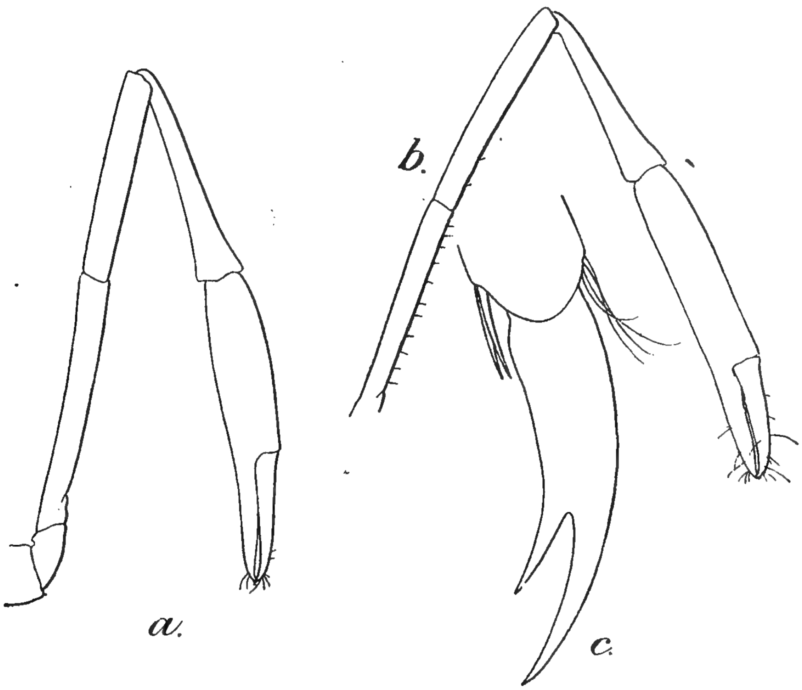
fused portion of the outer antennular flagellum is shorter and composed of only 4 or 5 segments.

The mouth-parts, maxillipeds and first peraeopods do not exhibit any distinctions worthy of note. The second peraeopods are often a little unequal and show much variation in the proportionate lengths of the segments. As in *P. indicus* they are unarmed. In ovigerous females (text-fig. 15*b*) the carpus is slightly shorter than, as long as, or rather longer than the palm. In males (text-fig. 15*a*) it is sometimes longer than the palm, rarely shorter than it, while young individuals not infrequently resemble *P. indicus* in having the carpus as long as the chela. The fingers are as a rule clearly shorter than the palm, thus differing from those of *P. indicus* which are always fully as long as the palm. In young specimens, however, and rarely in full-grown females the dactylus

[1] Of thirty-three specimens thirty-one have a single ventral tooth and two have 2 ventral teeth.

is equal in length with the palm. The fingers are usually unarmed, but sometimes an obscure tooth is found on each, that on the fixed finger in advance of that on the dactylus.

The last three peraeopods are for the most part similar to those of the allied species. The dactylus, however, is shorter; it is from 4 to 4·5 times as long as its basal breadth, whereas in *P. indicus* it is from 5·5 to rather more than 6 times (*cf.* text-figs. 13*b* and 15*c*). No clear distinctions are to be found in the abdomen, telson or uropods.



TEXT-FIG. 15.—*Periclimenes obscurus*, sp. nov.
a. Second peraeopod of a male. *b*. Second peraeopod of a female.
c. Dactylus of fifth peraeopod.

Large specimens reach a length of about 17 mm.

C 345–6/1.	Springhaven, Madras Harbour.	S. Kemp, May, 1918.	Twenty-four, including TYPES.
C 347–1/1.	Ennur backwater, near Madras.	N. Annandale, Sept., 1915.	Nine.

The specimens from Springhaven were taken swimming round buoys and piles encrusted with sponges, hydroids and other marine organisms. Those from Ennur backwater were found in company with *P. indicus*, from which they were easily distinguished by the well-marked rostral characters.

Periclimenes (Periclimenes) scriptus (Risso).

1916. *Urocaris de Mani*, Balss, in Michaelsen's *Beitr. Kennt. Meeresfaun. West-afrikas* II, p. 29, text-fig. 10.
1917. *Periclimenes (Cristiger) scriptus*, Borradaile, *Trans. Linn. Soc.* (2) *Zool.* XVII, p. 362 (*synon.*).

I am unable to find in Balss' description any character which will distinguish his *Urocaris de Mani* from *P. scriptus*, the type of the genus *Periclimenes*.

P. scriptus is common in the Mediterranean and has been found at the Channel Is.; if I am right regarding the identity of the specimen described by Balss its distribution extends southwards along the West African coast to French Congo.

Periclimenes (Periclimenes) amethysteus (Risso).

1826. *Alpheus amethystea*, Risso, *Hist. nat. Europe Mérid.* V, p. 77, pl. iv, fig. 16.
1863. *Anchistia amethystea*, Heller, *Crust. züdlich. Europa*, p. 258.
1917. *Periclimenes (Falciger) amethysteus*, Borradaile, *Trans. Linn. Soc.* (2) *Zool.* XVII, p. 370.

Other references are given by Borradaile. The original description is based entirely on colour and I know of no other character by which the species can be separated from *P. scriptus*. Heller's account of the colouration differs considerably from that given by Risso and the only definite points of distinction appear to be those which I have noted above in the key to the species of the subgenus. At the Oceanographical Museum at Monaco I have examined specimens from Bône, in Algeria, which bore the name *amethysteus*, but was unable to find any difference in structure from *P. scriptus*. The validity of the species must remain uncertain until fresh information based on living material is forthcoming.

P. amethysteus is known only from the Mediterranean.

Periclimenes (Periclimenes) impar, sp. nov.

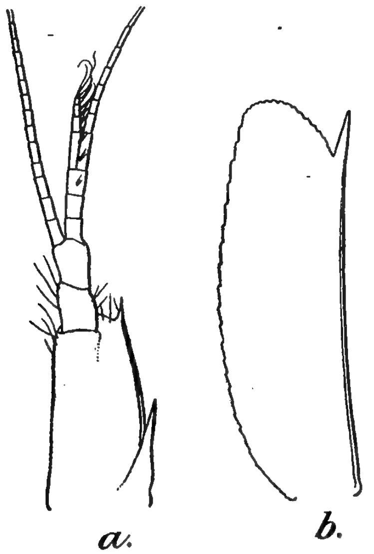
(Plate III, fig. 1.)

This species is allied to the four preceding forms but differs in the much broader dactylus of the last three pairs of legs.

The rostrum is a little longer than the antennular peduncle, but does not reach the end of the antennal scale. The upper margin is convex and in the single specimen examined bears 9 more or less evenly spaced teeth. The hindmost tooth is placed on the carapace behind the orbit but is not separated from the second by a greater distance than that between the second and third. The middle teeth of the dorsal series are the largest. On the lower border there are 2 teeth, placed near the tip, and the margin from the posterior tooth to the base is nearly straight.

There is no supra-orbital spine. The antennal spine is sharp with the hepatic behind it but on a lower level. The eyes are rather stout and the ocular spot touches the cornea.

The lateral process of the antennule (text-fig. 16*a*) reaches about to the middle of the basal segment; the spine at the end of the external margin extends beyond the middle of the second segment. The second and third segments are together less than half as long as the basal segment. The free portion of the shorter ramus of the outer flagellum is longer than the fused part, the latter comprising only 3 segments. The antennal scale (text-fig. 16*b*) is about 3·2 times as long as broad; the outer margin is slightly concave and terminates in a spine which reaches almost to the end of the lamella.



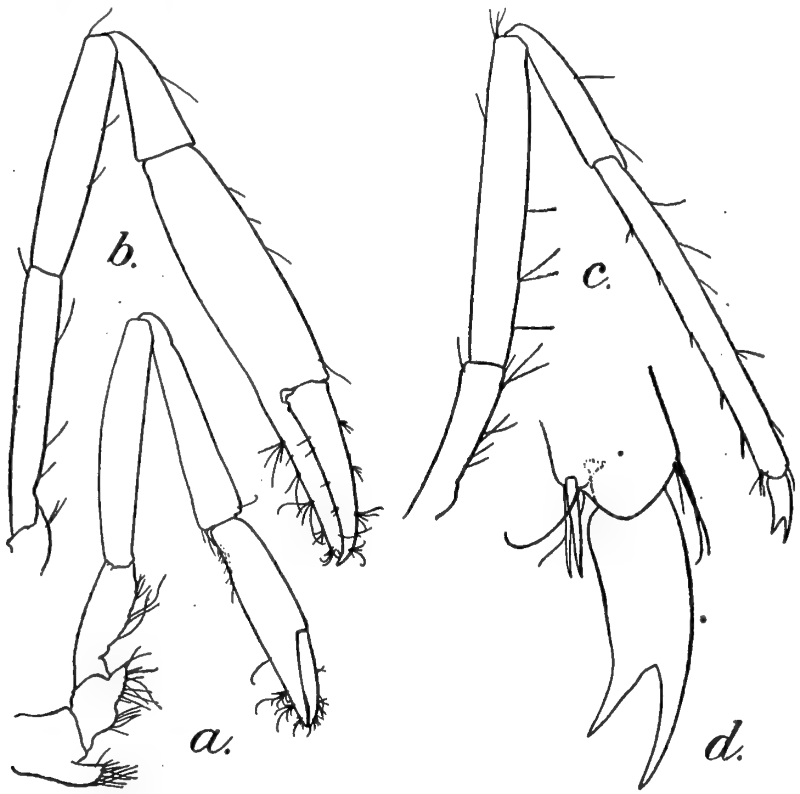
TEXT-FIG. 16.—*Periclimenes impar*, sp. nov.
a. Antennule.
b. Antennal scale.

The first peraeopods (text-fig. 17*a*) reach about to the end of the scale. The coxopodite has the usual ventral process and a similar process, much better developed than in allied species, is present on the basipodite. The carpus is equal in length with the chela and is a little shorter than the merus; the fingers are unarmed and are nearly three-quarters the length of the palm.

The second peraeopods are unarmed and are unequal and dissimilar, both reaching considerably beyond the end of the scale. In the larger limb (text-fig. 17*b*) the merus and ischium are subequal. The carpus is conical, about 2·3 times as long as its distal breadth, and is half the length of the palm and rather more than half the length of the merus. The chela is somewhat swollen, with fingers about two-thirds as long as the palm. In the middle of the cutting edge of each finger there is a shallow excavation bounded at either end by a small tooth; the fingers in consequence gape a little when they are closed. In the smaller limb the carpus is much longer, only a little shorter than the palm and three-quarters the length of the merus; it is at least four times as long as its distal breadth.

The third peraeopods reach about to the end of the basal segment of the antennule. The propodus in all the last three pairs (text-fig. 17*c*) bears spinules on its posterior margin and is from 5·5 to 6 times as long as the dactylus. The dactylus itself (text-fig. 17*d*) is biunguiculate with a rather wide excavation between the two claws. It is considerably broader than in any of the allied species, the length from the base to the bottom of the cleft being only twice the basal breadth.

The sixth abdominal somite is less than twice the length of the fifth. The anterior pair of dorsal spinules of the telson are placed in the middle of its length, the posterior pair midway between the anterior and the apex. The external margin of the outer uropod is ciliated.



TEXT-FIG. 17.—*Periclimenes impar*, sp. nov.

a. First peraeopod. *c*. Third peraeopod.
b. Larger second peraeopod. *d*. Dactylus of third peraeopod.

The species is described from a single ovigerous female about 10 mm. in length.

C 348/1.	Port Blair, Andamans, 5 fms.	S. Kemp, March, 1915.	One, TYPE.

The specimen was found on a sponge of a pinkish colour and was transparent when alive with reddish patches on the abdominal pleura.

Periclimenes (Periclimenes) parvus Borradaile.

1898. *Periclimenes parvus*, Borradaile, *Ann. Mag. Nat. Hist.* (7) II, p. 384.

1899. *Periclimenes parvus*, Borradaile, in Willey's *Zool. Results*, p. 407, pl. xxxvi, fig. 3.

New Britain.

Periclimenes (Periclimenes) incertus, Borradaile.

1915. *Periclimenes (Cristiger) incertus*, Borradaile, *Ann. Mag. Nat. Hist.* (8), XV, p. 210.

1917. *Periclimenes (Cristiger) incertus* Borradaile, *Trans. Linn. Soc.* (2) *Zool.* XVII, p. 364, pl. liii, fig. 7.

I have examined the types of this species and of *P. parvus* and agree with Borradaile that they are specifically distinct. In addition to the characters which he has mentioned, the carpus of the second peraeopod is proportionately longer in *P. incertus* and the apex of the antennal scale more sharply rounded. In both species the foremost pair of spines on the dorsum of the telson is placed at about the middle of its length.

P. incertus was found at the Maldive Is.

Periclimenes (Periclimenes) gracilis (Dana).

1852. *Anchistia gracilis*, Dana, *U. S. Explor. Exped., Crust.* I, p. 578, pl. xxxvii, figs. 5*a–m*.

Judging from Dana's figures this species, the type of the genus *Anchistia*, will fall in the subgenus *Periclimenes*, but its position is a little doubtful, for the accessory tooth on the dactylus of the posterior legs is not mentioned in the description and according to figure 5*l* it is articulated at the base.

The lamella of the antennal scale is shown to be acutely pointed anteriorly in fig. 5*a*, but this is probably an error.

P. gracilis is recorded by Dana from the Sooloo Sea.

Periclimenes (Periclimenes) latipollex, sp. nov.

(Plate IV, fig. 3.)

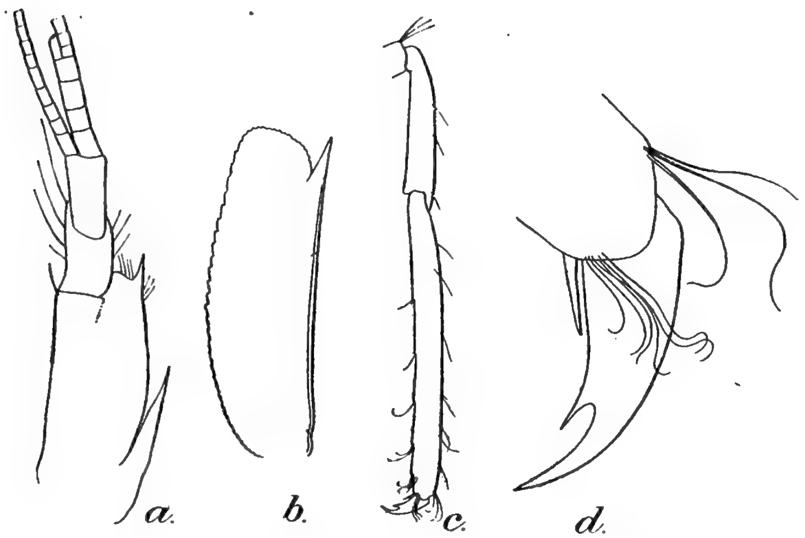
The rostrum is very slender, straight in its proximal part and trending very slightly upwards at its distal end. It reaches a little beyond the apex of the antennal scale and is armed above with 7 or 8 teeth, of which the posterior 2 or 3 are situated on the carapace behind the orbit. The posterior tooth is not widely separated from the second. Towards the apex the teeth are more distantly spaced than at the base, but in both the specimens with complete rostra the distribution is somewhat irregular. On the lower edge of the rostrum in its distal half there are 3 teeth.

The supra-orbital spine is wanting. The hepatic spine is placed on a level with the antennal. The lobe on the frontal edge forming the lower limit of the orbit is acute. The ocular spot is merged in the cornea and can only be distinguished with difficulty.

The spine at the outer distal end of the basal segment of the antennular peduncle (text-fig. 18*a*) is long; the lateral process reaches about to the middle of the segment. The fused portion of the outer antennular flagellum is composed of three or four segments and is about two-thirds the length of the free portion of the shorter ramus. The antennal scale (text-fig. 18*b*) is rather more than 3 times as long as wide (in an adult female); its outer margin is slightly concave and terminates in a spine which reaches as far forwards as the lamella.

The third maxilliped bears an arthrobranch; the ultimate segment is considerably shorter than the antepenultimate. The first peraeopod reaches beyond the scale by the length of the fingers. The carpus is much shorter than the merus and slightly shorter than the chela. The fingers are unarmed and about two-thirds the length of the palm.

The second peraeopods are equal or subequal and reach beyond



TEXT-FIG. 18.—*Periclimenes latipollex*, sp. nov.

a. Antennule. *c*. Last two segments of third peraeopod.
b. Antennal scale. *d*. Dactylus of third peraeopod.

the scale by the whole length of the chela. Both merus and carpus are unarmed. The merus is nearly twice the length of the ischium; the carpus is conical, about 1·5 times as long as broad and scarcely one-fifth the length of the chela. The chela is as long as the three preceding segments combined and much exceeds the carapace-length; the palm is from 2·2 to 2·7 times the length of the dactylus and is from 4·5 to 5 times as long as broad. The fixed finger has a cutting edge armed in its proximal half with three small teeth and on the dactylus there is a cutting edge with a single basal tooth. When the claw is closed the cutting edges do not coincide but slide past each other like the blades of a pair of scissors, the single tooth on the dactylus fitting into a recess in the fixed finger. The tip of each finger is provided with an inturned claw. On the external side of the dactylus there is a thin blade or flange which runs the whole length of the segment and is somewhat reflected outwards; from certain points of view the dactylus thus appears very broad.

The last three peraeopods are comparatively stout; the third reach beyond the scale by about twice the length of the dactylus. The merus is about 9 times as long as broad. The propodus (text-fig. 18*c*) bears some setae and a few fine spinules on its posterior border and is from about 6·5 to 7 times as long as the dactylus. The latter segment (text-fig. 18*d*) is rather broad and the accessory tooth is small.

The sixth abdominal somite is half as long again as the fifth. The foremost of the two pairs of spinules on the upper surface of the telson is placed a little in front of the middle of the telson-length, the second midway between it and the apex.

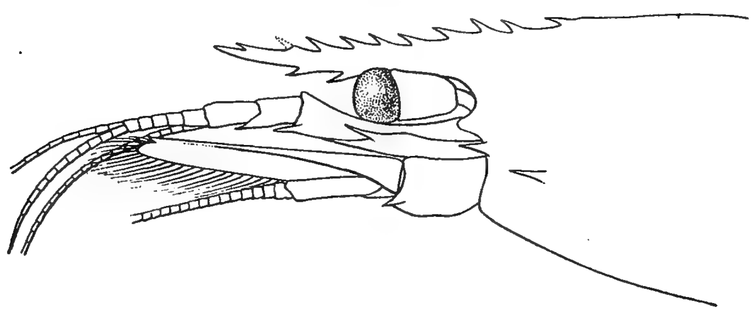
The largest specimen, an ovigerous female, is about 16 mm. in length.

C 349/1.	Mergui Archipelago, 62 fms., 12°15′20″N., 97°10′10″E.	'Investigator,' April, 1913.	Three (two ovig. ♀). TYPES.

Periclimenes (Periclimenes) laccadivensis (Alcock and Anderson).

1894. *Palaemonella laccadivensis*, Alcock and Anderson, *Journ. Asiat. Soc. Bengal* LXIII, p. 157.
1896. *Palaemonella laccadivensis*, Alcock and Anderson, *Illust. Zool. 'Investigator,' Crust.* pl. xxvi, fig. 4.
1901. *Palaemon (Brachycarpus) laccadivensis*, Alcock, *Cat. Ind. Deep-Sea Crust. Decap. Macrura and Anomala*, p. 138 (*in part*).
? 1906. *Palaemonella laccadivensis*, Rathbun, *Bull. U. S. Fish Comm.* XXIII, iii, p. 925.
1917. *Palaemonella laccadivensis*, Borradaile, *Trans. Linn. Soc.* (2) *Zool.* XVII, p. 358.

This species, originally described as a *Palaemonella* and subsequently transferred by Alcock to *Brachycarpus*, belongs in reality

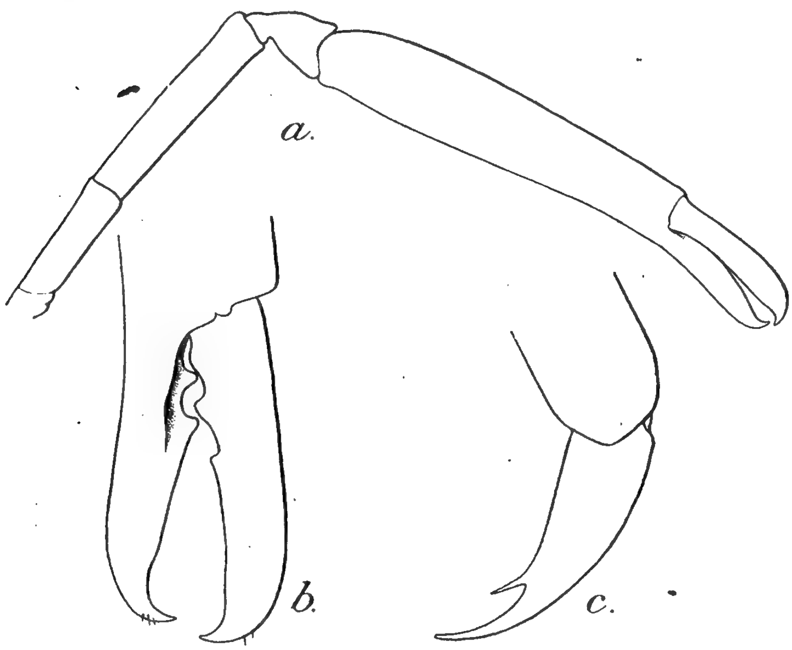


TEXT-FIG. 19.—*Periclimenes laccadivensis* (Alc. and And.). Anterior part of carapace, rostrum, etc.

to *Periclimenes*. The fact that the telson has six terminal spines and that there is no pleurobranch above the base of the third maxilliped indicates that the species must be referred to the Pontoniinae and, as the mandible does not possess a palp, it cannot be placed in Dana's *Palaemonella.* The dactyli of the last three legs are biunguiculate and the species in all other characters agrees with *Periclimenes s.s.*, as defined in this paper.

Alcock in 1901 recorded four specimens of this species, all of which I have examined. The largest of the four is in my opinion specifically distinct from the other three, and I have described it below under the name of *P. alcocki*.

Periclimenes laccadivensis is very closely related to *P. latipollex*, but is distinguished by the following characters :—



TEXT-FIG. 20.—*Periclimenes laccadivensis* (Alc. and And.).
a. Second peraeopod. *b*. Fingers of second peraeopod.
c. Dactylus of third peraeopod (setae at distal end of propodus omitted).

The rostrum (text-fig. 19) is less slender and is shorter, not quite reaching the end of the antennal scale; it is armed with 10 teeth above and 2 or 3 below. The hepatic spine is situated on a lower level than the antennal. The antennal scale is rather broader, about 2·75 times as long as wide in an ovigerous female, and the distal spine does not reach quite as far forwards as the apex of the lamella. The carpus of the first peraeopod is a little longer than the chela. The peraeopods of the second pair (text-fig. 20*a*) are distinctly unequal, but otherwise resemble those of the related species; the dactylus, however, is not flanged along its outer edge. The armature of the cutting edges of the fingers (text-fig. 20*b*) is similar and in minor details is variable. There are one or two teeth on the dactylus which fit into a recess in the fixed finger, while on the fixed finger itself there are only two teeth, both rather large, in place of the three found in *P. latipollex.*

The last three peraeopods are rather more slender. In the third pair the merus is about 11·5 times as long as wide and the propodus is 9 times as long as the dactylus. The accessory claw of the dactylus (text-fig. 20*c*) is small and slender; it is sometimes missing, having apparently been broken off.

The three specimens are all ovigerous females. The largest, from which the figure in the *Illustrations of the Zoology of the 'Investigator'* is drawn, is about 27 mm. in length. The specimens are from deep water and have a soft membranous integument.

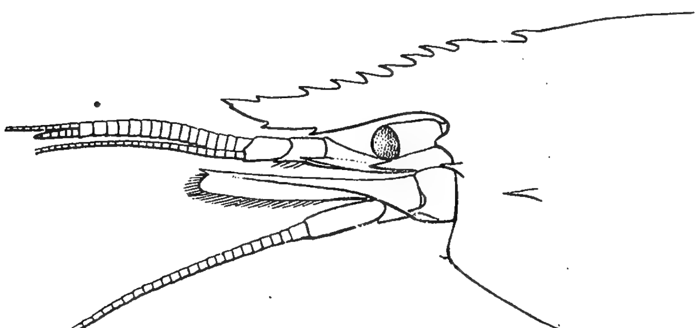
9221/9.	Laccadive Sea, 703 fms., 10°47′45″ N., 72°40′20″E.	'Investigator,' Nov., 1891.	One, TYPE.
2129–30/10.	Laccadive Sea, 430 fms., 7°17′30″ N., 76°54′30″ E.	'Investigator,' Oct., 1897.	Two, TYPES.

The identity of the two specimens recorded by Miss Rathbun (*loc. cit.*) from the Hawaiian Is. appears to me to be doubtful.

Periclimenes (Periclimenes) alcocki, sp. nov.

1901. *Palaemon (Brachycarpus) laccadivensis,* Alcock, *Cat. Ind. deep-sea Crust. Decap. Macrura and Anomala,* p. 138 (*in part*).

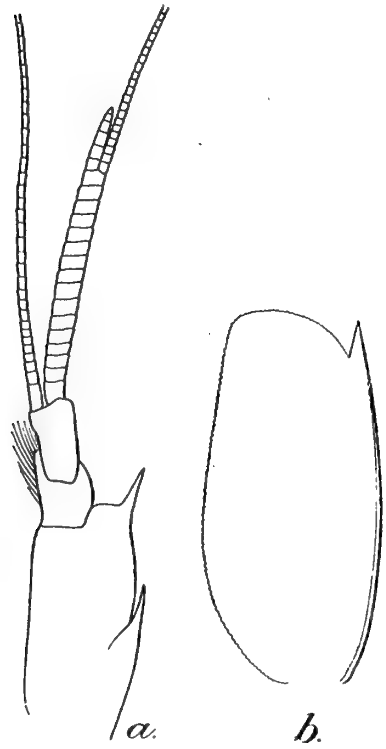
This species is represented in the collection by a single large specimen obtained by the 'Investigator' and referred by Alcock to *Palaemon* (*Brachycarpus*) *laccadivensis.* It differs from the types of the latter species and from *Periclimenes latipollex* in



TEXT-FIG. 21.—*Periclimenes alcocki*, sp. nov.
Anterior part of carapace, rostrum, etc.

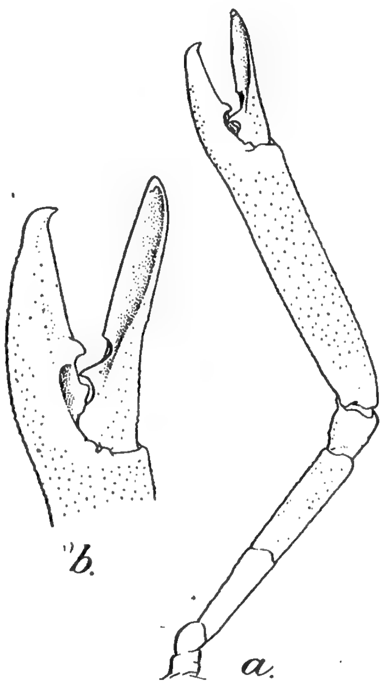
a number of particulars which appear to entitle it to specific distinction. It may be separated from the related forms by the following characters:—

The rostrum (text-fig. 21) is deep and reaches just beyond the end of the antennular peduncle. On its upper margin it bears 9 teeth, of which the foremost and hindmost are rather remote from the rest; three posterior teeth stand on the carapace behind the orbit. On the lower margin there are 3 teeth, the foremost small and placed close to the apex. The hepatic spine is placed on a lower level than the antennal. The two rami composing the outer antennular flagellum (text-fig. 22*a*) are fused basally for a much longer distance than in the related species; the fused portion is 3·5 times as long as the free part of the shorter ramus and consists of 12 segments. The antennal scale (text-fig. 22*b*) is



TEXT-FIG. 22.—*Periclimenes alcocki*, sp. nov.

a. Antennule.
b. Antennal scale.

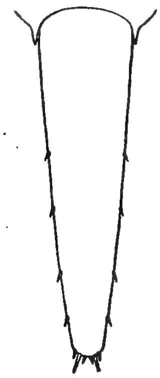


TEXT-FIG. 23.—*Periclimenes alcocki*, sp. nov.

a. Larger second peraeopod.
b. Fingers of same leg.

broader, scarcely more than twice as long as wide; the outer margin is convex and terminates in a spine which reaches nearly to the end of the lamella. The carpus of the first peraeopods is proportionately longer than in either of the related species and is 1·5 times the length of the chela.

The second peraeopods (text-fig. 23*a*) are unequal and are closely covered throughout with small tubercles, a remarkable character also found in certain species of the subgenus *Ancylocaris*. The fingers in both limbs are almost exactly half the length of the palm and are thus proportionately longer than in the allied forms. In the longer limb the dactylus is conspicuously spatulate (text-fig. 23*b*) and has a single large and sharp tooth in its basal third which fits into a cavity in the fixed finger when the claw is closed. There are two teeth on the fixed finger, one a little behind the middle, which is accommodated in a socket placed in advance of the tooth on the dactylus, and another which is blunt and molariform nearer the base. The smaller chela is similar, but there are two teeth on the dactylus—the posterior blunt and inconspicuous—and one, which is small, on the fixed finger.



TEXT-FIG. 24.—*Periclimenes alcocki*, sp. nov. Telson.

The merus of the third peraeopod is about 8 times as long as broad; the propodus is rather less than 7 times the length of the dactylus. The accessory claw of the latter is small, as in *P. laccadivensis*. The telson (text-fig. 24) differs from that of all other Pontoniinae in the possession of four pairs of dorsal spines in addition to the six which occur at the apex. It is possible that this is merely an abnormality, but the spines are arranged symmetrically on the two sides.

The single specimen, an ovigerous female, is 50 mm. in length.

4789/7.	Laccadive Sea, 406 fms. 9°34′57″ N., 75°36′30″ E.	'Investigator,' Jan., 1895.	One, TYPE.

As in the preceding species the integument is soft and membranous.

Periclimenes (Periclimenes) lanipes, sp. nov.

(Plate IV, fig. 4.)

The rostrum is strongly curved downwards, with the tip a little upturned. It reaches just beyond the apex of the antennal scale and in lateral view is shallow. On the strongly convex upper border it bears 8 or 9 [1] evenly spaced teeth, decreasing in size from behind forwards and with the hindmost situated above or a little behind the posterior limit of the orbit. The lower margin is unarmed, or with a single small tooth [1] placed beneath the seventh or eighth of those on the upper side.

In dorsal view the rostrum is broad at the base, with a carina on either side forming a sort of superciliary ridge over the upper portion of the orbit. The lower limit of the orbit is defined by a

[1] Of three specimens two have 8 dorsal teeth and one has 9; in two specimens the lower margin bears a single tooth and in one it is unarmed.

sharp angle, beneath which there is a strong antennal spine; the hepatic spine is behind the antennal and on a level with it. There is no supra-orbital. Immediately behind the eye the orbital margin is conspicuously depressed, forming a hollow which apparently serves to accommodate the eyestalk when it is directed backwards. The eyes are short and stout, with the cornea hemispherical and not wider than the stalk. The ocular spot touches the cornea.

The lateral process of the antennular peduncle reaches about to the middle of the basal segment; the distal spine of this segment is very long, reaching the articulation of the second and third segments. The free portion of the shorter ramus of the outer flagellum is a little shorter than the fused part, the latter comprising 4 or 5 segments. The antennal scale is very broad, only twice as long as wide. The outer margin is slightly convex and terminates in a large tooth which reaches almost or quite as far forwards as the apex of the lamella.

The third maxilliped bears a small arthrobranch. The exopod reaches the end of the antepenultimate segment and the last segment is three quarters the length of the penultimate.

The first peraeopods reach beyond the scale by more than the length of the chela. The carpus is a little longer than the merus and considerably longer than the chela. The fingers are a little shorter than the palm and are spatulate, without teeth or spines on their inner edges.

The second peraeopods are stout and reach beyond the antennal scale by fully half the length of the chela. The merus is scarcely more than 2·5 times as long as wide and bears a strong spine at the distal end of its lower border. The carpus is conical and very short, about as long as broad and half as long as the merus; it bears no spines but is fringed with setae anteriorly and is deeply notched on the inner side of its distal margin. The heavy chela is also clothed with setae, sparsely at the proximal end, but densely in the vicinity of the fingers. The palm is 2·5 times as long as broad and is rather more than twice the length of the fingers. The fingers have inturned tips and on the inner edge of the dactylus in its proximal half there is a large acute tooth. The fixed finger is sometimes unarmed, sometimes with a small tooth in advance of that on the dactylus and with three or four serrations at the proximal end. When the claw is closed the fingers slide past one another like the blades of a pair of scissors and the large dactylar tooth is received into a socket in the fixed finger.

The last three peraeopods are stout; the third pair reaches beyond the scale by more than the length of the dactylus, the fifth reach the middle of the scale. In each pair the inferior edges of the ischium of merus are thickly set with soft hairs. The lower border of the merus ends in a strong tooth, behind which there are a few spinules. The propodus is stout and is densely clothed with long woolly hairs, which, at the distal end, are so thick as to conceal the dactylus. The dactylus itself has a small tooth on the posterior margin and is strongly curved and only about one-sixth the length of the propodus.

The sixth abdominal somite is very little longer than the fifth. The anterior of the two pairs of dorsal spines on the telson is situated in the middle of its length; the posterior pair is a little nearer to the apex than to the anterior pair. The external margin of the outer uropod is ciliated.

The largest of the three specimens, an ovigerous female, is about 13 mm. in length.

This species is clearly allied to *P. latipollex*, *P. laccadivensis* and *P. alcocki*, but is easily distinguished by numerous well-marked characters.

C 405/1.	Mergui Archipelago, 12°48′ N., 98°16′10″ E., 24 fms.	'Investigator.'	One, TYPE.

The other two specimens belong to the Paris Museum and were obtained by M. Heartel at Mozambique in water 20–25 m. deep.

Periclimenes (Periclimenes) rex, sp. nov.

(Plate V, fig. 5.)

The rostrum extends beyond the end of the antennular peduncle but does not reach the tip of the antennal scale. It is extremely deep in lateral view and is very strongly curved downwards. The convex upper border is serrated like a saw and in the single specimen examined, bears 22 small equidistant teeth, with one additional tooth placed far back on the carapace and widely separated from the rest. The lower border is unarmed and is strongly convex in its distal half.

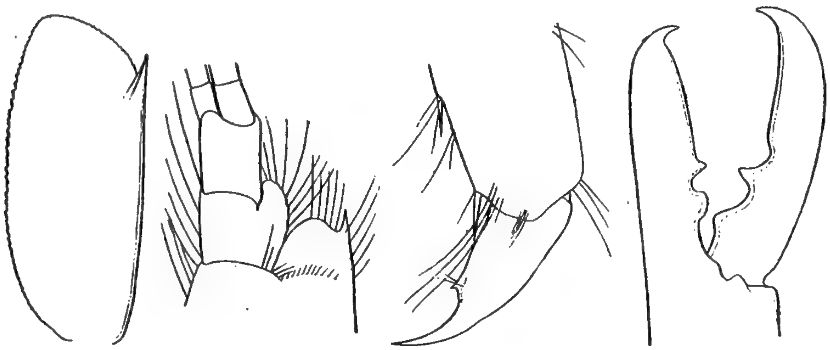
There is no supra-orbital spine. The lower limit of the orbit is drawn out into a narrow pointed process, beneath which is the antennal spine. The hepatic spine is large and placed on a lower level than the antennal.

In dorsal view the eyestalk is widest at the base; the cornea is rounded and scarcely wider than the stalk, on which it is set obliquely. The ocular spot is distinct and touches the cornea.

The antennular peduncle reaches only to about two-thirds the length of the antennal scale. The basal segment is very broad with a short lateral process. The distal margin external to the insertion of the second segment is produced anteriorly as a rounded lobe (text-fig. 25*b*); this lobe bears the customary terminal spine on the outer side of its apex and extends almost as far forwards as the articulation between the second and third segments. The external margin of the second segment is similarly produced beyond the insertion of the third segment. The free portion of the shorter of the two rami composing the outer antennular flagellum is about half the length of the fused part, the latter comprising 7 segments. The antennal scale (text-fig. 25*a*) is broad, about twice as long as wide; its outer margin is convex and terminates in a spine which fails to reach the end of the lamella.

The third maxillipeds are stout and reach nearly to the end of the basal antennular segment. They possess a small arthrobranch and the ultimate segment is about two-thirds the length of the penultimate. The first peraeopods are unusually heavy and reach beyond the scale by rather more than the length of the fingers. The merus is a little longer than the carpus and is about 5 times as long as broad. The carpus is 4 times as long as its distal breadth and is a little shorter than the chela. The fingers bear tufts of setae and are broadly spatulate, rather shorter than the palm.

The second legs are markedly unequal in the single specimen examined. The left leg, which is the larger, reaches beyond the



a. *b.* *d.* *c.*

TEXT-FIG. 25.—*Periclimenes rex*, sp. nov.

a. Antennal scale. *b.* Last two segments of antennule. *c.* Fingers of larger second peraeopods. *d.* Dactylus of third peraeopod.

scale by the whole length of the carpus and chela, the smaller leg by the chela only. The merus of the larger limb is rather less than 4 times as long as wide and bears a blunt tooth at the distal end on the lower side; it is about 2·2 times the length of the carpus. The carpus is conical, scarcely longer than its greatest breadth and has a deep and narrow excavation on the upper side of its distal margin. The chela is fully 1·5 times the length of the carapace and is 2·25 times as long as the merus. The palm is rather less than 4 times as long as wide and is 2·5 times the length of the fingers. The fingers (text-fig. 25*c*) have yellow inturned claws at their tips and are beset with a multitude of fine hairs.[1] On the inner edge of the dactylus at the base there is a large tooth which bears against a grinding surface at the proximal end of the dactylus, and in front of this, a little behind the middle point, there is a sharp conical tooth with a rounded excavation on either side. On the fixed finger there is a sharp tooth near the middle

[1] Not shown in text-fig. 25*c*.

point and behind it a semicircular excavation followed by a broad lobe with small denticulations on its summit. The smaller limb is closely similar, but the teeth on the fingers are less well developed.

The three posterior pairs of peraeopods are short and stout. The third reach the tip of the rostrum, the fifth the end of the merus of the first pair. The propodites bear some fine hairs but are without spinules on their posterior margins. In the third pair the merus is about 6 times and the propodus about 7 times as long as wide. The dactylus (text-fig. 25*d*) is broad and is less than a quarter the length of the propodus. The accessory dactylar spine is greatly reduced.

The sixth abdominal somite is about 1·5 times the length of the fifth. The anterior pair of spinules on the dorsum of the telson is placed at about the middle of the telson length, and the posterior pair midway between it and the apex. The terminal spines are short.

The single individual in the collection is an adult male about 21 mm. in length.

When living, the specimen was most gorgeously pigmented. The general colour was bright red; on the carapace there was a very large transverse diamond-shaped patch of pale fawn with closely aggregated cream spots, the whole patch circumscribed by deep red. The rostrum was red with minute spots of white and of white ringed with black. On each abdominal somite there was a transverse pale dorsal patch similar to that on the carapace, the patches on adjacent somites being confluent with one another. The last abdominal somite and telson were entirely pale fawn with cream-coloured spots. The cornea was red and the eyestalks red with whitish spots. The antennal scale was pale red, similarly spotted, and with the tip broadly margined with deep purple. The first two pairs of legs were red with the distal ends of the merus and carpus and the whole of the fingers purple. The last three legs were entirely rich purple, while the pleopods were red.

Periclimenes rex seems to hold an isolated position in the subgenus, but is perhaps distantly related to the *P. laccadivensis* section. By the form and armature of the rostrum it is readily distinguished from all other known forms.

C 402/1.	Port Blair, Andamans, 8 fms.	S. Kemp, March, 1921.	One male, TYPE.

The specimen, together with a single chela of a second individual, was found in Ross Channel, near the southern end. In the same haul of the net fragments of a red sponge with white tips were taken, the similarity in colouration suggesting that the prawn and the sponge were possibly associated with one another.

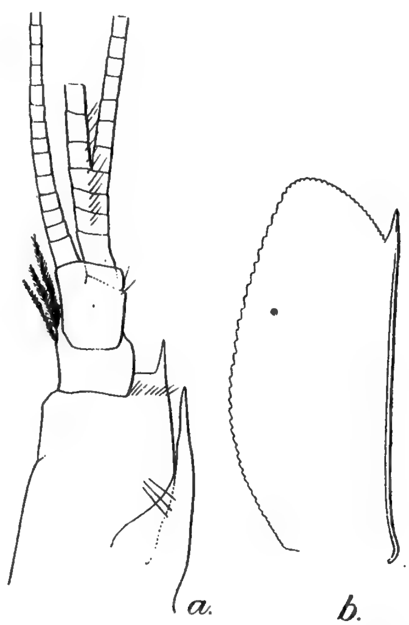
Periclimenes (Periclimenes) investigatoris, sp. nov.

(Plate V, fig. 6.)

A species of rather stout build. The rostrum is deep; it extends a little beyond the end of the antennular peduncle but does not reach the apex of the scale. It is quite straight, with slightly convex upper border, and bears 9 dorsal teeth in the single specimen examined. The posterior tooth is placed on the carapace behind the orbit, but is not separated from the second by a greater interval than that between the second and third; the second tooth is placed immediately above the posterior limit of the orbit. The sixth, seventh and eighth teeth are larger than the rest; the foremost is extremely small and placed close to the apex. The lower margin is strongly convex and bears a single tooth situated below the penultimate of those forming the dorsal series.

There is no supra-orbital spine. The antennal spine is sharp, with the hepatic placed behind it on a lower level. The eye is stout, with the ocular spot touching the cornea.

The basal segment of the antennular peduncle (text-fig. 26*a*) is broad; the spine forming the lateral process is of exceptional length, reaching as far forwards as the articulation of the second segment. The terminal spine of the outer margin is also very long, reaching the base of the third segment. The second and third segments are short and broad and the fused portion of the outer flagellum is composed of only four segments. The antennal scale (text-fig. 26*b*) is not quite 2·5 times as long as wide; the outer margin is straight and terminates in a strong tooth which does not reach the end of the lamella.

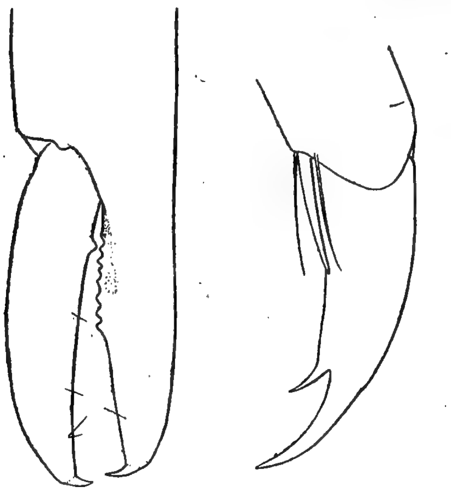


TEXT-FIG. 26.—*Periclimenes investigatoris*, sp. nov.

a. Antennule.
b. Antennal scale.

The antepenultimate segment of the third maxilliped is somewhat twisted and the ultimate segment is shorter than the antepenultimate. The first peraeopods reach beyond the end of the scale by the length of the chela. The carpus is shorter than the merus and about equal in length with the chela; the fingers are unarmed and shorter than the palm.

The second peraeopods are unequal, the left much larger than the right and reaching beyond the scale by more than the length of the chela; the two are, however, similar in structure. In the larger the merus is 1·75 times the length of the ischium and is less than 4 times as long as wide.[1] There are no spines on either merus or carpus. The carpus is conical, more than 1·5 times as long as wide. The palm is 3 times as long as broad and the fingers are about two-thirds its length. The fingers (text-fig. 27*a*) have large apical claws which cross one another when the claw is shut. The cutting edge of the fixed finger bears a series of small teeth in the proximal half of its length and there is one rather larger tooth in the basal third of the dactylus. The smaller limb of the same pair is similar, but the carpus is twice as long as wide and the fingers almost as long as the palm and without teeth.



TEXT-FIG. 27.—*Periclimenes investigatoris*, sp. nov.

a. Fingers of larger second peraeopod.
b. Dactylus of third peraeopod.

The last three pairs of peraeopods are rather stout; those of the third pair scarcely reach the tip of the scale. The propodus bears setae on its posterior margin; in the third and fourth pairs it is about 4·5 times the length of the dactylus and in the fifth pair about 6 times. The dactylus (text fig. 27*b*) is curved, rather slender and with a small accessory tooth.

The sixth abdominal somite is fully one and a half times the length of the fifth. The telson bears the usual two pairs of dorsal spinules, the first a little in advance of the middle, the second nearer to the first than to the apex. The external margin of the uropod is ciliated.

The above description is based on a single ovigerous female 15 mm. in length.

P. investigatoris is easily distinguished from any other species in the same subgenus by the great length of the spine forming the lateral process of the antennule.

C 350/1.	Persian Gulf, 13 fms., 29°20′ N., 48°47′ E.	"Investigator," Oct., 1905.	One, TYPE.

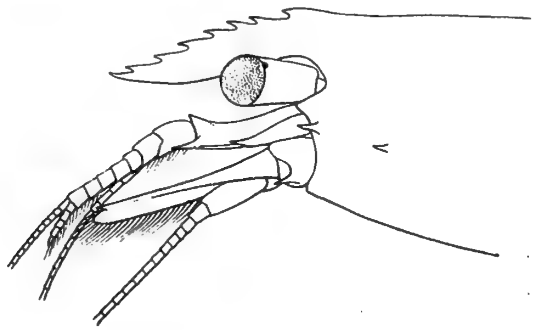
The specimen is labelled "found on an Alcyonarian."

Periclimenes (Periclimenes) noverca, sp. nov.

The rostrum (text-fig. 28) reaches a little beyond the end of the antennular peduncle. It is straight, but directed downwards

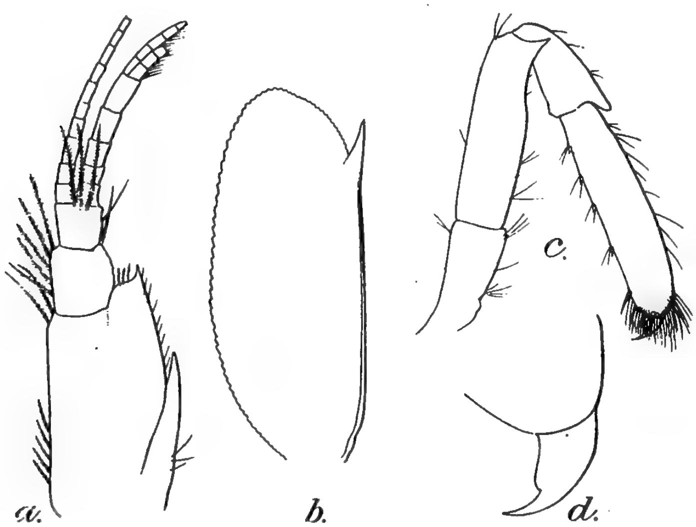
[1] The merus is too slender in the figure.

and is rather shallow in lateral view. On the upper border there are, in the single specimen examined, 7 equidistant teeth, the hindmost well in front of the posterior limit of the orbit. The lower border is slightly convex and is unarmed.



TEXT-FIG. 28.—*Periclimenes noverca*, sp. nov. Anterior part of carapace, rostrum, etc.

There is no supra-orbital spine. The lower limit of the orbit is acute. The antennal spine is strong, with the hepatic placed behind it on a slightly lower level. The eyes are rather slender.

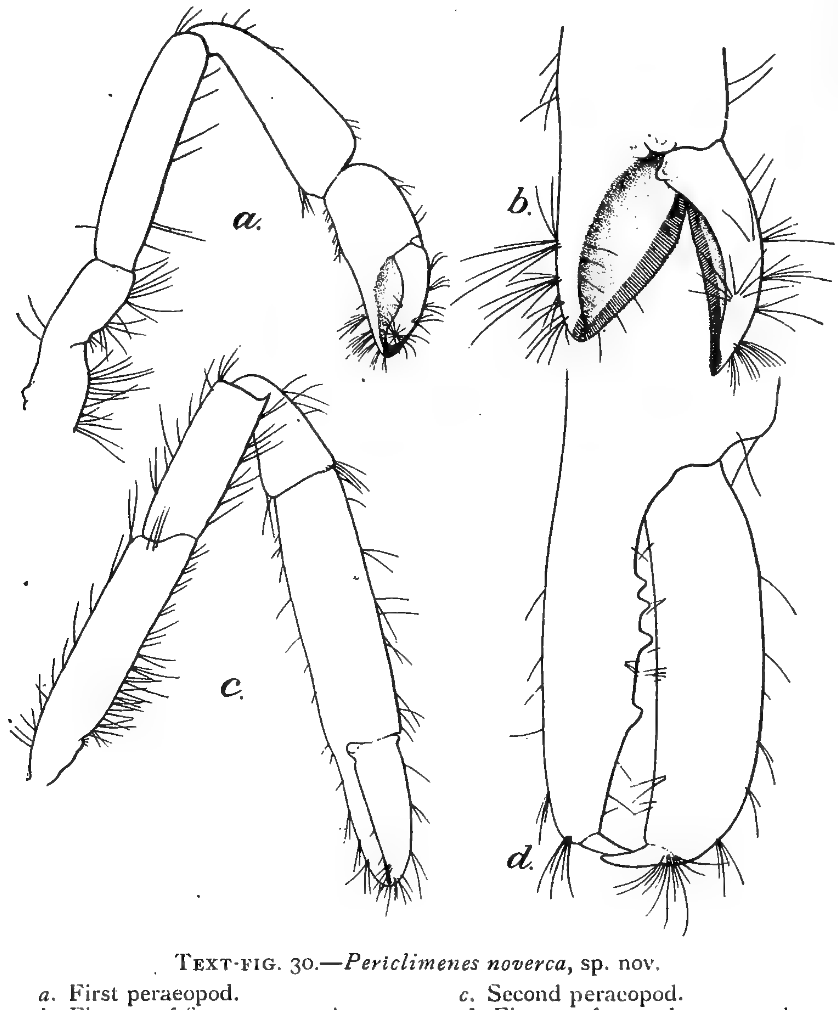


TEXT-FIG. 29.—*Periclimenes noverca*, sp. nov.

a. Antennule. *c*. Third peraeopod.
b. Antennal scale. *d*. Dactylus of third peraeopod (setae omitted).

The ocular spot is confluent with the cornea, which is hemispherical and a little wider than the stalk.

The lateral process of the antennular peduncle (text-fig. 29*a*) reaches beyond the middle of the basal segment; the anterior margin of this segment is greatly produced externally, the spine reaching beyond the middle of the second segment. The free portion of the stouter of the two rami composing the outer flagellum is rather more than half the length of the fused portion, the latter comprising 5 segments. The total length of the stouter ramus is less than the length of the peduncle. The antennal scale (text-fig. 29*b*) is about 2·5 times as long as wide. The outer margin is



TEXT-FIG. 30.—*Periclimenes noverca*, sp. nov.

a. First peraeopod. *c.* Second peraeopod.
b. Fingers of first peraeopod. *d.* Fingers of second peraeopod.

straight and ends in a spine which does not reach as far forwards as the very broadly rounded apex of the lamella.

The first peraeopod (text-fig. 30*a*) is unusually stout and reaches a little beyond the end of the antennal scale. The carpus is conspicuously shorter than the merus and is only 3 times as long as its distal breadth. The chela is very nearly as long as the carpus. The fingers (text-fig. 30*b*) are equal in length with the palm; each is broadly spatulate with the inner margin finely pectinate throughout.

The left second leg is missing in the single specimen examined, The right (text-fig. 30*c*) reaches beyond the antennal scale by less than half the length of the chela. The merus is about 3 times as long as wide and only two-thirds the length of the ischium; it bears a strong tooth at the distal end of the lower border. The carpus is short and conical, two-thirds the length of the merus and about 1·6 times as long as its distal breadth. The chela is about 3·6 times the length of the carpus; the palm is a little more than 3 times as long as wide. The fingers (text-fig. 30*d*) are rather more than half the length of the palm and have inturned tips; the dactylus is unarmed, but there are four small teeth on the fixed finger. There are long sparse hairs on all the segments.

The three posterior legs (text-fig. 29*c*) are short and stout; the third reach about to the end of the antennal scale. The merus in this pair is nearly 3·5 times as long as wide and bears a strong tooth at the distal end of its lower border; the propodus is 4·5 times as long as wide and from 5·5 to 6 times as long as the dactylus. The propodus bears spinules on its posterior margin and at the distal end is thickly clad with hairs that partially conceal the dactylus. The dactylus (text-fig. 29*d*) is small and curved, with the accessory claw found in most species of the subgenus replaced by a conspicuous rounded lobe.

The sixth abdominal somite is scarcely longer than the fifth. The anterior of the two pairs of spines on the dorsum of the telson is placed at about the middle of its length, the second pair midway between the first and the apex.

The single specimen is an ovigerous female about 16 mm. in length.

P. *noverca* is closely related to Nobili's *P. soror*, but is distinguished, as shown below, by a number of well-marked characters.

The type and only known example of this species was found at New Caledonia and is the property of the Paris Museum.

Periclimenes (Periclimenes) soror Nobili.

1904. *Periclimenes soror*, Nobili, *Bull. Mus. Paris*, X, p. 232.
1906. *Periclimenes soror*, Nobili, *Ann. Sci. nat., Zool.* (9) IV, p. 50, pl. ii. fig. 6.

This species, which I have not seen, agrees with *P. noverca* and differs from all other members of the subgenus *Periclimenes* in possessing a comb of fine teeth on each finger of the first peraeopod. According to Nobili's description it differs from the allied species in the following points:—

(i) There are 11–13 teeth on the upper margin of the rostrum.

(ii) The tooth at the outer distal angle of the basal antennular segment is short.

(iii) The first peraeopods are more slender, with carpus 4 times as long as its distal breadth.

(iv) The merus of the second leg is equal to or slightly longer than the ischium and does not bear a spine at the distal end of its lower border.

(v) The fingers of the second leg are only one-third the length of the palm.

(vi) The lower border of the merus of the last three legs does not end in a tooth.

(vii) The dactylus of the last three legs is provided with a small accessory spine and is only one-ninth the length of the propodite.

P. soror was described from Djibouti in the Red Sea.

Periclimenes (Periclimenes) commensalis Borradaile.

1915. *Perclimenes (Cristiger) commensalis*, Borradaile, *Ann. Mag. Nat. Hist.* (8) XV, p. 211.
1915. *Periclimenes commensalis*, Potts, *Publ. Carnegie Inst. Washington*, no. 212, p. 82.
1917. *Periclimenes (Cristiger) commensalis*, Borradaile, *Trans. Linn. Soc.* (2) *Zool.* XVII, p. 364.

I have examined the type of this species and think that Borradaile is mistaken in stating that there are two spines at the distal end of the basal antennular segment. The margin between the outer spine and the articulation of the second segment is somewhat more produced than usual, but is rounded and does not end in a spine. *P. frater*, Borradaile, which I refer to the subgenus *Ancylocaris*, appears to be the only species of the genus in which two spines occur in this position.

The accessory tooth on the dactyli of the last three peraeopods is small and inconspicuous in this species.

P. commensalis was found by Mr. Potts on *Comanthus annulatus* at the Murray Is., Torres Straits.

Subgenus **Periclimenaeus** Borradaile.

1915. *Periclimenaeus*, Borradaile, *Ann. Mag. Nat. Hist.* (8) XV, p. 207.
1916. *Periclimenes* subgen. *Hamiger*, Borradaile, *Brit. Antarct. Exped.* 1910, *Zool.* III, p. 87.
1917. *Periclimenaeus*, Borradaile, *Trans. Linn. Soc.* (2) *Zool.* XVII. p. 377.

The species of this subgenus resemble those of *Periclimenes* s.s. in having the dactyli of the last three peraeopods biunguiculate, but differ in the absence of the hepatic spine of the carapace. The second peraeopods are unequal and dissimilar and the chela of the larger limb is always very massive.

The status of the subgenus is precarious. The three species referred to it appear to form a natural group, but the only unequivocal point of distinction from *Periclimenes* s.s. is the absence of the hepatic spine. If, as is not improbable, a species is discovered which lacks this spine, but possesses affinities with *Periclimenes* s.s. rather than with *Periclimenaeus*, the latter subgenus will have to be abandoned. It will not be possible to distinguish the subgenus in a satisfactory manner by the form of the second peraeopods, as these limbs exhibit a very wide range of variation in *Periclimenes s.s.*

Borradaile in proposing *Hamiger*, a new subgenus of *Periclimenes*, for his *P. novae-zealandiae*, seems to have overlooked the fact that the species is closely related to the members of his *Periclimenaeus*. *P. novae-zealandiae* differs from the two species referred to the latter genus only in minor details of rostrum and chela which are clearly no more than specific.

Key to the species of the subgenus *Periclimenaeus*.

No teeth on lower border of rostrum; inner edges of fingers of larger chela provided with a knob fitting into a socket.
- Two posterior teeth of upper rostral series situated on carapace; larger chela with knob on dactylus and socket on fixed finger; fringes of setae on legs not remarkably long; R. 9 : 0 ... ... *robustus* (Borradaile).
- No teeth of upper rostral series situated on carapace; larger chela with knob on fixed finger and socket on dactylus; fringes of setae on legs remarkably long; R. 4-7 : 0 ... ... *fimbriatus* (Borradaile).

Two teeth on lower border of rostrum; larger chela with a huge bifid tooth at base, overlapping dactylus; R. 8 : 2 ... . *novae-zealandiae* (Borradaile).

Periclimenes (Periclimenaeus) robustus (Borradaile).

1915. *Periclimenaeus robustus*, Borradaile, *Ann. Mag. Nat. Hist.* (8) XV, p. 213.
1917. *Periclimenaeus robustus*, Borradaile, *Trans. Linn. Soc.* (2) *Zool.* XVII, p. 378, pl. lv, fig. 20.

Amirante I., 29-39 fms.

Periclimenes (Periclimenaeus) fimbriatus (Borradaile).

1915. *Periclimenaeus fimbriatus*, Borradaile, *Ann. Mag. Nat. Hist.* (8) XV, p. 213.
1917. *Periclimenaeus fimbriatus*, Borradaile, *Trans. Linn. Soc.* (2) *Zool.* XVII, p. 379. pl. lv, fig. 19.

Mulaku Atoll, Maldives. Providence I., 39–50 fms.

Periclimenes (Periclimenaeus) novae-zealandiae (Borradaile).

1916. *Periclimenes* (*Hamiger*) *novae-zealandiae*, Borradaile, *Brit. Antarct. Exped.* 1910, *Zool.* III, p. 87, text-fig. 4.

7 mi. E. of N. Cape, New Zealand, 70 fms.

Subgenus **Ancylocaris** Schenkel.

I include under this subgeneric name all those species of *Periclimenes* in which the dactylus of the last three legs is simple, without the additional claw or process found in *Periclimenes s.s.* and in *Periclimenaeus*.

As a primary character in dividing the large number of species which the subgenus contains I have employed the presence or absence of a spine or tooth at the distal end of the merus of the second peraeopod. De Man has found that a similar character in the third peraeopod is of great value in the genus *Alpheus*. I think it probable that a primary separation on these lines is at least as likely to demonstrate the true relationships of the species as any other, but the principal specific characters are combined in so many different ways that it is impossible in the present state of our knowledge to determine which indicate affinity and which are examples of convergence. The key which follows must therefore be regarded as artificial.

Key to the species of the subgenus *Ancylocaris*.

Section I. Merus of second leg without a spine or tooth at distal end of lower border.

- *A*. Supra-orbital spine present [hepatic spine present].
  - *B*. Cornea hemispherical.
    - *C*. Rostrum shallow; merus of second leg longer than carpus; R. 9 : 4 ... ... *nilandensis* Borr.
    - *C'*. Rostrum deep; merus and carpus of second leg subequal; R. 7 : 3 ... ... *edwardsi* (Paulson).
  - *B'*. Cornea conoidal, more or less pointed distally.
    - *C'*. Rostrum not reaching end of antennular peduncle.
      - *D*. Eye with conspicuous terminal papilla; R. 4 : 0 ... ... *ceratophthalmus* Borr.
      - *D'*. Eye without conspicuous terminal papilla; R. 7 : 1 ... ... *cornutus*[1] Borr.
    - *C'*. Rostrum reaching beyond end of antennular peduncle [eye without conspicuous terminal papilla]; R. 6 : 1 ... ... *amboinensis*,[1] de Man.
- *A'*. Supraorbital spine absent.
  - *B*. Hepatic spine present.
    - *C*. Rostrum reaching far beyond end of scale; carpus of second leg twice as long as chela; R. 6 : 0 ... ... *psamathe* (de Man).
    - *C'*. Rostrum not reaching beyond end of scale; carpus of second leg little if at all longer than chela.
      - *D*. Second legs excessively long, ischium almost reaching end of scale (? in males only); fingers of second leg scarcely one quarter length of palm; R. 7 : 0 ... ... *longipes* (Stimpson).
      - *D'*. Second legs rarely long, ischium not nearly reaching end of scale; fingers of second leg at least one-third as long as palm.
        - *E*. Carpus of second leg more than half as long as palm.
          - *F*. Distal spine of antennal scale reaching to or beyond end of lamella.
            - *G*. Carpus of second leg conspicuously longer than palm; dactylus of last three legs nearly one half as long as propodus.

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[1] In this species the second legs are unknown; it is assumed from its structural resemblance to *P. ceratophthalmus* that it falls in this section of the genus.

H. Second leg with carpus slightly longer than chela, fingers unarmed or with one minute tooth and much longer than palm; R. 8–9 : 2 ... *leptopus*, sp. nov.

H'. Second leg with carpus shorter than chela, fingers shorter than palm with large teeth; R. 8–9 : 4–5 ... *calmani* Tattersall.

G'. Carpus of second leg equal to or shorter than palm; dactylus of last three legs less than one third length of propodus.

H. A small papilla on eyestalk; carpus and chela of first leg subequal; second leg with carpus as long as palm and palm about as long as fingers; R. 7–9 : 2–5 ... ... *seychellensis* Borr.

H'. No papilla on eyestalk; carpus of first leg longer than chela; second leg with carpus shorter than palm and palm fully twice as long as fingers; R. 7–9 : 2–3 ... ... *americanus* (Kingsley).

F'. Distal spine of antennal scale not nearly reaching end of lamella.

G. Rostrum very shallow, downcurved, with 3 posterior dorsal teeth placed on carapace; last three legs extending far beyond scale; R. 9 : 3 ... .. *tenellus* (Smith).

G'. Rostrum deep or moderately deep, straight, with at most 1 posterior dorsal tooth placed on carapace; last three legs not extending beyond scale.

H. Upper border of rostrum very strongly convex, ventral tooth placed behind foremost dorsal tooth; R. 5–7 : 0–2 ... ... *diversipes*, sp. nov.

H'. Upper border of rostrum straight, ventral tooth in advance of foremost dorsal tooth; R. 5 : 1 ... ... *potina* Nobili.

E'. Carpus of second leg less than half as long as palm [distal spine of antennal scale not nearly reaching end of lamella].

F. No conspicuous[1] comb of spines on fingers of first leg.

G. Rostrum with at least ten dorsal teeth; sixth abdominal somite more than twice length of fifth; R. 10–13 : 3 ... *korni* (Lo Bianco).

G'. Rostrum with at most eight dorsal teeth; sixth abdominal somite less than twice as long as fifth.

H. Carpus of first leg longer than chela.

J. Rostrum deep in lateral view; a single spine at distal end of basal antennular segment.

K. Carapace of female greatly swollen dorsally; telson with dorsal spines very small, both pairs situated in distal half of its length; R. 5–7 : 0–2 ... *brevicarpalis* Schenk.

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[1] Under the microscope fine incisions may sometimes be detected in the cutting edges of the fingers of the first leg in *P. diversipes* (text-fig. 39*b*, p. 182).

K'. Carapace of female not swollen; telson with dorsal spines well developed, anterior pair situated in middle or in proximal half of its length.
L. Form stout; rostrum bent downwards, upper border almost straight with foremost tooth placed very close to apex; R. 6-8 : 0–2 ... *inornatus*, sp. nov.
L'. Form slender; rostrum straight, upper border strongly convex with foremost tooth not placed close to apex, R. 5–7 : 0–2 ... ... *diversipes*, sp. nov.
J'. Rostrum very shallow in lateral view; two spines at distal end of basal antennular segment; R. 6 : 1 ... ... *brocketti* Borr.
H'. Carpus of first leg about half length of chela; R. 6 : 3 ... *compressus* Borr.
F'. Each finger of first leg with a conspicuous comb of spines [two spines at distal end of basal antennular segment]; R. 12 : 0 ... ... *frater* Borr.
B'. Hepatic spine absent.
C. Second legs shorter than first; R. 5 : 0 ... *brevinaris* Nobili.
C'. Second legs longer than first; R 6 : 2 ... *pusillus* Rathbun.

Section II. Merus of second leg with a spine or tooth at distal end of lower border.

A. Each finger of first leg with a conspicuous comb of spines [hepatic spine present].
B. Supra-orbital spine present [other characters as in *P. petitthouarsi*]; R. 6–9 : 2–5 ... ... *spiniferus* de Man.
B'. Supra-orbital spine absent.
C. Merus of second leg with one spine below, carpus with two terminal spines, inner margin of each finger with a large oval pit; R. 6-9 : 3–5 *petitthouarsi* (Audouin).
C'. Merus of second leg with four spines below, carpus with three terminal spines, inner margin of each finger with a series of small denticles; R. 7 : 3 ... ... *denticulatus* Nobili.
A'. Fingers of first leg without a comb of spines.
B. Supra-orbital spine present.
C. Hepatic spine present.
D. Distal spine of antennal scale projecting far beyond end of lamella.
E. Rostrum shallow; last three legs long and slender, third pair with merus at least 11 times as long as broad, fifth pair reaching beyond scale.
F. No conspicuous terminal spine on inner side of carpus of second legs.
G. Carpus of first leg at least 1·75 times as long as chela; chela of second leg in males not more than 1·25 times, in females equal to or a little shorter than carpus; R. 7–9 : 1–3 ... ... *agag*, sp. nov.
G'. Carpus of first leg less than 1·5 times as long as chela; chela of second leg

more than 1·3 times as long as carpus in both sexes; R. 6–7 : 2–3 ... *proximus*, sp. nov.

F'. A conspicuous terminal spine on inner side of carpus of second leg.

G. Rostrum usually with 8 or more dorsal teeth; carpus of second leg of male about equal to or shorter than merus; R. 7–9 : 2–4 ... ... *andamanensis*, sp. nov.

G'. Rostrum with 6 or 7 dorsal teeth; carpus of second leg of male conspicuously longer than merus; R. 6–7 : 2 *suvadivensis* Borr.

E'. Rostrum moderately deep; last three legs stouter, third pair with merus at most 10 times as long as broad, fifth pair not reaching end of scale.

F. No spine at distal end of carpus of second leg; R. 7–8 : 3 ... ... *ensifrons* (Dana).

F'. At least one spine at distal end of carpus of second leg.

G. Only one spine at distal end of carpus of second leg, situated on inner side.

H. Foremost pair of dorsal spines of telson situated in anterior half of telson-length; R. 6–10 : 2–5 ... *grandis* (Stimpson).

H'. Both pairs of dorsal spines of telson situated in posterior half of telson-length; R. 6 : 4 ... ... *vitiensis* Borr.

G'. Two spines (at least in males) at distal end of carpus of second leg, one on inner side and one above.

H. Carpus of second leg 3 to 6 times as long as distal breadth; propodus of last three legs with spinules on posterior border.

J. Carpus of second leg of male about 6 times as long as wide, slightly longer than merus; R. 7 : 2 ... ... *affinis* Borr.

J'. Carpus of second leg of male not more than 4·5 times as long as wide, shorter than merus.

{ R. 6–8 : 3–5 ... *elegans* (Paulson).
{ R. 6–7 : 3–4 ... *holmesi* Nobili.

H'. Carpus of second leg (in female) scarcely 2·5 times as long as distal breadth; propodus of last three legs without spinules on posterior border; R. 8 : 3 ... ... *amymone* de Man.

D'. Distal spine of antennal scale not projecting beyond end of lamella [a terminal spine on inner side of carpus of second leg]; R. 7–9 : 1–3 ... ... *demani* Kemp.

C'. Hepatic spine absent ... ... *lifuensis* Borr.

B'. Supra-orbital spine absent.

C. Hepatic spine present.

D. Rostrum reaching far beyond antennal scale with at least 6 ventral teeth; R. 9–12 : 6–9 *tenuipes* Borr.

D'. Rostrum reaching little if at all beyond antennal scale with at most 2 ventral teeth.

E. Antennular peduncle reaching beyond antennal scale, its last two segments extremely long and slender; no ventral teeth on rostrum; R. 6 : 0 ... ... *longimanus* (Dana).

E'. Antennular peduncle not reaching end of antennal scale, its last two segments of normal proportions; at least one ventral tooth on rostrum.
F. Rostrum with at least 9 dorsal teeth; carpus of second leg unarmed.
G. Carpus and merus of second leg equal in length and longer than palm; propodus of third leg little more than twice as long as dactylus; R. 11 : 2 ... *digitalis*, sp. nov.
G'. Carpus of second leg very much shorter than either merus or palm; propodus of third leg fully 4 times as long as dactylus; R. 9-10 : 1 ... *brocki* (de Man).
F'. Rostrum with only 6 dorsal teeth; carpus of second leg with distal spine [carpus and palm of second leg subequal]; R. 6 : 2 .. .. *rotumanus* Borr.
C'. Hepatic spine absent; R. 3-4 : 1 ... *gerlachei* Nobili.[1]

Periclimenes (Ancylocaris) nilandensis Borradaile.

1915. *Periclimenes* (*Falciger*) *nilandensis*, Borradaile, *Ann. Mag. Nat. Hist.* (8) XV, p. 211.
1917. *Periclimenes* (*Falciger*) *nilandensis*, Borradaile, *Trans. Linn. Soc.* (2) *Zool.* XVII, p. 372, pl. liv, fig. 13.

S. Nilandu Atoll, Maldives.

Periclimenes (Ancylocaris) edwardsi Paulson.

1875. *Anchistia edwardsi*, Paulson, *Crust. Red Sea*, p. 114, pl. xvii, fig. 2.
1906. *Anchistia edwardsi*, Nobili, *Ann. Sci. nat., Zool.* (9) IV, p. 53.

Red Sea.

Periclimenes (Ancylocaris) ceratophthalmus Borradaile.

1915. *Periclimenes* (*Corniger*) *ceratophthalmus*, Borradaile, *Ann. Mag. Nat. Hist.* (8) XV, p. 211.
1917. *Periclimenes* (*Corniger*) *ceratophthalmus*, Borradaile, *Trans. Linn. Soc.* (2) *Zool.* XVII, p. 365, pl. liv, figs. 9*a*, *b*.

Male Atoll, Maldives, on crinoid.

Periclimenes (Ancylocaris) cornutus Borradaile.

1915. *Periclimenes* (*Corniger*) *cornutus*, Borradaile. *Ann. Mag. Nat. Hist.* (8) XV, p. 211.
1917. *Periclimenes* (*Corniger*) *cornutus*, Borradaile. *Trans. Linn. Soc.* (2) *Zool.* XVII, p. 365, pl. liv, figs. 10*a*, *b*.

Male Atoll, Maldives, on red and brown crinoid.

Periclimenes (Ancylocaris) amboinensis (de Man).

1887. *Anchistia amboinensis*, de Man, *Arch. Naturgesch.* LIII, i, p. 546, pl. xxii*a*, figs. 2, 2*a*,*b*.

[1] This species belongs to the genus *Harpilius*, but is included here as it is very likely to be confused with members of the subgenus *Ancylocaris*.

Both this species and *P. cornutus* were described from specimens in which the second peraeopods were missing; it is thus not altogether certain that they are properly referred to the subgenus *Ancylocaris*. They appear, however, to be closely related to *P. ceratophthalmus*, in which the merus of the second peraeopod is unarmed. *P. amboinensis* was described from Amboina.

Periclimenes (Ancylocaris) psamathe (de Man).

1902. *Urocaris psamathe*, de Man, *Abhandl. Senck. naturf. Ges.* XXV, p. 816, pl. xxv, figs. 51, 51*a–j*.
1917. *Urocaris psamathe*, Borradaile, *Trans. Linn. Soc.* (2) *Zool.* XVII, p. 323.

I have examined a specimen of this species in the Cambridge Museum and am able to state that it does not possess a mandibular palp. *P. psamathe* must thus be referred to the subgenus *Ancylocaris*, in which, however, by reason of the remarkable character of the rostrum and second peraeopod, it occupies a very isolated position.

The species was described from Ternate and has since been recorded by Borradaile from N. Male Atoll in the Maldives and from Diego Garcia in the Chagos Archipelago.

Periclimenes (Ancylocaris) longipes (Stimpson).

1860. *Urocaris longipes*, Stimpson, *Proc. Acad. Sci. Philadelphia*, p. 39.

Stimpson remarks that the end of the ischium of the second leg in this species reaches almost to the apex of the antennal scale; it is thus probable that this leg is proportionately even longer than in such extreme forms as *P. agag* and *P. tenuipes*. Stimpson's specimen was no doubt a male and, on analogy with other long-limbed species, it may be expected that the female does not possess such an inordinate length of leg. The species was found near Ousima I. at a depth of 20 fathoms.

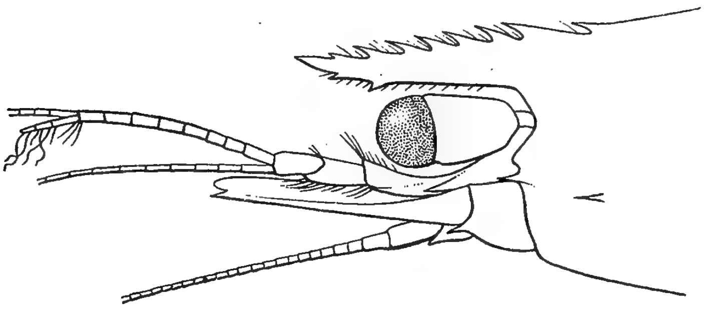
Periclimenes (Ancylocaris), leptopus sp. nov.

A species of slender habit with long legs. The rostrum (text-fig. 31) is straight and reaches to the end of the second or middle of the third segment of the antennular peduncle. It is armed above with 8 or 9 teeth,[1] the hindmost of which is separated by a considerable interval from the next of the series and is situated on the carapace behind the posterior limit of the orbit. On the lower margin there are 2 teeth, smaller than those on the upper margin and situated in the anterior third of the rostral length, beneath the two foremost of those comprising the dorsal series.

There is no supra-orbital spine. The hepatic and antennal

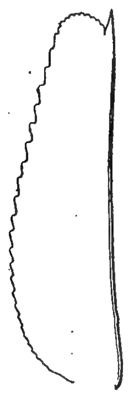
[1] In two specimens there are 8 teeth and in one 9.

are both sharp and are situated nearly on a level with one another. The eyes are large and stout, slightly flattened dorso-ventrally, and the ocular spot is confluent with the cornea.



TEXT-FIG. 31.—*Periclimenes leptopus*, sp. nov.
Anterior part of carapace, rostrum, etc.

The basal segment of the antennular peduncle is broad; the terminal spine of the outer margin is short and the lateral process reaches about to the middle of the segment. The two rami composing the outer antennular flagellum are fused for a distance almost equal to the total length of the peduncle, the fused portion consisting of 8 to 10 elongate segments. The free portions of both rami are extremely short. The antennal scale (text-fig. 32) is narrow, nearly 4 times as long as wide. The outer margin is slightly concave and terminates in a spine which reaches a little beyond the apex of the lamella.

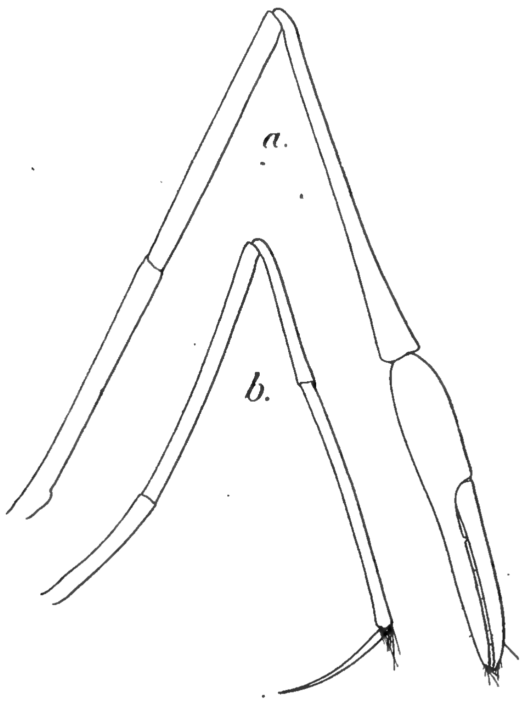


TEXT-FIG. 32.—*Periclimenes leptopus*, sp. nov.
Antennal scale.

The ultimate segment of the third maxilliped is scarcely more than three-quarters the length of the penultimate. All the peraeopods are very slender. The first pair reaches beyond the scale by the length of the chela. The carpus is a little shorter than the merus and a little longer than the chela; the fingers have simple cutting edges and are about one-fifth longer than the palm.

The second peraeopods (text-fig. 33*a*) extend beyond the scale by the whole length of the chela and carpus. All the segments are unarmed. The carpus considerably exceeds the length of the carapace (rostrum excluded); it is longer than the merus in the proportion of 4 to 3 and is fully 2·5 times as long as the palm. Its breadth at the distal end is about one-tenth its length. The chela is intermediate in length between the merus and carpus and the breadth of the palm is rather more than one-third its length. The fingers are straight with terminal claws that cross one another when the chela is shut; they are without teeth on their cutting edges and are nearly 1·5 times as long as the palm.

The last three peraeopods are extremely slender. The third pair (text-fig. 33*b*) reaches beyond the apex of the scale by two-thirds the length of the propodus, the fifth by about half the length of the propodus. There are some setae at the distal ends of the propodites, but no spinules on their posterior margins. The dactylus in each pair is very slender, simple, slightly curved and almost half the length of the propodus.



TEXT-FIG. 33.—*Periclimenes leptopus*, sp. nov.
a. Second peraeopod. *b.* Third peraeopod.

The sixth abdominal somite is about 1·5 times the length of the fifth. The anterior pair of dorsal spinules of the telson is placed a little in front of the middle point. The intermediate pair of apical spines is very long, about one-third the length of the telson. The outer uropod is nearly three times as long as wide.

The largest specimen is an ovigerous female about 12½ mm. in total length.

P. leptopus is easily distinguished by the proportions of the segments of the second peraeopods and by the comparatively great length of the dactyli in the last three peraeopods.

C. 354/1.	Port Blair, Andamans.	S. Kemp, Feb., 1915.	Three (two ovig.), TYPES.

The specimens were caught in Brigade Creek in a net hauled over a bottom composed of decaying vegetation at a depth of 2–5 fathoms.

Periclimenes (Ancylocaris) calmani Tattersall.

1921. *Periclimenes calmani*, Tattersall, *Journ. Linn. Soc., Zool.* XXXIV, p. 385, pl. xxvii, fig. 11; pl. xxviii, figs. 14–15.

The characters given for this species in the key on p. 169 are not all included in the description referred to above. Dr. Tattersall has, however, kindly informed me that the spine at the distal end of the antennal scale reaches to or very slightly beyond the apex of the lamella and that the dactylus of the last three peraeopods is simple. As in *P. leptopus* the dactylus of these limbs is very long, about two-fifths the length of the propodus.

The species was described by Tattersall from the Sudan coast.

Periclimenes (Ancylocaris) seychellensis, Borradaile.

(Plate VI, fig. 7.)

1915. *Periclimenes (Falciger) seychellensis*, Borradaile, *Ann. Mag. Nat. Hist.* (8) XV, p. 212.
1917. *Periclimenes (Falciger) seychellensis*, Borradaile. *Trans. Linn. Soc.* (2) *Zool.* p. 375, pls. liv, lv, figs. 14 *a–i*.

The rostrum reaches to, or a little beyond the apex of the antennal scale and is deep in lateral view with a concave upper border. Dorsally it bears from 7 to 9 teeth,[1] usually 8. The two hindmost teeth are situated on the carapace behind the orbit and are separated by a rather wide interval, the first being only a little in advance of the middle of the carapace. On the lower border there are from 2 to 5 teeth,[2] usually 3 or 4. The foremost teeth, both dorsally and ventrally, are placed close to the tip.

The supra-orbital spine is absent; the hepatic is present and is situated on a lower level than the antennal.

The eyes are rather slender, with hemispherical cornea. On the upper and anterior aspect of the stalk there is a small conical papilla, situated close to the cornea but separated from it by a shallow excavation. The development of the papilla is a little variable; as a rule it is quite conspicuous (text-fig. 34*a*), occasionally it is small and rarely it is almost indistinguishable, though the excavation is always distinctly seen when the eye is viewed from the proper angle. The ocular spot touches the cornea and is large. The cornea itself is traversed by two parallel wavy bands of dark pigment which are conspicuous in life and can often be detected in well preserved specimens.

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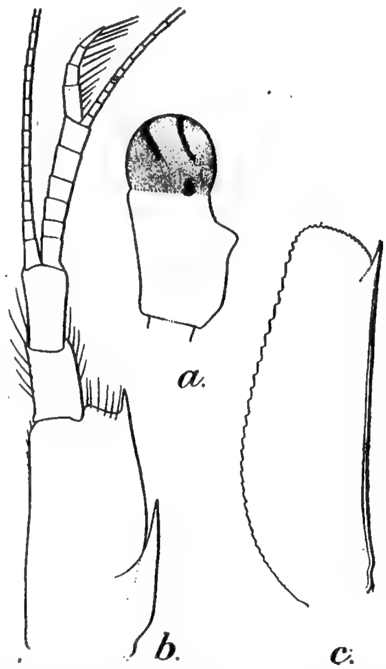
[1] Of sixty specimens seven have 7 dorsal teeth, forty have 8 and thirteen have 9.

[2] Of sixty specimens one has 2 ventral teeth, nineteen have 3, thirty-four have 4 and six have 5.

The lateral process of the antennule reaches to the middle of the basal segment and the terminal spine of this segment is well developed (text-fig. 34*b*). The second and third segments are rather slender and subequal. The free portion of the shorter ramus of the outer antennular flagellum is about two-thirds the length of the fused basal part, the latter comprising from 5 to 7 segments. The antennal scale (text-fig. 34*c*) is 3, or rather more than 3 times as long as wide. The outer margin is usually a little concave and ends in a spine which reaches almost or quite to the end of the lamella.



TEXT-FIG. 34.—*Periclimenes seychellensis* Borradaile.

a. Eye. *b*. Antennule. *c*. Antennal scale.

The third maxilliped bears on arthrobranch: the ultimate segment is about two-thirds the length of the penultimate. The first peraeopods (text-fig. 35*a*) reach about to the end of the antennular peduncle. The merus, carpus and chela are subequal in length and the fingers, which are unarmed, are about 1·25 times the length of the palm.

The second peraeopods (text-fig. 35*b*) are shorter than usual, extending beyond the scale by not more than half the length of the chela. There are no distal spines on the merus or carpus. In large specimens the carpus is a little shorter than the merus and equal to or slightly shorter than the palm; in smaller individuals the carpus is proportionately rather longer. The palm is a little inflated and is as long as or a trifle longer than the fingers. The fingers have inturned tips and straight cutting edges, with one or more small teeth at the proximal end.

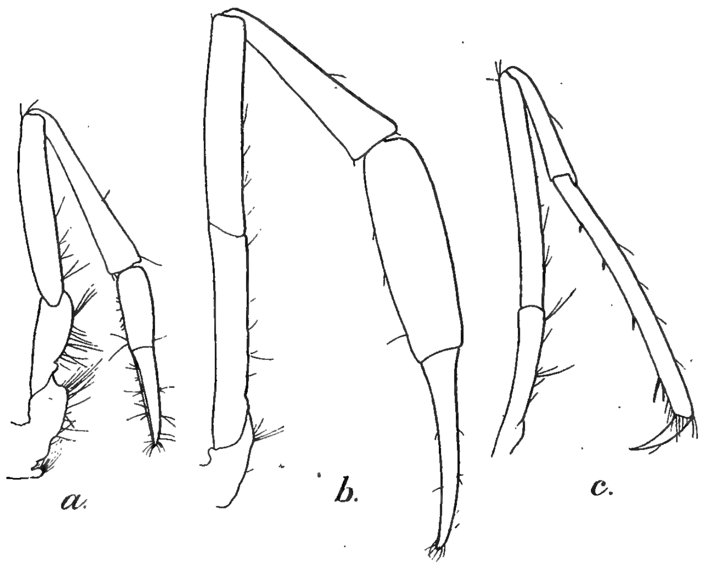
The last three pairs of peraeopods (text-fig. 35*c*) are slender and short, the third reaching by only a dactylus-length beyond the eye. The propodus bears a series of slender spines, frequently arranged in pairs, on its inferior margin and is from 3·5 to 4 times the length of the dactylus. The dactylus is moderately curved and is simple.

The sixth abdominal somite is 1·5 times the length of the fifth. The two pairs of dorsal spines on the telson are large and are placed so as to divide its length into three equal parts. The apex of the telson is sharply pointed and the intermediate pair of terminal spines is long.

Large females from the Gulf of Manaar reach a length of about 19 mm. Those I have seen from other localities are smaller, none exceeding 14 mm.

Specimens from the Andaman Is., when alive, were closely mottled with pale buff, lichen-green and brown.

Borradaile does not mention the curious papilla on the eye-stalk, but I have examined his type-specimens and find that it is present.



TEXT-FIG. 35.—*Periclimenes seychellensis* Borradaile.
a First peraeopod. *b.* Second peraeopod.
c. Third peraeopod.

The specimens in the collection are from the following localities:—

C 355/1.	Ain Musa, G. of Suez.	R. B. S. Sewell, 1916.	One.
C 356/1.	Tor, G. of Suez.	ditto	Ten.
C 357/1.	Kilakaraï, G. of Manaar.	S. Kemp, Feb., 1913.	Nineteen.
C 358/1.	Pamban, G. of Manaar.	ditto	F fteen.
C 359/1.	Port Blair, Andamans.	S. Kemp, Feb., 1915; Feb., March, 1921.	Many.

The species was described by Borradaile from Praslin, Seychelles.

The great majority of the specimens in the collection are ovigerous females. In the localities where I myself have found it, the species was taken among weeds in shallow water.

Periclimenes (Ancylocaris) americanus (Kingsley).

1878. *Anchistia americana*, Kingsley, *Proc. Acad. Sci. Philadelphia*, p. 96.
1882. *Anchistia americana*, Kingsley, *Bull. Essex Inst.* XIV, p. 109 pl. ii, fig. 10.
1901. *Periclimenes americanus*, Rathbun, *Bull. U. S. Fish Comm.* XX, ii, p. 121.

This species is related to *P. seychellensis*, but differs in the following points :—(i) the rostrum is shallow and its upper border is nearly straight; (ii) there is no papilla on the eyestalk; (iii) the antennal scale is proportionately narrower; (iv) the first peraeopods are much longer, extending beyond the scale by the length of the chela; (v) the carpus of these legs is conspicuously longer than the chela; (vi) the second peraeopods are much longer, extending beyond the scale by the whole of the carpus and chela; (vii) the carpus in these legs is shorter than the palm and the fingers are less than half as long as the palm; (viii) the last three peraeopods are much longer, the third reaching beyond the scale by nearly half the length of the propodus.

The species is known from the West Indies, Yucatan, Florida and the Bermudas. The specimens I have seen are from the last named locality.

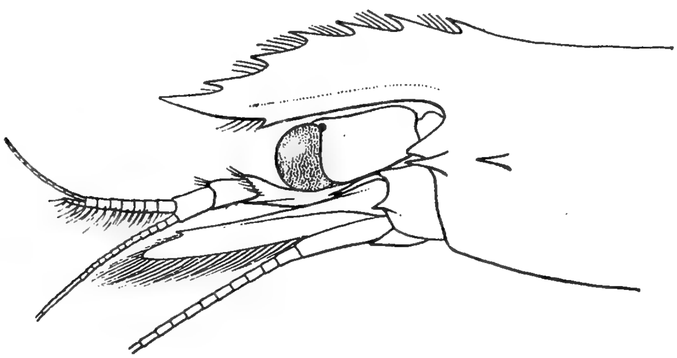
Periclimenes (Ancylocaris) tenellus (Smith).

1882. *Anchistia tenella*, Smith, *Bull. Mus. Comp. Zool. Harvard* X, p. 55, pl. ix, fig. 1.

N. W. Atlantic, 32°7′ N., 78°37′30″ W., 229 fathoms.

Periclimenes (Ancylocaris) diversipes, sp. nov.

The rostrum (text-fig. 36) varies considerably in length. Usually it reaches to the end of the second segment of the antennular peduncle; sometimes it is shorter, reaching only to the end of the first segment, sometimes longer, reaching the end of the

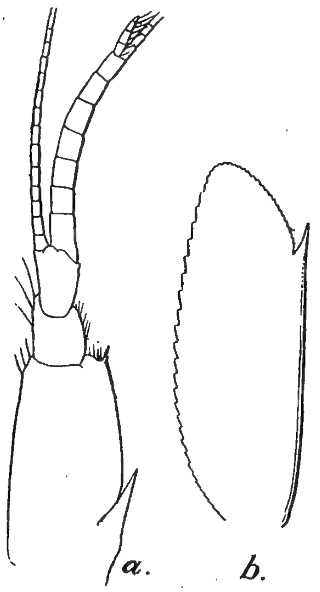


TEXT-FIG. 36.—*Periclimenes diversipes*, sp. nov. Anterior part of carapace, rostrum, etc.

peduncle. The upper portion of the blade is strongly arched and the rostrum is consequently deep in lateral view; the lower margin is straight at the base and slightly convex near the tip. On the convex upper border there are from 5 to 7 teeth,[1] most commonly 6. The hindmost of these is usually situated on the carapace behind the orbit and is not separated by any considerable interval from the next of the series. On the lower border there are from 0 to 2 teeth,[2] usually 1. The precise position of the ventral teeth is variable; the single tooth which the majority of specimens possess is situated below the ultimate or penultimate member of the dorsal series.

There is no supra-orbital spine. The hepatic spine is placed some distance behind the antennal and is on a level with it. The eye is moderately stout, with the stalk wider than the cornea. The ocular spot is placed close to the cornea but is separate from it.

The lateral process of the antennule (text-fig. 37*a*) reaches to the middle of the basal segment; the distal tooth of the outer margin is slender. The free portion of the shorter ramus of the outer flagellum is much less than half the length of the fused portion, the latter comprising 7 to 9 segments. The antennal scale (text-fig. 37*b*) is from 2·5 to 2·75 times as long as wide; the outer margin is straight, terminating in a spine which is far exceeded by the narrowly pointed apex of the lamella.



TEXT-FIG. 37.—*Periclimenes diversipes*, sp. nov.

a. Antennule.
b. Antennal scale.

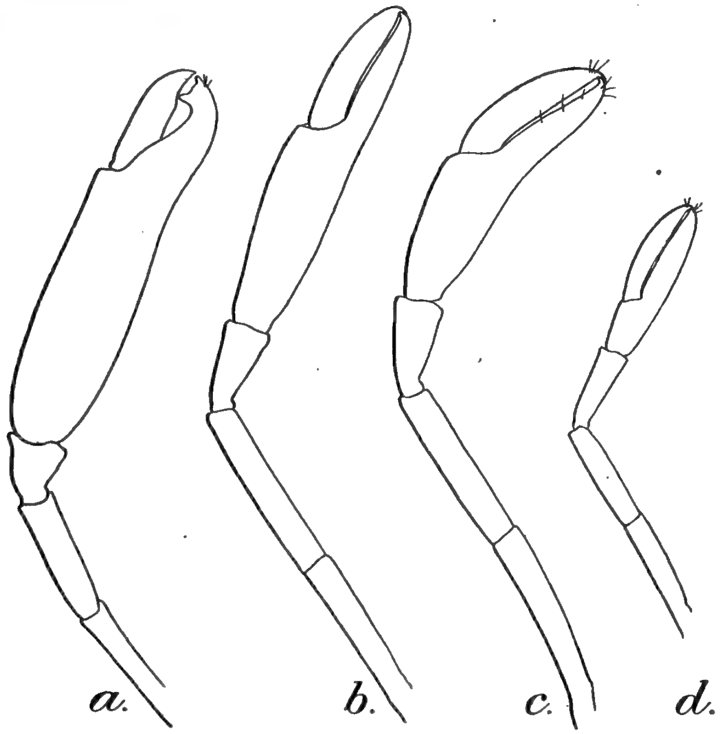
There is a small arthrobranch on the third maxilliped. The first peraeopods (text-fig. 39*a*) reach about to the end of the antennal scale. The carpus is about equal in length with the merus and is from 1·3 to 1·6 times as long as the chela. The fingers bear some tufts of setae and are almost or quite as long as the palm. They are somewhat spatulate; under all ordinary magnifications their cutting edges appear to be entire, but when viewed under a high power of the microscope the edge is sometimes seen to be

[1] Of ninety-six specimens twenty-seven have 5 dorsal teeth, forty-eight have 6 and twenty-one have 7.

[2] Of ninety-six specimens nineteen have no ventral teeth, seventy-five have 1 ventral tooth and two have 2 teeth.

divided by fine incisions into series of blunt-tipped teeth (text-fig. 39*b*).

The second peraeopods are usually unequal and are remarkable in that they exhibit four distinct types of structure within the limits of the species. The segments are always unarmed. In type *a*, the most highly developed form (text-fig. 38*a*), the limb may reach beyond the scale by more than half the length of the chela. The carpus is conical, little longer than broad and not much more than half the length of the merus. The chela is from 2·7



TEXT-FIG. 38.—*Periclimenes diversipes*, sp. nov.
The four types of second peraeopod.

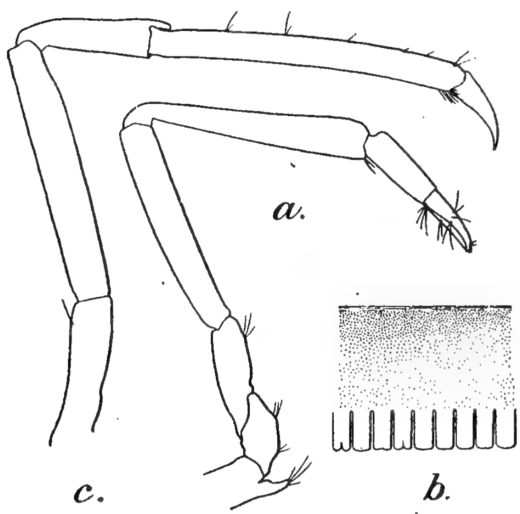
to 3·3 times as long as the merus and the fingers are less than half the length of the palm. The dactylus is normal in form with straight or nearly straight cutting edge and an inturned tooth at the tip. The fixed finger is very strongly curved and is provided at the apex with a short chisel edge with a blunt tooth at either end, opposed to the distal part of the dactylus. Owing to the strong curvature of the dactylus the fingers gape considerably when the claw is closed.

The second peraeopod of type *b* (text-fig. 38*b*)[1] may be nearly as large as type *a*. The carpus is more slender and the

[1] The chela is viewed a little obliquely and its full breadth is consequently not shown.

chela is at most twice the length of the merus; the fingers are both normal in form and are about two-thirds the length of the palm. Type *c* (text-fig. 38*c*)[1] is closely similar to type *b*, but the fingers are equal in length with the palm. The whole limb is smaller and is frequently not so long as the first peraeopod. Type *d* (text-fig. 38*d*) differs widely from any of the others; it is shorter than the first peraeopod and just as slender. The carpus is very slender, more than 2·5 times as long as wide and the fingers are twice or rather more than twice as long as the palm. On the inner face of the chela in types *b*, *c* and *d* the fingers tend to be hollowed out or spooned and this feature is particularly noticeable in *d*. I give below, at the end of this description, some notes on the different ways in which these four types of second peraeopod are combined to form a pair.

The last three pairs of peraeopods are rather slender; the third pair (text-fig. 39*c*) reaches to or a little beyond the end of the antennular peduncle. The propodus bears some fine setae, but except for one, rarely two, at its distal end the posterior edge is devoid of spinules. The dactylus is moderately stout, simple and curved; it is from one-third to one-fourth the length of the propodus.



TEXT-FIG. 39.—*Periclimenes diversipes*, sp. nov.
a. First peraeopod.
b. Cutting edge of finger of first peraeopod, very greatly enlarged.
c. Third peraeopod.

The sixth abdominal somite is about 1·7 times the length of the fifth. The anterior of the two pairs of dorsal spinules of the telson is situated a little behind the middle of its length; the posterior pair is midway between the anterior pair and the apex.

Adult specimens do not exceed 11 mm. in length; those from the Andamans are decidedly smaller than those from the Gulf of Manaar. In life the species is transparent, sometimes with short streaks of red pigment on the eyestalk, carapace, sides of abdomen and pleopods.

P. diversipes is closely related to Nobilis *P. piotina* and to *P. inornatus*, sp. nov.; the differences are explained below (pp. 184 and 194).

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[1] The carpus is sometimes rather more slender than in this figure.

C 364–5/1.	Kilakarai, Gulf of Manaar.	S. Kemp, Feb., 1913.	Forty-four, including TYPES.
C 366/1.	Port Blair, Andamans.	S. Kemp, March, 1915; March, 1921.	About one hundred.

In the Gulf of Manaar the species was caught at low water by working a hand-net among corals belonging to the genus *Montipora*. At Port Blair it was obtained by precisely similar methods from a large Alcyonarian belonging to the family Alcyonidae. When the net was worked elsewhere no prawns were captured and this fact leads me to believe that there is a real association between the Carids and the Coelenterates on which they were found.

The diversity of form in the second peraeopods is a very remarkable feature of this species. The largest specimens, as noted above, are from the Gulf of Manaar and of these the great majority are ovigerous females. The collection from this locality has unfortunately suffered damage and only a comparatively small number of individuals possess both the second peraeopods. The collection from Port Blair contains very few ovigerous specimens; the majority are young and it is possible that the characters of the second legs would undergo modification with further growth.

In specimens in which both the second legs are present the combination of structural types which go to form a pair is as follows :—

Types of structure found in a pair.[1]	Number of specimens.	
	G. of Manaar.	Andamans.
ad	3	1
bb	...	2
bc	5	30
bd	3	...
cc	...	60
cd	4	...
dd	2	...

Legs of types *b* and *c* show a certain amount of variation and it is sometimes a little difficult to distinguish between them. Those of types *a* and *d*, on the other hand, appear to be very constant; they show little variation and can always be recognised at a glance.

Legs of type *a* are invariably associated with those of type *d* and the specimens which possess this combination are all ovigerous

[1] The letters in this column refer to the description on pp. 181, 182 and to the figures in text-fig. 38.

females. The numbers are unfortunately low but there are numerous detached legs of type *a* in the Manaar collection.

Type *b* is most commonly associated with type *c*; the combination occurs in both collections and the specimens are often ovigerous. From the Andamans there are two examples of *bb*, both females, and from the Gulf of Manaar a few *bd*, all males.

Legs of type *c*, when not combined with *b*, are associated with *d* or with another limb of type *c*. The combination *cc* appears only in the Andaman collection, where it is very abundant in males and young females; *cd* is found in the Manaar collection in one male and three ovigerous females.

The combination *dd* is found only in two males from the Gulf of Manaar.

Although the specimens on which these observations are based are numerous, any speculations on the significance of this remarkable diversity in the form of the legs would at present be unprofitable. Further large collections of adults are necessary to provide more accurate data and valuable clues may be expected from field observations and from a knowledge of the relations that exist between the prawn and its hosts I will only remark here that I regard it as almost certain that legs of type *c* in course of growth reach type *b* and that it is not improbable that type *b* may develop into type *a*.

One point remains to be mentioned—the very curious differences between the two collections of specimens. The combination *cc*, to which the majority of the Andaman specimens belong, is not represented in the Manaar series, while type *d*, found in a large proportion of specimens from the latter locality, occurs only in one individual (in the combination *ad*) from the Andamans. Had it not been for this last specimen I should have been doubtful whether the Andaman form did not belong to a separate race or subspecies. On the information available I am satisfied that all are properly attributed to a single species. The only difference between the two sets of specimens lies in the types of second peraeopod which are combined to form a pair. This may be concerned with the different hosts on which the two series were found and it will be noticed that all four types of leg occur in both collections.

Periclimenes (Ancylocaris) potina Nobili.

1905. *Periclimenes potina*, Nobili, *Bull. Mus. Paris* XI, p. 159.
1906. *Periclimenes potina*, Nobili, *Bull. sci. France Belgique* XL, p. 44, pl. iii, fig. 8.

This species appears to be related to *P. diversipes* but, according to Nobili's description, is distinguished by the form of the rostrum and the proportions of the segments of the second peraeopod. The upper portion of the rostrum is not strongly arched, the posterior dorsal tooth is not situated on the carapace and the single tooth on the lower border is in advance of the foremost on the upper border. The carpus of the second peraeopod is scarcely more than a quarter the length of the chela and the fingers are longer than the palm. In specimens of *P. diversipes* in which the carpus is very short, the palm is always longer than the fingers.

P. potina was described by Nobili from three specimens obtained in the Persian Gulf, 16°35′ N., 54°26′ E., on floating brown seaweed.

Periclimenes (Ancylocaris) korni (Lo Bianco).

1903. *Anchistia kornii*, Lo Bianco, *Mitt. zool. Stat. Neapel* XVI, p. 250, pl. vii, fig. 13.
? 1910. *Periclimenes korni*, Kemp, *Journ. Marine Biol. Assoc.* VIII, p. 411.

Near Capri, Mediterranean, about 600 fathoms. ? Bay of Biscay, 412 fathoms.

Periclimenes (Ancylocaris) brevicarpalis (Schenkel).

(Plate VI, fig. 8.)

? 1880. *Nicht bestimmte Palaemonide*, Richters, in Möbius' *Meeresfauna Mauritius*, pl. xviii, fig. 10.
? 1893. *Palaemon* sp., Saville-Kent, *Barrier Reef of Australia*, p. 145, col. pl. ii.
? 1894. *Palaemonella amboinensis*, Zehntner, *Rev. suisse Zool.* II, p. 206, pl. ix, figs. 27, 27*a*.
1898. *Bithynis* sp., Coutière, *Bull. Mus. Paris* IV, p. 198.
1902. *Ancylocaris brevicarpalis*, Schenkel, *Verh. naturf. Ges. Basel* XIII, p. 563, pl. xiii, figs. 21*a–m*.
1904. *Palaemonella aberrans*, Nobili, *Bull. Mus. Paris* X, p. 233.
1905. *Harpilius latirostris*, Lenz, *Abhandl. Senck. naturf. Ges.* XXVII, p. 380, pl. xlvii, figs. 14, 14*a–c*.
1906. *Ancylocaris aberrans*, Nobili, *Bull. sci. France Belgique* XL, p. 52, pl. iv, figs. 9, 9*a*, *b*.
1906. *Ancylocaris aberrans*, Nobili, *Ann. sci. nat., Zool.* (9) IV, p. 64.
1914. *Periclimenes hermitensis*, Rathbun, *Proc. Zool. Soc. London*, p. 655, pl. i, figs. 1–3.
1916. *Ancylocaris aberrans*, Kemp, *Rec. Ind. Mus.* XII, p. 389.
1917. *Ancyclocaris aberrans, latirostris, hermitensis, brevicarpalis*, Borradaile, *Trans. Linn. Soc.* (2) *Zool.* XVII, pp. 355, 356.

Four specific names have been applied to brilliantly coloured Pontoniine prawns which are found living in association with giant anemones belonging to the genus *Discosoma*, but it appears to me improbable that more than one such species is at present known.

Borradaile, who has summarized the characters by which the four described forms are distinguished, remarks on the difficulty of separating them and suggests that some will eventually have to be united. This is the more probable since the species, being assigned to four different genera, were originally described without any thought of comparison with one another.

A series of specimens from Indian waters shows that the differential characters employed by Borradaile do not possess specific value. Though the normal variation is not great, it is sufficient to account for all or nearly all the differences he has noted. The descriptions themselves do not indicate other features of any importance and it is clear that if Nobili's *aberrans*, Lenz's *latirostris* and Miss Rathbun's *hermitensis* are to be retained as distinct, it must be by reason of fresh and hitherto undisclosed characters.

While in Paris in 1920 I was unable to examine the type of Nobili's *Palaemonella aberrans* from Djibouti, as the specimen had unfortunately been mislaid; but, through the courtesy of Prof. Ch. Gravier, I was able to see the female from Bahrein I. in the Persian Gulf which Nobili subsequently referred to the same species. In the figure of this specimen (*loc. cit.*, 1906, pl. iv, fig. 9) the dorsal swelling of the carapace is very greatly exaggerated, and the statement that a podobranch occurs on the second maxilliped is erroneous.

P. brevicarpalis in my estimation is a species of very wide distribution, extending from the Red Sea and east coast of Africa to the Santa Cruz Is. in Oceania. I have examined a specimen from the last named locality and have compared examples from the Torres Straits with the series in the Indian Museum collection. I am convinced that all belong to a single species.

The rostrum varies considerably in length. As a rule it reaches to or a little beyond the end of the antennular peduncle; rarely it is shorter, sometimes extending only to the middle of the second peduncular segment. In lateral view it is deep, with convex upper and lower margins and at the apex it is sometimes a trifle upturned. On the upper margin there are from 5 to 7 teeth[1] usually 6, which are for the most part evenly spaced. In about half the specimens the posterior dorsal tooth is situated a little behind the back of the orbit; in most of the others it is immediately above this point, while very rarely it is placed further forward. The distal upper tooth is not so near to the tip as to give it a bifid appearance. On the lower margin there are 1 or 2 teeth,[2] nearly always 1; these are scarcely smaller than those on the upper margin and are situated in the distal third of the rostral length. Very rarely specimens are found with the lower border unarmed.

The strong curvature or swelling of the dorsum of the carapace is only seen in large females; in males, and in females that are small or of moderate size, there is scarcely an indication of it.[3]

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[1] Of fifty-one specimens fifteen have 5 dorsal teeth, thirty-two have 6 and four have 7.

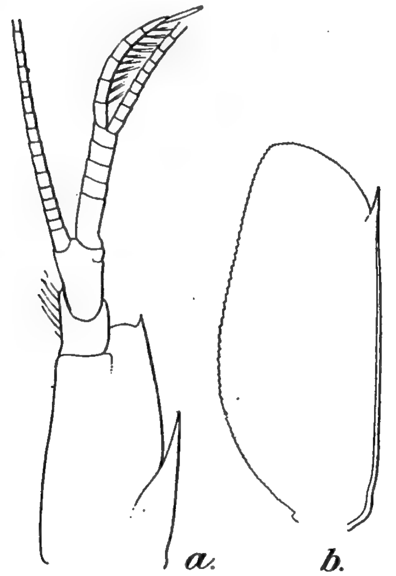
[2] Of fifty-one specimens one has the ventral margin unarmed, forty-six have 1 ventral tooth and four have 2 teeth.

[3] Only fourteen of the sixty-two specimens in the collection possess this swollen carapace. That the feature is not shown in Schenkel's figure is sufficiently explained by his statement,—"der Cephalothorax war wie es scheint etwas aufgetrieben, namentlich auf der Oberseite; leider hat er sich, der Weichheit des Tegumentes halber, nicht gut conserviert." In Nobili's figure, as I have remarked above the character is greatly exaggerated.

The antennal and hepatic spines are well developed, the latter being on a much lower level than the former.[1]

The eye is small and slender. In dorsal view the stalk is swollen at the base and broader than the hemispherical cornea.[2] There is a small ocular spot, placed close to the cornea but isolated from it.

The lateral process of the basal segment of the antennule (text-fig. 40*a*) reaches a little beyond the middle of the segment. Distally the basal segment projects beyond the articulation with the second and bears a small spine externally. The free portion of the shorter ramus of the outer flagellum is rather longer than the fused part, the latter consisting of 5 to 9 segments, most commonly 5 or 6. The outer margin of the antennal scale (text-fig. 40*b*) is slightly convex, terminating in a small spine which does not reach nearly as far forwards as the somewhat pointed apex of the lamella. In large specimens the scale is rather less than 2·5 times as long as wide.



TEXT-FIG. 40.—*Periclimenes brevicarpalis* (Schenkel).

a. Antennule.
b. Antennal scale.

The second maxilliped does not possess a podobranch. The third maxilliped is short and slender; it bears an arthrobranch and the exopod reaches to the middle of the penultimate segment. The ultimate segment is a little shorter than the penultimate.

The first peraeopods (text-fig. 41*a*) reach beyond the end of the scale by fully half the length of the chela. The merus is slightly longer than the carpus, the carpus distinctly longer than the chela; the fingers are unarmed and are about equal in length with the palm. The second peraeopods (text-fig. 41*b*) may reach beyond the scale by the whole of the chela and carpus in adult males; in females and young males they are slightly shorter. The legs of a pair are similar both in structure and size and except that they are longer in the male, there is no difference between the sexes.

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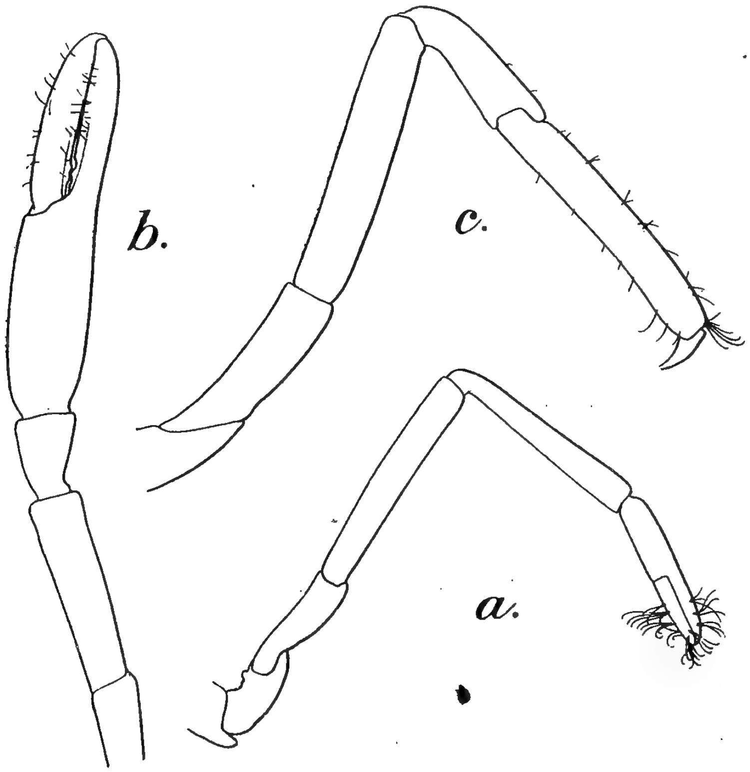
[1] Nobili's remark that the hepatic spine is placed further forwards in his specimens than in Schenkel's is not borne out by his figures or by his specimen from the Persian Gulf.

[2] In the figure the eye is greatly fore-shortened with the result that the cornea appears broader than the stalk.

There are no teeth on ischium, merus or carpus. The merus is nearly twice the length of the ischium and is equal to or a little longer than the palm. The carpus is short and conical, about 1·5 times as long as wide, with a deep notch on the inner side of the distal margin. The chela is large and in adults is about 5 times as long as broad. The fingers are at least two-thirds the length of the palm and have incurved tips and a cutting edge extending throughout their length. In adult males there are teeth in the proximal



TEXT-FIG. 41.—*Periclimenes brevicarpalis* (Schenkel).
a. First peraeopod. *b.* Second peraeopod.[1]
c. Third peraeopod.

third of the opposed margins, two on the dactylus and three or four on the fixed finger. These teeth are absent or inconspicuous in females.

The last three peraeopods (text-fig. 41*c*) are similar, the third reaching to or a little beyond the apex of the antennal scale. All are comparatively stout, with some setae but no spinules on the propodus; the latter segment is from 4·5 to 5 times as long as the dactylus. The dactylus itself is simple, broad at the base and curved.

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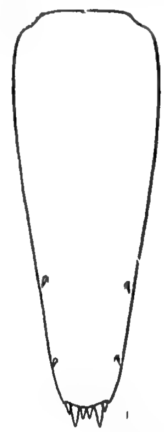
[1] Less magnified than the other figures.

The sixth segment of the abdomen is about 1·5 times the length of the fifth. The telson (text-fig. 42) is rounded above with two pairs of very small and inconspicuous dorsal spines. These spines are placed further back than usual, the foremost pair being situated much behind the middle of the telson The terminal spines are unusually thort. The outer uropod is scarcely more than twice as long as broad. At the distal end of its outer margin there is, as usual, a movable spine separating the ciliated and non-ciliated portions of the margin; but the fixed spine commonly found immediately in front of this movable spine is absent.



TEXT-FIG. 42.—*Periclimenes brevicarpalis* (Schenkel). Telson.

The largest specimen I have seen is a female 31 mm. in length.

The literature contains a number of references to the marvellous colouration of this species when alive and to its association with anemones of the genus *Discosoma*. Saville-Kent (*loc. cit.*, 1893) has given a coloured drawing of a prawn found on *Discosoma haddoni* which is perhaps intended for this species, but the figure is extremely poor. Coutière (*loc. cit.*, 1898), who refers to the prawn as *Bithynis* sp., says of specimens subsequently described by Nobili as *Palaemonella aberrans*,—"Un Palémonidé du genre *Bithynis* Dana mérite une mention spéciale par son habitat et sa coloration. Il est absolument transparent, mais se signale par quelques anneaux d'un violet pâle sur les appendices et l'abdomen, et surtout par des taches d'un blanc nacré éclatant, occupant la région stomacale tout entière, le coude de l'abdomen, l'extrémité des rames caudales et les épimères du deuxième segment. Ce magnifique Crustacé se tient obstinément dans la zone de protection que circonscrit une grande Actinie assez commune dans les flaques profondes qui séparent les madrépores. Étalé sur le sable, le disque oral de l'Actinie, de couleur blanchâtre, armé d'un très grand nombre de courts tentacules urticants, atteint souvent o m. 30 de diamètre. *Bithynis* se tient dans ce circle, nageant à peu de distance au-dessus, souvent par couples, et se laisse assez aisément capturer à l'aide d'une éprouvette pleine d'eau que l'on descend doucement sur l'animal."

Lenz (*loc. cit.*, 1905) describes the colour thus,—" Voeltzkow gibt die Farbe im Leben als wasserhell an. Beine an den Gelenk stellen dunkelblau, Körper dunkel und hell, mit rotbraunen und dunkelgelben Flecken ; Scheren an den Seiten mit weissem Längsstreifen. Augenstiele weiss." This description does not agree well with my own observations.

Miss Rathbun (*loc. cit.*, 1914) has described the colour of a specimen preserved in formalin and I have myself (*loc. cit.*, 1916) given a brief account of the colouration of the species when describing a Hippolytid which is also associated with *Discosoma.*

The following colour description was drawn up from an ovigerous female obtained in the Gulf of Manaar :—

The entire prawn, except for certain pigmented areas noted below, was almost completely transparent. The colouration of the ventral side could clearly be seen in dorsal view and the nerve-cord was distinctly visible. On the upper side of each eyestalk there was a white stripe which was continuous from side to side beneath the base of the rostrum. There was a large pure white patch on either side of the carapace and the gonad and associated organs were invested with a membrane covered with large closely-set white spots, clearly visible in dorsal view.

The hepatic regions and lower muscular portions of the carapace were dull venetian red. On the sides of each of the first three abdominal somites there was a large oval patch of glistening white, heavily outlined in black, which extended on to the sternum, and there was a broad band of the same colour on the posterior edge of the last abdominal somite and on the anterior half of the telson and uropods. In the latter half of the telson and of each uropod there was a brilliant eyespot; that on the telson was light orange bordered with black, while that on each uropod was similar, but with the orange centre shading distally to dark purple. All the other appendages, except the pleopods, were strongly suffused with blue, which was specially dark at the distal ends of the merus, carpus and palm of the second legs and formed a transverse band across the fingers. The cornea was grey and the eggs sage green.

It is evident from other notes, made by Col. Alcock on Gt. Coco I. and by myself at Port Blair, that there is very considerable variation in colour. The white patches on the abdomen were outlined in black in the specimen described above; but, just as frequently, they are bordered with orange, deep blue, or, according to Coutière, pale violet, while the eyespots in the tail-fan may be yellow in the centre, verging to red at the periphery and circumscribed with deep red-brown. In the distribution of the pigment, however, there appears to be little variation in specimens of the same sex and age.

Males lack the two white spots on the carapace and the membrane which invests some of the internal organs is without pigment. In young specimens the pigmentation is less well developed than in adults.

The appearance of this magnificently coloured prawn crawling and swimming in the immediate vicinity of the anemone is a sight not readily forgotten. That the colouration is in no degree protective is evident from the above description. The large white patches render it very conspicuous and I have already (*loc. cit.*, 1916) drawn attention to the remarkable fact that similar white patches or bands are a characteristic feature of the colour pattern of a Hippolytid and two species of fish which are also associated with *Disco-*

soma at Port Blair. Much careful observation in the field is necessary before we can come to any conclusions regarding the significance of the colour pattern or the exact nature of the relations that exist between the prawn and the anemone.

At Port Blair *P. brevicarpalis* was found at low water, either beneath the fringe of tentacles of the anemone, crawling on the disc or swimming in the immediate vicinity. I have not myself seen it enter the mouth of the anemone, though it is not improbable that it may do so. On several occasions, both at Port Blair and in the Gulf of Manaar the species has been taken in nets hauled in shallow water. I think that its occurrence under these conditions is to be explained by the assumption that the net passed over an anemone in its passage along the bottom. I have frequently seen the anemone at Port Blair in 10 feet of water.

The following specimens are in the collection of the Zoological Survey of India :—

C 360/1.	Kilakarai, G. of Manaar.	S. Kemp, Feb., 1913.	Two.
9299/6.	Spike I., Andamans.	'Investigator,' Nov., 1888.	One.
2966–70/7. 2984–90/7.	Gt. Coco I., Andaman group.	'Investigator,' Nov., 1890.	Twelve.
C 361-2/1.	Port Blair, Andamans.	S. Kemp, Feb., March, 1915; Febr., 1921.	Forty-five.

In the British Museum I have examined specimens from Murray I., Torres Straits (Potts coll.) and a much damaged individual from Singapore (Bedford and Lanchester coll.). In the Paris Museum I have seen the specimen from Bahrein I. in the Persian Gulf, recorded by Nobili as *Ancylocaris aberrans*; also one from Pulo Condore (Germain coll.) labelled " corps gélatineuse, taches jaunes," and one from Vanikoro in the Santa Cruz group, Oceania, labelled " sur actinie."

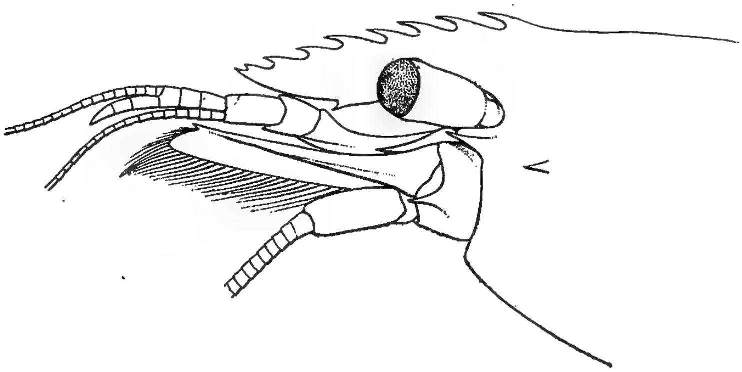
The species is recorded from Zanzibar, Kokotoni and Bawi in E. Africa (Lenz), from Djibouti in the Red Sea (Nobili), from Bahrein I., Persian Gulf (Nobili), from Macassar (Schenkel) from Hermite I., N.W. Australia (Rathbun) and from the Torres Straits (Borradaile). The specimens figured by Richters from Mauritius and by Saville-Kent from the great Barrier Reef of Australia probably also belong to this species.

Periclimenes (Ancylocaris) inornatus, sp. nov.

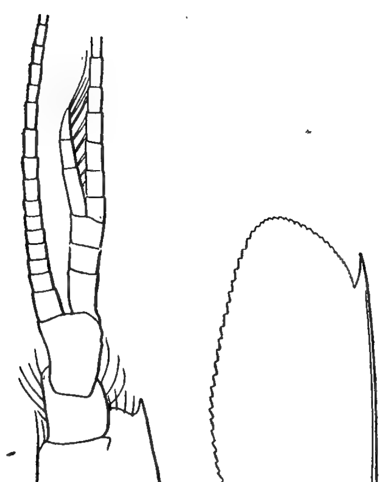
This species is closely allied to *P. brevicarpalis* and is also found in association with anemones of the genus *Discosoma*. The two species differ in the following particulars :—

P. brevicarpalis Sch.	*P. inornatus*, sp. nov.
Rostrum with 5 to 7 dorsal teeth, the foremost not placed close to apex.	Rostrum with 7 or 8 dorsal teeth, the foremost placed close to apex and often giving it a bifid appearance.
Carapace greatly swollen dorsally in adult females.	Carapace not swollen dorsally.
Hepatic spine of carapace situated on a much lower level than antennal.	Hepatic spine of carapace situated nearly on a level with antennal.

P. brevicarpalis Sch.	*P. inornatus*, sp. nov.
Dactylus of second peraeopod at least two-thirds as long as palm.	Dactylus of second peraeopod not more than half as long as palm.
Dorsal spines of telson very small, both pairs situated in distal half of its length.	Dorsal spines of telson large, anterior pair situated in proximal half of its length.
Brilliantly coloured when alive.	Without colour when alive.



TEXT-FIG. 43.—*Periclimenes inornatus*, sp. nov. Anterior part of carapace, rostrum, etc.



TEXT-FIG. 44.—*Periclimenes inornatus*, sp. nov. *a*. Antennule. *b*. Antennal scale.

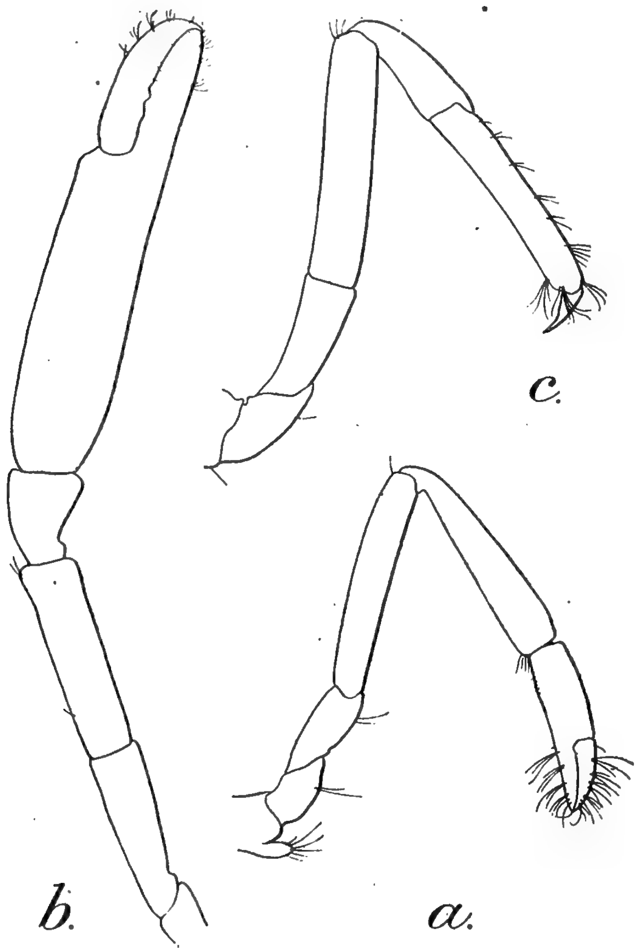
The rostrum is bent downwards and reaches to or a little beyond the end of the antennular peduncle (text-fig. 43). The upper margin is very slightly convex; the dorsal teeth[1] are evenly spaced, with the posterior tooth, as in the allied species, behind, above or a little in front of the hinder limit of the orbit. The single ventral tooth usually found[2] is small and situated beneath the fifth or sixth of those on the upper margin.

The eye is less slender than in *P. brevicarpalis*, but possesses an ocular spot as in that species. The fused part

[1] Of twenty specimens one has 6 dorsal teeth, eleven have 7 and eight have 8.
[2] Of twenty specimens one has no ventral teeth, eighteen have 1 tooth and one has 2 teeth.

of the outer antennular flagellum (text-fig. 44*a*) is almost or quite as long as the free portion of the shorter ramus and comprises 3 segments only. The antennal scale (text-fig. 44*b*) is about 2·25 times as long as broad.

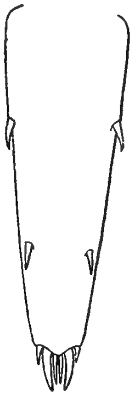
There is no arthrobranch on the third maxilliped. The proportionate lengths of the segments of the peraeopods are much



Text-fig. 45.—*Periclimenes inornatus*, sp. nov.
a. First peraeopod. *b.* Second peraeopod.
c. Third peraeopod.

the same as in the related species but the first and last three pairs are stouter (text-figs. 45*a*, *c*) and the fingers of the second pair are never more than half the length of the palm (text-fig. 45*b*). In large specimens the fingers of the second pair are provided with teeth on the proximal half of their inner margins; on the dactylus there are two or three recurved teeth and on the fixed finger four or five of irregular disposition. The dactyli of the last three peraeopods are simple and rather stout.

The dorsal spines of the telson (text-fig. 46), by their size and position, afford a ready means of distinguishing the species from *P. brevicarpalis*. The terminal spines also are longer. The outer uropod is nearly 2·5 times as long as broad, with a single movable spine near the end of its outer margin as in the allied species.



TEXT-FIG. 46.—*Periclimenes inornatus*, sp. nov. Telson.

The largest specimen is an ovigerous female about 17 mm. in length.

In life the species is almost completely transparent with a faint brownish tinge and with transparent eggs. It can only be detected with difficulty as it crawls among the short tentacles of the anemone.

In many of its characters *P. inornatus* resembles *P. diversipes*. The latter, however, is a much more slender species, with highly arched rostrum and with the foremost dorsal tooth not placed so near the apex. The fused part of the outer antennular flagellum is much longer than the free part of the shorter ramus and is composed of 7 to 9 segments, and the antennal scale is narrower and more sharply pointed distally. The second peraeopods of type *b* in *P. diversipes* are not unlike those of *P. inornatus*, but the fingers in this type are always more than half the length of the palm.

C 363/1.	Port Blair, Andamans.	S. Kemp. March, 1915.	Eighteen, including TYPES.
2991–2/7.	Gt. Coco I., Andaman group.	'Investigator,' Nov., 1890.	Two.

On both occasions the species was found on anemones of the genus *Discosoma* in company with *P. brevicarpalis*.

Periclimenes (Ancylocaris) brocketti Borradaile.

1915. *Periclimenes* (*Falciger*) *brocketti*, Borradaile, *Ann. Mag. Nat. Hist.* (8) XV, p. 212.
1917. *Periclimenes* (*Falciger*) *brocketti*, Borradaile, *Trans. Linn. Soc.* (2) *Zool.* XVII, p. 374, pl. lv, fig. 15.

Male Atoll, Maldives, on brown crinoid.

Periclimenes (Ancylocaris) compressus Borradaile.

1915. *Periclimenes* (*Falciger*) *compressus*, Borradaile, *Ann. Mag. Nat. Hist.* (8) XV, p. 212.
1917. *Periclimenes* (*Falciger*) *compressus*, Borradaile, *Trans. Linn. Soc.* (2) *Zool.* XVII, p. 373, pl. lv, fig. 18.

Saya de Malha.

Periclimenes (Ancylocaris) brevinaris Nobili.

1905. *Periclimenes borradailei*, Nobili, *Bull. Mus. Paris* XI, p. 159.
1906. *Periclimenes brevinaris*, Nobili, *Bull. sci. France Belgique* XL, p. 42, pl. iii, figs. 7, 7*a*.

Nobili in his description of this species speaks of the spines on the carapace as the "antennale" and "branchiostégale," but judging from his figure the former is merely the acute lower angle of the orbit, while the latter is the antennal spine. If I have interpreted the description accurately *P. brevinaris* lacks a hepatic spine and is related to Miss Rathbun's *P. pusillus*. In *P. brevinaris* the second peraeopods are shorter than the first, a character also found in some forms of *P. diversipes*.

The species is known only from a single specimen, obtained on the pearl-oyster banks in the Persian Gulf in 10–12 fathoms of water.

Periclimenes (Ancylocaris) pusillus Rathbun.

1906. *Periclimenes pusillus*, Rathbun, *Bull. U. S. Fish Comm.* XXIII, iii, p. 921, fig. 71.

Oahu, Hawaiian Is.

Periclimenes (Ancylocaris) spiniferus de Man.

1902. *Periclimenes petitthouarsi* var. *spinifera*, de Man, *Abhandl. Senck. naturf. Ges.* XXV, iii, p. 824.
1917. *Periclimenes (Falciger) spiniferus*, Borradaile, *Trans. Linn. Soc.* (2) *Zool.* XVII, p. 369, pl. LII.

Other references are given by Borradaile. In the series of specimens that I have examined there are from 6 to 9 teeth on the upper border,[1] usually 6 or 7, and from 2 to 5 on the lower border,[2] usually 3 or 4.

This species and *P. petitthouarsi* differ from all other Pontoniids in the curious armature of the fingers of the second chela. A pit or socket in one finger, for the reception of a tooth borne on the other finger, is not an uncommon arrangement in the subfamily; but in *P. spiniferus* and the related species each finger bears a large oval cup-shaped depression, the two cups being opposed to each other when the claw is shut. Tattersall remarks that a similar arrangement is found in *P. calmani*,[3] but judging from his figure he has misunderstood the structure in *P. spiniferus*. The cutting edges of the fingers in *P. calmani* appear to be quite normal and to bear teeth separated by rather deep notches, just as in *P. demani* and many other species of the genus.

In all well-preserved specimens a ring of black pigment may be seen on the upper side of the cornea. Adult males, when living, are for the most part semi-transparent with minute red and white

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[1] Of sixty-eight specimens twenty-one have 6 dorsal teeth, forty-five have 7, one has 8 and one has 9.

[2] Of sixty-eight specimens three (young) have 2 ventral teeth, thirty-eight have 3, twenty-five have 4 and two have 5.

[3] Tattersall, *Journ. Linn. Soc., Zool.* XXXIV, p. 386 (1921).

dots. On the anterior part of the carapace (sometimes on the posterior parts also) there are oblique or transverse bands of white dots, broadly outlined with deep carmine or black and the eyestalks are striped with the same colour. The distal ends of the merus, carpus and palm of the second peraeopods are suffused with orange or orange red and beyond this suffusion a white patch is frequently found. The fingers are spotted with black and often have a blue tinge. The other legs are finely dotted with red or reddish brown and with white. At the distal ends of the telson and each uropod there is a white spot and the setae of the uropods are sometimes dark blue at the base.

C 367–8/1.	Pamban, G. of Manaar.	S. Kemp, Feb., 1913.	Sixty-three.
9184/6.	Off Sentinel I., Andamans, 20 fms.	'Investigator,' Jan., 1888.	Two.
C 369/1.	Port Blair, Andamans.	S. Kemp, March, 1915.	Five.
C 370/1.	Samoa.	Purchased.	One.

The species has been recorded from Tamative Reef, Madagascar (Lenz), from Chagos Archipelago, Coetivy, the Seychelles and the Maldives (Borradaile), from Pulo Edam in the B. of Batavia, Amboina and Ternate (de Man) and from Tahiti (Heller). The species is usually, if not always, found on madrepore corals.

Periclimenes (Ancylocaris) petitthouarsi (Audouin).

1825. *Palaemon petitthouarsi*, Audouin, *Explic. somm. des planches de Crust.*, p. 91, in Savigny's *Descr. Egypte*, pl. x, fig. 3 (1809).
1915. *Periclimenes Petitthouarsii*, Balss, *Denk. math.-naturw. Kl. K. Akad. Wien* XCI, p. 25.
1917. *Periclimenes* (*Falciger*) *petitthouarsi*, Borradaile, *Trans. Linn. Soc.* (2) *Zool.* XVII, p. 369.
1921. *Periclimenes petitthouarsi*, Tattersall, *Journ. Linn. Soc., Zool.* XXXIV, p. 385.

For other references see Borradaile. In the series of specimens I have examined there are from 6 to 9 teeth on the upper border [1] of the rostrum, usually 7 or 8, and from 3 to 5 on the lower border, [2] usually 4. The ring of black pigment noticed in *P. spiniferus* on the upper side of the cornea is also present in this species.

C 371/1.	Tor, G. of Suez.	R. B. S. Sewell, 1916.	Twenty-three.

The species is abundant in the Red Sea and has been recorded by Nobili [3] from the vicinity of Arzana I. in the Persian Gulf. I have examined specimens from this last locality, belonging to the Paris Museum.

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[1] Of twenty-two specimens one has 6 dorsal teeth, fourteen have 7, six have 8 and one has 9.

[2] Of twenty-two specimens four have 3 ventral teeth, seventeen have 4 and one has 5.

[3] Nobili, *Bull. sci. France Belgique* XL, p. 42 (1906).

Periclimenes (Ancylocaris) denticulatus Nobili.

1906. *Periclimenes Petitthouarsi* var. *denticulata*, Nobili, *Bull. Mus. Paris* XII, p. 257.
1907. *Periclimenes Petitthouarsi* var. *denticulata*, Nobili, *Mem. Accad. Sci Torino* (2) LVII, p. 358.

Gatavake, Polynesia.

The species of the *P. grandis* group.

The following eleven species are very closely allied and belong to what may be termed the *P. grandis* group. They agree (i) in the possession of supra-orbital and hepatic spines, (ii) in the narrow antennal scale with distal spine far outreaching the end of the lamella, (iii) in the unarmed fingers of the first peraeopod, and (iv) in the presence of a spine at the distal end of the merus of the second peraeopod.

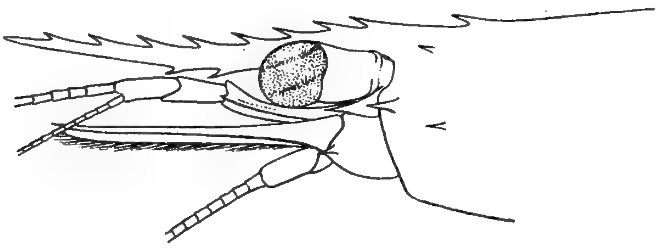
The species of this group are more difficult to identify than any others of the subfamily. Many of the characters depend on the proportions of various segments of the legs, which are never very easy to determine and there is considerable variation within the limits of a species. The proportions of the segments of the second legs undergo remarkable alteration with growth, especially in males, and are usually very different in adults of the two sexes.

In view of these difficulties I have thought it best to avoid the comparative method of description and, at the risk of becoming tedious, to give a detailed account of each of the species I have examined.

Periclimenes (Ancylocaris) agag, sp. nov.

(Plate VII, fig. 9.)

The rostrum (text-fig. 47) is slender; it reaches to or a little beyond the end of the antennal scale and is longer than the



TEXT-FIG. 47.—*Periclimenes agag*, sp. nov.
Anterior part of carapace, rostrum, etc.

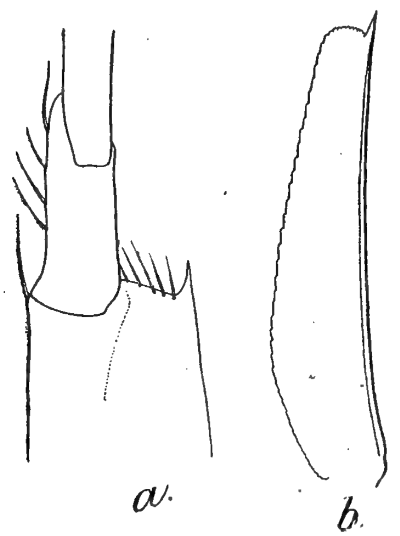
carapace. At the base it is straight, but it is a little upturned in its distal half. On the slightly concave upper border it bears from 7 to 9 teeth, nearly always 8 or 9.[1] The posterior tooth is rather

[1] Of twenty-seven specimens two have 7 dorsal teeth, twelve have 8 and thirteen have 9.

widely separated from the others and is placed on the carapace, the second being immediately above the orbit, the foremost near the tip and the rest more or less evenly spaced. On the lower border there are from 1 to 3 teeth, nearly always 2,[1] placed at about the middle of the rostral length.

The supra-orbital spine is conspicuous. The lower orbital angle is rounded, with the antennal spine below it; the hepatic is placed behind the antennal but on a lower level. The eyes are large and somewhat depressed. The cornea is wider than the stalk and usually shows traces of two concentric bands of dark pigment. The ocular spot touches the cornea.

The basal segment of the antennular peduncle has a short lateral process and the terminal spine (text-fig. 48*a*) is short, reaching little beyond the articulation of the second segment; the margin between the spine and the articulation is nearly straight. The second and third segments are slender. The free portions of the two rami composing the outer antennular flagellum are extremely short; the fused portion comprises some 9 to 11 segments. In the male the total length of the stouter ramus is not much less than that of the peduncle, in the female it is proportionately rather shorter. The antennal scale (text-fig. 48*b*) is nearly 5 times as long as wide; the outer margin is slightly concave, ending in a spine which extends far beyond the lamella. The apex of the lamella is broader than in most of the related species.



TEXT-FIG. 48.—*Periclimenes agag*, sp. nov.
a. Part of antennular peduncle.
b. Antennal scale.

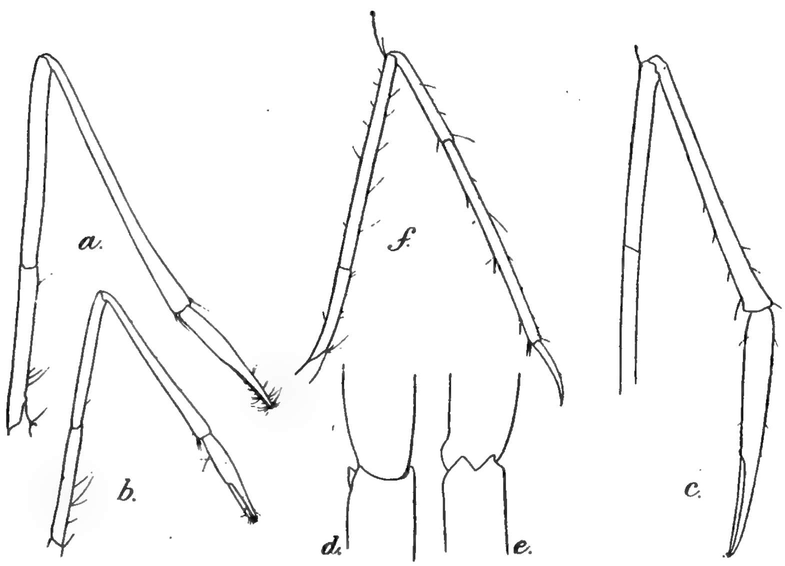
The third maxilliped bears a small arthrobranch. The exopod reaches the end of the antepenultimate segment, the latter bearing a few short spines on its outer margin. Excluding the terminal spine the ultimate segment is about three-quarters the length of the penultimate.

The first peraeopods (text-figs. 49*a*, *b*) are long and slender; in adult males the mero-carpal articulation reaches at least to the end of the second antennular segment. The carpus in adult males

[1] Of twenty-seven specimens one has 1 ventral tooth, twenty-four have 2 teeth and two have 3.

is fully 14 times as long as its distal breadth and may be nearly 1·5 times as long as the merus. In females the carpus is about 11 times as long as broad and 1·3 times the length of the merus. In large males the carpus is twice or rather more than twice the length of the chela, in small males and females about 1·75 times. The fingers are about equal in length with the palm and are unarmed.

The second peraeopods in large males reach beyond the scale by the chela, carpus and a considerable portion of the merus and are from 7 to 8·5 times the length of the carapace. The whole limb is



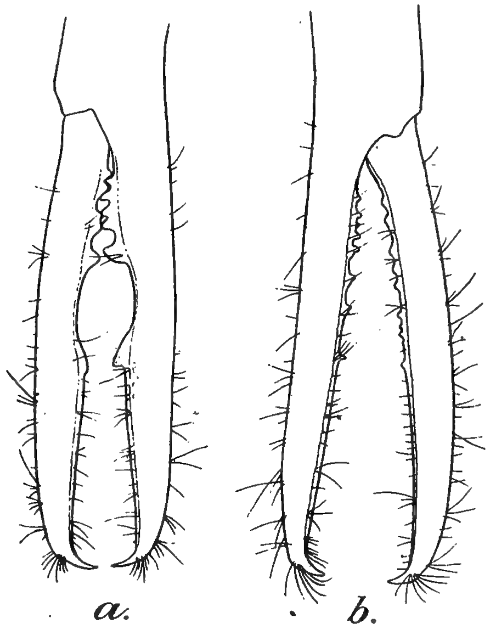
TEXT-FIG. 49.—*Periclimenes agag*, sp. nov.

a. First peraeopod of male.
b. First peraeopod of female.
c. Second peraeopod of female (less highly magnified than *a*, *b* or *f*).
d. Carpo-propodal articulation of right second peraeopod of male, viewed from above.
e. The same, viewed from the inner side.
f. Third peraeopod.

covered with minute asperities, visible only under the microscope. The ischium bears a small tubercle at the distal end of the lower margin. The merus is from 10 to 14 times as long as wide,[1] with a strong distal spine on the lower side; it is from 1·3 to 2 times as long as the ischium and about three-quarters the length of the carpus. The carpus is from 12 to 15 times as long as its distal breadth in large males,[2] from 10 to 12 times in small males. There is no conspicuous terminal spine on the inner side of the carpus; the distal end of the segment, viewed from the inner side shows two angular projections (text-fig. 49*e*) and one of these when seen from

[1] In measuring the breadth the spine at the distal end is not reckoned.
[2] The carpus is too slender at the distal end in plate vii, fig. 9.

above has the appearance of a short blunt tooth (text-fig. 49*d*). In this respect there is a marked difference between *P. agag* and certain related species such as *P. andamanensis* (*cf.* text-figs. 57*a*, *b*, p. 207) in which there is a sharp and prominent spine in this position. The chela is from 1·1 to 1·25 times the length of the carpus; the palm in the largest males is 2·5 times, in medium-sized specimens 1·9 times and in the smallest 1·6 times the length of the fingers. The fingers show great variation in form; frequently the cutting edges are straight and meet throughout their length when the claw is closed, bearing a series of small teeth in the proximal half or two-thirds of their length (text-fig. 50*b*). Often, however, there is a



TEXT-FIG. 50.—*Periclimenes agag*, sp. nov.
Fingers of second peraeopod of adult males.
a. Excavate type. *b*. Non-excavate type.

rounded excavation in each cutting edge a little behind the middle, with the result that a gap, sometimes almost circular in outline, is seen when the claw is shut (text-fig. 50*a*). The excavation in each finger is limited at either end by a tooth and a series of 3 to 6 teeth is found between the gap and the base of the fingers Males are not dimorphic in the structure of the fingers for specimens occur in an intermediate stage of development, with the notches in the fingers shallow and inconspicuous. In all large males which possess both the second legs the chelae of a pair are closely similar in structure.

In adult females the second peracopods (text-fig. 49*c*) are much shorter than in large males. The carpus is from 1·3 to 1·5 times the length of the merus and is equal to, or a little longer than the chela. The palm is about 1·4 times the length of the fingers, which are unarmed or with very small and inconspicuous teeth near the base.

The last three pairs of peraeopods are long and very slender (text-fig. 49*f*). In adult males the mero-carpal articulation of the third pair reaches almost or quite to the end of the basal antennular segment. In both sexes the fifth pair reaches beyond the end of the antennal scale by fully the length of the dactylus. The merus of the third pair is from 16 to 18 times as long as broad in adult males, 13 to 14 times in females. The propodites bear a few slender spinules on their posterior edges; in the male they from 3 to 3·3 times the length of the dactylus, from 2·7 to 3 times in the female. The dactylus is simple and curved, with a few setae in the middle of the anterior margin; it is very slender, from 7 to 8 times as long as its basal breadth.

The sixth abdominal somite is about 1·7 times the length of the fifth.[1] The foremost pair of dorsal spinules of the telson are placed in the anterior third of its length, the second pair midway between the first and the apex. The intermediate apical spines are very long.

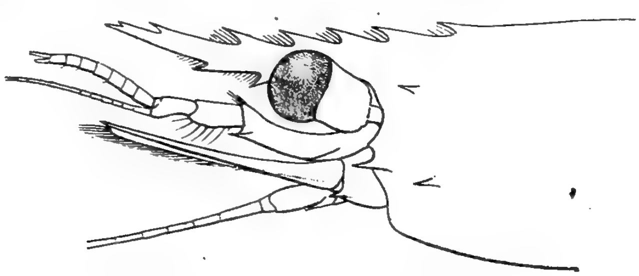
Large specimens are about 16·5 mm. in length.

C 374–6/1.	Port Blair, Andamans, 4–8 fms.	S. Kemp, Feb., 1915; Feb., March, 1921.	Thirty-five, including TYPES.

All the specimens were found in Ross Channel on a bottom composed mainly of small corals and sponge-encrusted stones.

Periclimenes (Ancylocaris) proximus, sp. nov.

The rostrum (text-fig. 51) is slender and reaches almost to or a little beyond the apex of the antennal scale. It is a little up-



TEXT-FIG. 51.—*Periclimenes proximus*, sp. nov. Anterior part of carapace, rostrum, etc.

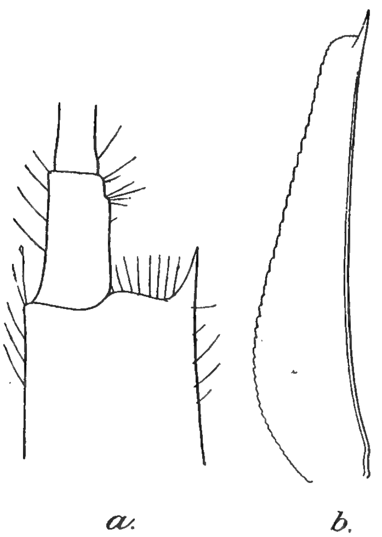
turned in its distal third and bears on the slightly concave upper margin 6 or 7 large teeth, usually 7.[2] The posterior tooth is placed on the carapace and is rather more distant from the second than the second is from the third; the remainder are more or less evenly

[1] It is too short in plate vii, fig. 9.
[2] Of twenty-one specimens four have 6 dorsal teeth and seventeen have 7.

spaced and the seventh tooth, when present, is much smaller than the rest and placed quite close to the apex. On the lower border there are 2 or 3, nearly always 2 teeth,[1] which are large and placed in advance of the middle of the rostrum.

Supra-orbital, antennal and hepatic spines are present as in *P. agag*. The eyes are large and depressed; the cornea is wider than the stalk and in freshly preserved specimens usually shows two concentric rings of dark pigment. The ocular spot touches the cornea.

The basal segment of the antennular peduncle has a short lateral process, not reaching the middle of the segment; its terminal spine is long, reaching the middle of the second segment, and the margin between the base of this spine and the articulation is gently convex (text-fig. 52*a*). The two distal segments are slender. The free portion of the stouter ramus of the outer antennular flagellum is very short; the fused portion consists of 7 to 11 segments. The total length of the stouter ramus is considerably less than that of the peduncle. The antennal scale (text-fig. 52*b*) is from 4·5 to 5·8 times as long as wide and is proportionately longest in large males. The scale is very narrow at the apex. The outer margin is strongly concave and terminates in a spine which far outreaches the end of the lamella.



TEXT-FIG. 52.—*Periclimenes proximus*, sp. nov.
a. Part of antennular peduncle.
b. Antennal scale.

The third maxilliped bears a small arthrobranch. The exopod reaches the end of the antepenultimate segment, the latter bearing one or two spines on its outer edge. The ultimate segment, excluding the terminal spine is about two-thirds as long as the penultimate.

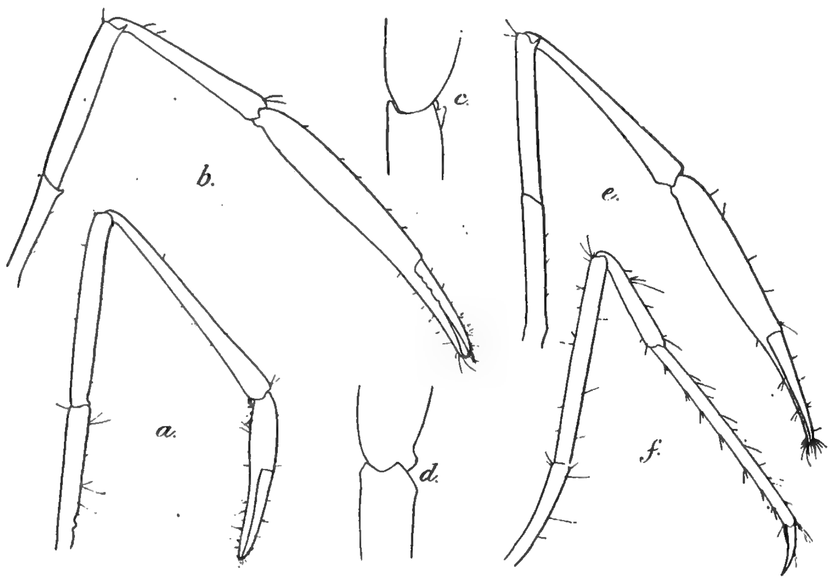
The mero-carpal articulation of the first peraeopods reaches the end of the second segment of the antennular peduncle in adult males, not quite so far in females. The carpus in adults of both sexes is from 1·2 to 1·3 times the length of the merus and about 1·4 times the length of the chela (text-fig. 53*a*). The limb is stouter than in *P. agag*; in an adult male the carpus is 10 times as long as

[1] Of twenty-one specimens twenty have 2 ventral teeth and one has 3.

its distal breadth, in an adult female 8·5 times. The fingers are longer than the palm and are unarmed.

The second peraeopods bear a conspicuous subterminal spine on the lower side of the merus. In large males they may be as much as 6 times the length of the carapace, extending beyond the scale by more than the length of the carpus and chela. The legs of a pair are equal or subequal and similar in structure. As in *P. agag* the second legs of males are closely covered with minute asperities only visible under a microscope.

In large males (text-fig. 53*b*) there is a conspicuous tubercle



TEXT-FIG. 53.—*Periclimenes proximus*, sp. nov.

a. First peraeopod of male.
b. Second peraeopod of male.
c. Carpo-propodal articulation of right second peraeopod of male, viewed from above.
d. The same, viewed from the inner side.
e. Second peraeopod of female.
f. Third peraeopod.

at the distal end of the lower border of the ischium. The merus is from 7·0 to 8·0 times as long as broad. The carpus is from 1·0 to 1·2 times as long as the merus and from 7·0 to 8·0 times as long as its distal breadth. The distal end of the carpus is similar in structure to that of *P. agag* and does not bear a conspicuous spine on the inner side (text-figs. 53*c*, *d*). The chela is from 1·4 to 1·7 times the length of the carpus; the palm is about 5 times as long as wide and from 1·95 to 2·2 times the length of the fingers. In all the males examined, the fingers meet throughout their length when the claw is closed.[1] Each is armed in the proximal half

[1] The number of large specimens in the collection is small; it is very probable that more highly developed males with gaping fingers remain to be discovered.

with a series of 4 to 8 small teeth, very irregular in their size and disposition.

In a small male the carpus is only about 6 times as long as its distal breadth, while the chela is 1·7 times its length. The palm is rather more swollen than in large males, about 4·5 times as long as broad.

The female differs conspicuously from that of *P. agag* in that the chela is always definitely longer than the carpus. In an ovigerous specimen (text-fig. 53*e*) the carpus is 7·5 times as long as its distal breadth and 1·25 times as long as the merus. The chela is 1·4 times as long as the carpus, with palm 1·6 times as long as the fingers.

The last three pairs of peraeopods are slender; the fifth reach to or a little beyond the end of the antennal scale. In the third pair (text-fig. 53*f*) the merus is from 11·5 to 12·5 times as long as wide. The propodite bears conspicuous spinules on its posterior border and is from 3·5 to 4·0 times as long as the dactylus. The dactylus is slender and curved, with a few setae in the middle of its anterior margin, and is from 5 to 6 times as long as its basal breadth.

The sixth abdominal somite is rather less than 1·5 times the length of the fifth. The telson resembles that of *P. agag*.

The largest specimen is a male, about 17·5 mm. in length.

I have no notes on the colouration of living specimens as the differences between this and other closely related forms were not noticed in the field. In specimens, however, which have only been a few months in alcohol a bright red spot is to be seen at the end of the carpus of the second leg and a narrow red band across the fingers of the same appendage. This colouration is not found in any of the allied species.

The principal differences between *P. proximus* and *P. agag* may be summarized thus:—

P. proximus, sp. nov.	*P. agag*, sp. nov.
Rostrum with 6 or 7 dorsal teeth.	Rostrum usually with 8 or 9 dorsal teeth.
Carpus of first peraeopods less than 1·5 times length of chela.	Carpus of first peraeopods in females and young males 1·75 times, in adult males twice the length of chela.
Chela of second peraeopods in males from 1·4 to 1·7 times length of carpus.	Chela of second peraeopods in males 1·1 to 1·25 times length of carpus.
Chela of second peraeopods in females conspicuously longer than carpus.	Chela of second peraeopods in females equal to or a little shorter than carpus

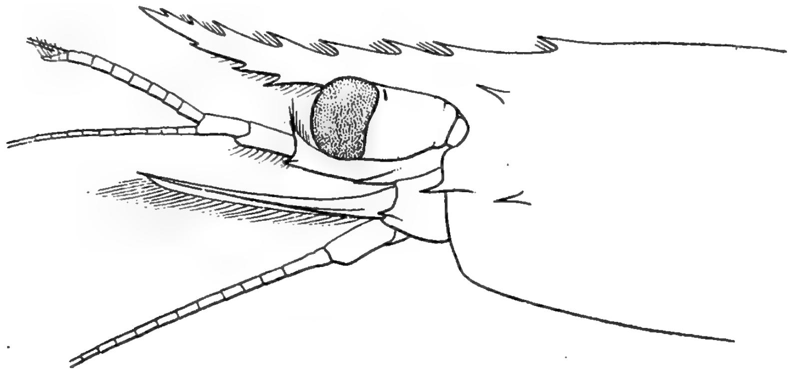
C 377–9/1.	Port Blair, Andamans. 4–8 fms.	S. Kemp, March, 1915; Feb., March, 1921.	Twenty-two, including TYPES.

The specimens were found in Ross Channel in company with *P. agag* and *P. andamanensis*.

Periclimenes (Ancylocaris) andamanensis, sp. nov.

This species differs conspicuously from the two preceding in the presence of a conspicuous distal spine on the inner side of the carpus of the second peraeopods.

The rostrum (text-fig. 54) is slender and reaches to or a little beyond the apex of the antennal scale. It is straight in its proximal half but trends upwards distally. On the slightly concave upper border it bears from 7 to 9 teeth, nearly always 8 or 9;[1]

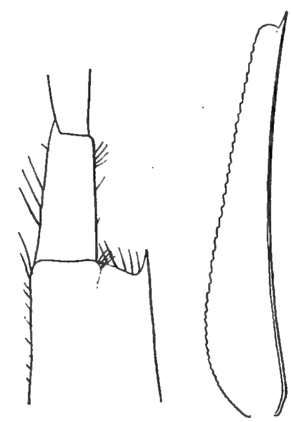


TEXT-FIG. 54.—*Periclimenes andamanensis*, sp. nov. Anterior part of carapace, rostrum, etc.

the hindmost of these is situated on the carapace and is separated by a rather wide interval from the second, which is placed above the hinder limit of the orbit. The rest of the teeth are more or less evenly spaced, extending to the tip. On the lower border there are 2 or 3 teeth, most commonly 2,[2] placed a little in advance of the middle of the rostrum.

The supra-orbital, antennal and hepatic spines resemble those of the preceding species. The eyes also are similar but usually show only one faint band of dark pigment on the cornea.

The basal segment of the antennular peduncle has a short lateral process; the distal spine of the outer margin is very short (text-fig. 55*a*), it extends little beyond the articulation between the first and second segments and the margin between the spine and the articulation is almost straight. The two distal seg-



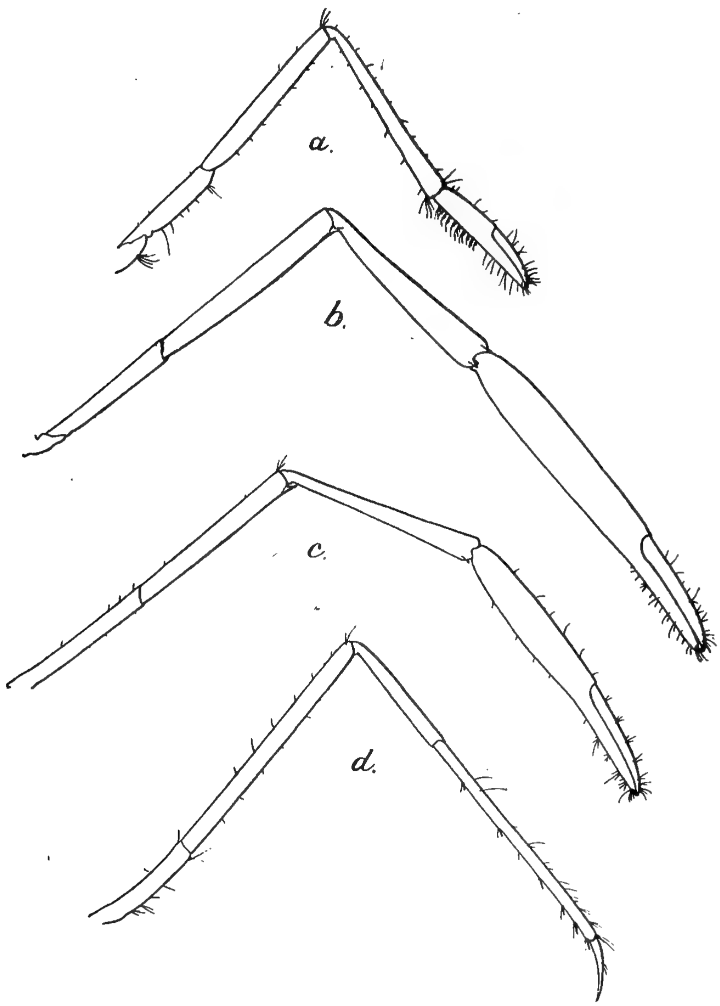
TEXT-FIG. 55.—*Periclimenes andamanensis*, sp. nov.

a. Part of antennular peduncle.
b. Antennal scale.

[1] Of fifty specimens four have 7 dorsal teeth, twenty-nine have 8 and seventeen have 9.

[2] Of fifty specimens thirty-seven have 2 ventral teeth and thirteen have 3.

ments are slender. The free portions of the rami composing the outer antennular flagellum are very short. The fused portion comprises some 8 to 11 segments and the total length of the stouter ramus, in males, is a little longer than the peduncle. The antennal scale is from 5 to 5·5 times as long as wide and is very



TEXT-FIG. 56.—*Periclimenes andamanensis*, sp. nov.

a. First peraeopod. *c.* Second peraeopod of female.
b. Second peraeopod of male. *d.* Third peraeopod.

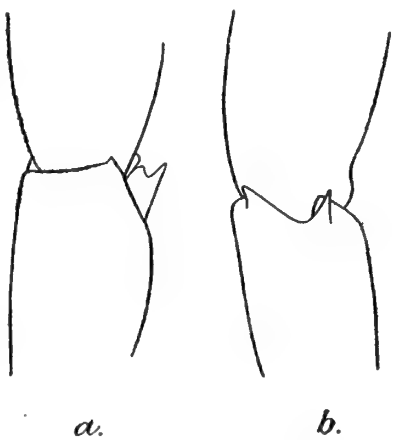
narrow at the apex. The outer margin is concave with the terminal spine far outreaching the end of the lamella.

The third maxilliped resembles that of the preceding species.

The mero-carpal articulation of the first peraeopods (text-fig. 56*a*) reaches nearly to the end of the basal antennular segment. The merus is 8 to 9 times as long as broad. The carpus is about

1·1 times as long as the merus, from 7 to 10 times as long as its distal breadth and from 1·4 to 1·7 times as long as the chela; it is proportionately longest and most slender in adult males. The fingers are about equal in length with the palm and are unarmed.

The second peraeopods of adult males (text-fig. 56*b*) extend beyond the antennal scale by the chela, carpus and a portion of the merus and may be as much as 6 times the length of the carapace. They do not show the minute asperities with which the second legs of the two preceding species are covered and there is no tubercle at the distal end of the ischium. The merus bears the usual strong spine at the distal end of the lower border and, in adults, is from 8 to 9 times as long as broad. In all well grown males the merus is very slightly longer than the carpus, from 1·05 to 1·1 times its length; in small males the merus and carpus are equal or the latter is a shade the longer. The carpus is from 6 to 7 times as long as its distal breadth in adults, but in young males is more slender, sometimes as much as 9 times as long as wide. The carpus always bears a conspicuous spine on the inner side of its distal margin and in large males there is in addition a small acute projection or tooth on the upper and inner aspect (text-figs. 57*a*, *b*). The chela is from 1·8 to 2·2 times the length of the carpus in adults, in young specimens 1·5 times or even less. The palm in large specimens is about 6 times as long as wide; in adults it is from 1·8 to 2·1 times as long as the fingers, in young males proportionately shorter, from 1·5 to 1·7 times. The fingers resemble those of *P. agag*; in some specimens they are excavate on their inner margins, in others they meet throughout their length when shut and bear a series of small teeth in their proximal two-thirds.



TEXT-FIG. 57.—*Periclimenes andamanensis*, sp. nov.

a. Carpo-propodal articulation of right second peraeopod of male, viewed from above.
b. The same, viewed from inner side.

In females (text-fig. 56*c*) the second peraeopods are more slender and proportionately shorter than in adult males. The carpus is equal to or a little longer than the merus and is 8 to 9 times as long as its distal breadth. As in males the carpal spine is conspicuous. The chela is from 1·35 to 1·6 times as long as the carpus, with the palm about 1·4 times the length of the fingers. The fingers have some inconspicuous teeth in the proximal half.

The last three pairs of peraeopods (textfig. 56*d*) are long and slender; the fifth pair reaches to or a little beyond the end of the antennal scale. The merus of the third pair is about 15 to 16 times as long as broad in adults. The propodus bears some slender spinules on its posterior edge and is from 2·7 to 3·6 times as long as the dactylus, proportionately longest in large males. The dactylus is simple and curved, with a few setae on the middle of its anterior margin; it is from 7·5 to 8 times as long as its basal breadth.

The sixth abdominal somite is about 1·7 times the length of the fifth. In the arrangement of the spines the telson resembles that of *P. agag*.

A large male is about 19 mm. in length.

Periclimenes andamanensis agrees with *P. proximus* and differs from *P. agag* in the comparatively stout first and second legs and in the greater length of the chela of the second legs, as compared with the carpus, in adults of both sexes. From both species it is distinguished by the presence of the carpal spine. It also differs from *P. proximus* in the greater number of upper rostral teeth, in the proportionate lengths of merus, carpus and chela in the second leg of the adult male and in the rather more slender legs of the last three pairs. Other minor differences will be found on comparison of the two descriptions given above.

C 380–1/1.	Port Blair, Andamans, 4–8 fms.	S. Kemp, Feb., 1915; Feb., March, 1921.	Many.

The specimens were found in Ross Channel in company with *P. agag* and *P. proximus*. The types bear the number C 380/1.

Certain additional specimens obtained on muddy ground at the inner end of Port Blair are tentatively referred to *P. andamanensis*, but differ in certain characters which will perhaps prove to possess at least varietal value. Of the nine specimens eight are females and one a young male.

The only points in which these specimens differ from the above description are as follows:—

The rostrum is less shallow and bears as a rule 9 dorsal teeth and 3 ventral.[1] The ovigerous females are larger than any typical *P. andamanensis* that I have seen, with the carpus of the second peraeopods decidedly stouter, from 5·5 to 6 times as long as its distal breadth. The chela also is longer in relation to the carpus, about 1·8 times its length. In the last three legs the dactylus is considerably longer than in typical specimens. In large females the propodus of the third pair is only 2·25 times and in the young male only twice the length of the dactylus. The dactylus is also rather more slender from 8 to 9 times as long as its basal breadth in females, 11 times in the young male.

[1] Of eight specimens one has 8 dorsal teeth, six have 9 and one has 11; seven specimens have 3 ventral teeth and one has 4.

In other respects there is practically no difference between the two sets of specimens. The young male resembles typical specimens of the same size and sex in the proportions of the segments of the second peraeopods. The carpus is about 7 times as long as its distal breadth and is a trifle longer than the merus; the chela is 1·5 times as long as the carpus. In females the carpus is a little shorter than the merus and, in all the specimens, the carpal spine is conspicuous. The merus of the third leg is 12 to 13 times as long as broad in females, 17 times in the young male.

In the absence of fully developed males it is not possible to identify the specimens with certainty, but the material examined seems to point to the conclusion that the muddy ground at the inner end of Port Blair is inhabited by a special variety of *P. andamanensis*.

The largest female is about 18 mm. in length.

C 382–3/1.	Port Blair, Andamans, 3–5 fms.	S. Kemp, Feb., March, 1921.	Nine.

The specimens were obtained off Viper I. and at the mouth of Brigade Creek on a bottom composed of mud and decaying vegetation.

Periclimenes (Ancylocaris) suvadivensis Borradaile.

1915. *Periclimenes* (*Falciger*) *suvadivensis*, Borradaile, *Ann. Mag. Nat. Hist.* (8) XV, p. 212.
1917. *Periclimenes* (*Falciger*) *suvadivensis*, Borradaile, *Trans. Linn. Soc.* (2) *Zool.* XVII, p. 375, pl. lv, fig. 16.

I have examined the types of this species and find that Borradaile was mistaken in supposing that they do not possess a supra-orbital spine. The species thus finds a place in the *P. grandis* section and is extremely closely allied to *P. andamanensis*. Unfortunately I was not able to make a critical comparison of the two forms and the only characters that I can now give for the separation of the two species are that (i) the upper rostral teeth (6 or 7) are less numerous in *P. suvadivensis* than is customary in *P. andamanensis* and (ii) that the carpus of the second peraeopods in adult males is conspicuously longer than the merus in the former species, whereas in the same sex of the latter the merus is longer than the carpus.

The species was described from specimens taken at Suvadiva Atoll in the Maldives.

Periclimenes (Ancylocaris) ensifrons (Dana).

1852. *Anchistia ensifrons*, Dana, *U. S. Explor. Exped., Crust.* I, p. 580, pl. xxxviii, figs. 1*a–g*.
1899. *Periclimenes ensifrons*, Nobili, *Ann. Mus. civ. Genova* (2) XX, p. 234.
1907. *Periclimenes ensifrons*, Nobili, *Mem. Accad. Sci. Torino* (2) LVII, p. 359.

Nobili (1907) has examined two young specimens of this species from Polynesia and has pointed out that they differ from those to which de Man and other authors have applied the name in the absence of the spine at the distal end of the carpus of the second peraeopods. In this respect his specimens agree with Dana's description "carpus long, not armed or acute at apex." According to Nobili de Man's specimens probably represent a variety of Dana's species, but with this I am unable to agree.

For *P. ensifrons*, as applied by de Man, Stimpson's name *grandis* may be employed. This species differs from true *P. ensifrons* in possessing the carpal spine on the second legs and also in the proportions of the merus and carpus of the same limb. In *P. ensifrons* the carpus is decidedly longer than the merus (see Dana's figure and Nobili's measurements), whereas in *P. grandis* the merus in males is longer than, and in females equal to or a little longer than the carpus.

P. ensifrons was described from the Straits of Balabac, North of Borneo and is recorded by Nobili from Beagle Bay, New Guinea and from the lagoons of Amanu and Fakahina in Polynesia. There does not appear to be any evidence that it occurs in the western part of the Indo-Pacific region.

Periclimenes (Ancylocaris) grandis (Stimpson).

(Plate VII, fig. 10.)

1860. *Anchistia grandis*, Stimpson, *Proc. Acad. Sci. Philadelphia*, p. 39.
1887. *Anchistia ensifrons*, de Man, *Arch. Naturgesch.* LIII, i, p. 545.
1887. *Anchistia ensifrons*, Müller, *Verh. naturf. Ges. Basel* VIII, p. 471.
1894. *Anchistia ensifrons*, Ortmann, *Jenaisch. Denkschr.* VIII, p. 16.
1902. *Periclimenes ensifrons*, de Man, *Abhandl. Senck. naturf. Ges.* XXV, p. 826.
1905. *Periclimenes vitiensis*, Pearson, *Ceylon Pearl Oyster Rep.* IV, p. 78.
1905. *Periclimenes ensifrons*, Lenz, *Abhandl. Senck. naturf. Ges.* XXVII, p. 80.
1906. *Periclimenes ensifrons*, Nobili, *Ann. Sci. nat., Zool.* (9) IV, p. 49.
1915. *Periclimenes ensifrons*, Balss, *Denk. math.-naturw. Kl. K. Akad. Wien* XCI, p. 26.

The rostrum reaches to or a little beyond the end of the antennal scale. In lateral view it is deep, more so in females than in males; it is straight at the base but in its distal half is directed upwards, the upper margin being thus slightly concave. The dorsal teeth are from 6 to 10 in number,[1] nearly always 7 or 8. The posterior tooth stands on the carapace and is separated from the next by a rather wide interval; the second is placed above or a little behind the posterior limit of the orbit; the foremost is very close to the apex and often gives it a bifid appearance. In the precise distribution of the teeth there is, as usual, some variation; frequently, and especially in males, four teeth are placed rather close together above the eye, one or two near the apex and one midway between the two groups. On the lower border there are from

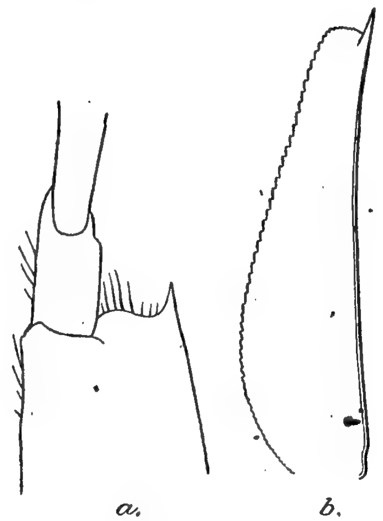
[1] Of eighty-four specimens one has 6 dorsal teeth, forty have 7, thirty-nine have 8, three have 9 and one has 10.

2 to 5 teeth,[1] usually 2 or 3; these teeth are large and the foremost is always placed behind the most anterior of those on the upper border.

Supra-orbital, antennal and hepatic spines are present; the hepatic is placed rather close behind the antennal, but on a lower level. The lower limit of the orbit is defined by a blunt angulation of the frontal margin.

The eyes are stout. The cornea is hemispherical and wider than the stalk; in life it is traversed by two concentric bands of dark pigment and these may frequently be seen in preserved material. The ocular spot is distinct and confluent with the cornea.

The lateral process of the antennule is short, not reaching the middle of the basal segment. The spine at the distal end of the outer border of this segment is stout, but does not reach to the middle of the second segment; the margin between the spine and the articulation is strongly sinuous (text-fig. 58*a*). The two distal segments are slender. The outer antennular flagellum is cleft for only a very short distance, the fused basal portion comprising 10 to 13 segments. In both sexes the total length of the outer ramus is considerably less than that of the peduncle. The antennal scale (text-fig. 58*b*) is narrow at the apex and is from 3·9 to 4·3 times as long as broad in adults; in young specimens it is more slender, sometimes as much as 5 times as long as broad. The outer margin is concave and ends in a spine which projects far beyond the end of the lamella.



TEXT-FIG. 58.—*Periclimenes grandis* (Stimpson).
a. Part of antennular peduncle.
b. Antennal scale.

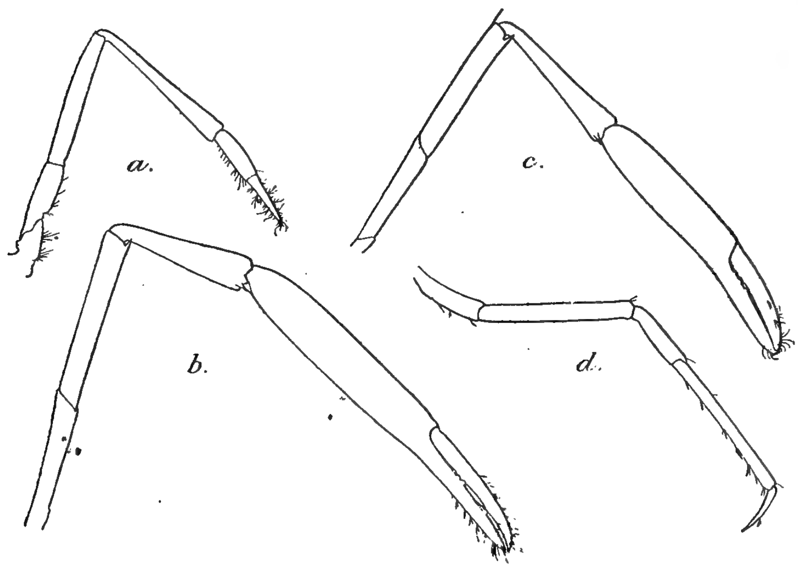
The third maxilliped bears a small arthrobranch and reaches about to the end of the basal antennular segment. The antepenultimate segment is somewhat curved and bears from 1 to 3 slender spines on the outer margin; the exopod reaches a little beyond its distal end. The ultimate segment is three-quarters the length of the penultimate.

The first peraeopods (text-fig. 59*a*) reach beyond the antennal

[1] Of eighty-four specimens thirty-four have 2 ventral teeth, thirty-seven have 3, eleven have 4 and two have 5.

scale by the length of the fingers. The carpus is a little longer than the merus, from 7 to 8 times as long as its distal breadth and from 1·35 to 1·5 times the length of the chela. The fingers are unarmed and are about as long as the palm.

The second peraeopods are equal; as in the forms already described they are much longer in males than in females and the proportions of the segments differ widely in the two sexes. In adult males (text-fig. 59*b*) they reach beyond the scale by the entire length of the chela and carpus. The merus is from 1·25 to 1·35 times the length of the carpus and is from 6 to 6·5 times as long as wide; it bears a conspicuous spine at the distal end of the lower margin. The carpus bears a curved, forwardly directed spine on



TEXT-FIG. 59.—*Periclimenes grandis* (Stimpson).

a. First peraeopod.
b. Second peraeopod of male.
c. Second peraeopod of female.
d. Third peraeopod.

the inner side of the distal border and is from 4 to 5 times as long as its greatest breadth, excluding the spine. The chela in well-grown specimens is from 2 to 2·5 times the length of the carpus. The palm is about 4·5 times as long as wide and is from 1·6 to twice the length of the fingers. The cutting margins of the fingers are excavate in the middle so that an oval gap is left when the claw is closed. In front of this excavation there is a single tooth on each finger, that on the dactylus being in advance of the other. Behind the excavation there is a large tooth on the fixed finger, succeeded by a variable number of smaller teeth and there is a series of medium-sized teeth, usually 4 or 5, on the proximal part of the dactylus. The tips of the fingers are inturned. The excavation in the fingers is to be seen only in very large males; usually both chelae show a similar development, but I have seen one specimen in which the gap was present in one chela only.

In the female (text-fig. 59*c*) the merus is rather more slender, about 6·5 to 7·0 times as long as wide and equal to or a little longer than the carpus. The carpus is from 5 to 5·25 times as long as its distal breadth and, as in the male, bears a conspicuous distal tooth on the inner side. The chela is from 1·6 to 1·8 times the length of the carpus. The palm is equal to, a little longer or little shorter than the carpus and is from 1·3 to 1·6 times as long as the fingers. The fingers have inturned tips and may be provided with small inconspicuous teeth on the proximal half or third of their cutting edges.

The last three peraeopods are moderately slender; the fifth do not reach the apex of the antennal scale. In the third pair (text-fig. 59*d*) the merus is from 9 to 10 times as long as broad. The propodus bears long spinules on its posterior margin and is from 2·8 to 3·3 times as long as the dactylus. The dactylus is simple and slightly curved with a few setae on its anterior margin; its length is from 6 to 6·5 times its basal breadth.

The sixth abdominal somite is about 1·5 times the length of the fifth. The dorsal spines of the telson are so arranged as to divide its length into three equal parts.

The largest specimen, a male, is about 23 mm. in length.

Specimens from the Gulf of Manaar were almost completely transparent when alive, minutely speckled with red and blue. In some individuals a blue patch was visible at the ends of the merus and carpus of the second legs and a brownish red patch on the outer side of the propodus.

Stimpson's description agrees in every particular with the large males that I have examined, except that the chela of the second legs is said to be nearly three times the length of the carpus with fingers less than half the length of the palm. The assumption that Stimpson described a more fully developed male than any I have seen will fully account for these discrepancies.

In many respects *P. grandis* agrees with *P. andamanensis*. It differs, however, in its deeper rostrum, in the stronger spine at the distal end of the first antennular segment, in the much stouter merus and carpus of the second legs of the male and in the shorter and stouter legs of the last three pairs. The merus of the third legs is only 10 to 11 times as long as wide in *P. grandis*, from 15 to 16 times in *P. andamanensis*.

C 384/1.	Kilakarai, G. of Manaar, 0–2 fms.	S. Kemp, Feb., 1913.	Many.
C 385/1.	Pamban, G. of Manaar.	S. Kemp, Feb., 1913.	One.
C 386/1.	Cochin backwater, near Ernakulam, S. India.	F. H. Gravely, Sept., 1914.	Thirteen.
C 387/1.	N. Cheval Paar, Ceylon.	T. Southwell, Nov., 1910.	Six.
C 338/1.	Paway I., Mergui Archipelago.	'Investigator,' Feb., 1914.	Two.

The species was very common in the Gulf of Manaar, among weeds in shallow water and also on the coral reefs.

The species was described from Ousima I. (Stimpson) and has been recorded from Ternate and Pulo Edam (de Man), Trincomalee (Müller), Cheval Paar (Pearson), Zanzibar (Lenz), Dar-es-Salaam (Ortmann) and the Red Sea (Nobili, Balss).

Periclimenes (Ancylocaris) vitiensis Borradaile.

1898. *Periclimenes vitiensis*, Borradaile, *Ann. Mag. Nat. Hist.* (7) II, p. 383.
1899. *Periclimenes vitiensis*, Borradaile, *Proc. Zool. Soc. London*, p. 1005, pl. lxiv, figs 6*a*, *b*.
1899. *Periclimenes vitiensis*, Nobili, *Ann. Mus. civ. Genova* (2), XX, p. 234.
1917. *Periclimenes vitiensis*, Borradaile, *Trans. Linn. Soc.* (2) *Zool.* XXII, p. 371 (part).

This species is very closely related to *P. grandis*. I have examined the type, an ovigerous female in the Cambridge Museum, but my work at that time was not sufficiently advanced to enable me to make full use of the opportunity. I noted, however, that in the telson of the type specimen both pairs of dorsal spines are situated in the posterior half, whereas in the specimens I have referred to *P. grandis* the foremost pair is situated in the anterior half. The position of these spines affords a valuable specific character in some species of *Periclimenes* (*cf. P. brevicarpalis* and *P. inornatus*) and I conclude, therefore, that *P. vitiensis* is possibly a distinct species. The specimens from Coetivy in the Seychelles subsequently referred by Borradaile to *P. vitiensis* should be re-examined, for it is not improbable that they belong in reality to *P. grandis*.

P. vitiensis was described by Borradaile from Viti Levu, Fiji.

Periclimenes (Ancylocaris) affinis Borradaile.

1915. *Periclimenes* (*Falciger*) *affinis*, Borradaile, *Ann. Mag. Nat. Hist.* (8) XV, p. 211.
1917. *Periclimenes* (*Falciger*) *affinis*, Borradaile, *Trans. Linn. Soc.* (2) *Zool.* XVII, p. 372, pl. liv, fig. 11.

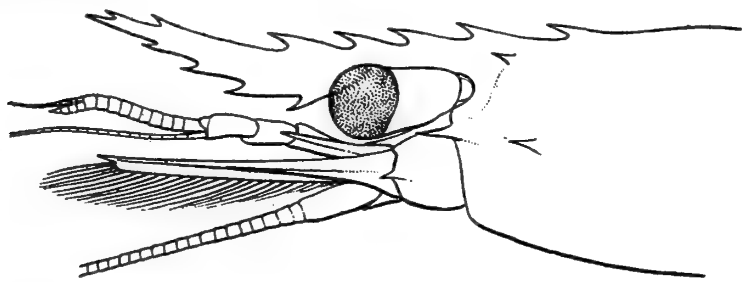
This species appears to be closely related to Paulson's *P. elegans*, which is described below. According to Borradaile's description and figures it differs (i) in its straighter rostrum, armed with only 2 teeth below, (ii) in the greater proportionate length of the first peraeopods which outreach the antennal scale by the chela and half the length of the carpus, and (iii) in the much more slender and proportionately longer carpus of the second peraeopods, about 6 times as long as wide according to the figure and a little longer than the merus.

P. affinis is recorded from Salomon I. in the Western Indian Ocean.

Periclimenes (Ancylocaris) elegans (Paulson).

1875. *Anchistia elegans*, Paulson, *Crust. Red Sea*, p. 113, pl. xvii, figs. 1, 1*a–h*.
1906. *Anchistia elegans*, Nobili, *Ann. Sci. nat., Zool.* (9) IV, p. 52.

The rostrum (text-fig. 60) is rather deep, especially in females, and reaches to or a little beyond the end of the antennal scale. It is straight at the base, but in its distal half is directed upwards.

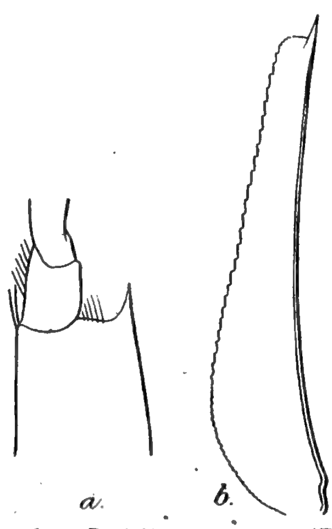


TEXT-FIG. 60.—*Periclimenes elegans* (Paulson). Anterior part of carapace, rostrum, etc.

On the concave upper border there are from 6 to 8 teeth,[1] nearly always 7 or 8. The teeth are arranged much as in *P. grandis*, but the distinction into two groups is sometimes even more clearly marked than in that species. On the lower border there are from 3 to 5 teeth,[2] nearly always 3 or 4.

In the spines of the carapace and the eyes the species resembles *P. grandis*. A single band of dark pigment is frequently seen on the cornea.

The antennules also resemble those of *P. grandis*, but the terminal spine of the basal segment is rather longer, reaching almost or quite to the middle of the second segment, and the margin between this spine and



TEXT-FIG 61.—*Periclimenes elegans* (Paulson).
a. Part of antennular peduncle.
b. Antennal scale.

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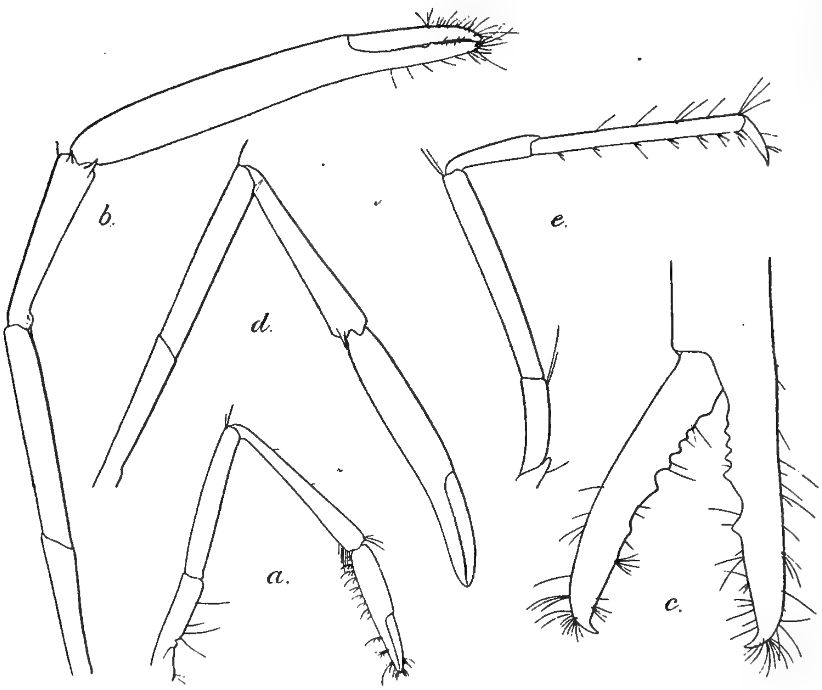
[1] Of fifty specimens two have 6 dorsal teeth, thirty-six have 7 and twelve have 8.

[2] Of fifty specimens thirty-one have 3 ventral teeth, eighteen have 4 and one has 5.

the articulation is less clearly sinuous (text-fig. 61*a*). In both sexes the stouter ramus of the outer flagellum is shorter than the peduncle. In its distal third the antennal scale is rather more narrowed than in *P. grandis* and its outer margin more strongly concave; it is from 4·5 to nearly 5·5 times as long as wide (text-fig. 61*b*).

The third maxilliped possess a small arthrobranch; the antepenultimate segment bears from 1 to 4 spines on its outer edge and the exopod reaches about to its end. The ultimate segment is about three-quarters the length of the antepenultimate.



TEXT-FIG. 62.—*Periclimenes elegans* (Paulson).

a. First peraeopod. *c*. Fingers of same.
b. Second peraeopod of male. *d*. Second peraeopod of female.
e. Third peraeopod.

The first peraeopods (text-fig. 62*a*) reach beyond the antennal scale by about half the length of the chela. The carpus is from one-ninth to one-twelfth longer than the merus and is from 7 to 7·5 times as long as its distal breadth and from 1·2 to 1·4 times as long as the chela. The fingers are equal to or a little shorter than the palm and are unarmed.

The second peraeopods are equal. In males they extend beyond the antennal scale by the length of the carpus and chela. In none of the specimens I have seen do the legs present the rugose appearance described by Paulson. In males (text-fig. 62*b*) the merus is from 6 to 7 times as long as broad, with the usual spine at the distal end of the lower margin; it is from 1·2 to 1·3 times as long as the carpus. The carpus is from 4 to 4·5 times as long as its distal breadth and bears two stout spines at the distal end, one on the inner side and one on the upper and inner aspect; inferiorly the distal end projects a little, producing the appearance of a tooth when seen in lateral view. The chela is from 2 to 2·5 times the length of the carpus and the palm is from 1·9 to 2·4 times as long as the fingers. The fingers (text-fig. 62*c*) frequently but not always show an excavation in the middle of their cutting edges as in *P. grandis*. Some specimens have comparatively large teeth on the fingers while others have only a few very small teeth.

In the female (text-fig. 62*d*) the merus of the second peraeopod is from 1·0 to 1·3 times as long as the carpus and is from 7 to 7·5 times as long as wide. The carpus varies from 4 to 5·5 times as long as its distal breadth; the spine on the inner side is well developed and frequently an acute process or short spine can be seen on the upper and inner aspect, corresponding to the second spine found in the male. The chela is from 1·4 to 2·1 times the length of the carpus, with palm from 1·3 times to twice[1] as long as the fingers. The fingers bear small teeth in the proximal half of their inner margins.

The last three peraeopods are stout; the fifth, when extended forwards, fall far short of the apex of the antennal scale. In the third pair (text-fig. 62*e*) the merus is from 7·5 to 8·5 times as long as broad; the propodite bears a series of spinules on its posterior edge and is from 3·5 to 4 times as long as the dactylus. The dactylus itself is simple, very slightly curved, and generally with one or two long setae in the middle of its anterior margin; its length is only from 4 to 4·5 times its basal breadth.

The last abdominal somite and telson agree with those of *P. grandis*.

The largest specimen, a male, is about 24 mm. in length.

Although the above account differs in some respects from Paulson's description (as translated by Nobili) and from his figures, I have little doubt that the identification is correct and that the discrepancies are mainly due to errors in the original account. A single adult male collected by Major R. B. Seymour Sewell in the Red Sea, belongs almost without question to Paulson's species and this individual is indistinguishable from specimens obtained in the Andamans. The specimen which Balss has recorded as *P. elegans* from St. John's I. in the Red Sea[2] apparently does not belong to this species as the spine on the carpus of the second leg is said to be absent.

C. 389–90/1.	Port Blair, Andamans.	S. Kemp, March, 1915; Feb., March, 1921.	Many.

[1] In exceptionally large females only.
[2] Balss, *Denk. math.-naturw. Kl. K. Akad. Wien*, XCI, p. 26 (1915).

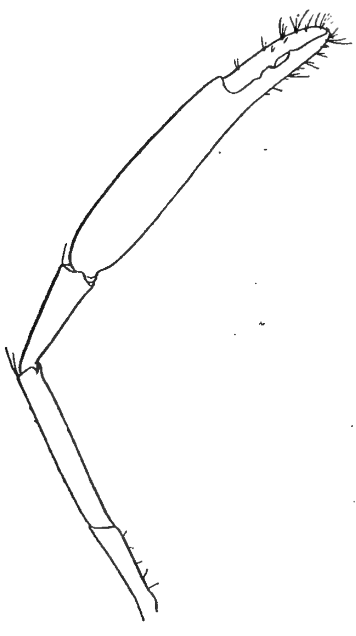
C 391/1.	East I., Andamans.	A. R. S. Anderson, 1898.	Two.
C 392/1.	Koweit Harbour, Persian Gulf.	R. B. Lloyd, Oct., 1905.	Two.
C 393/1.	Tor, Sinaitic Peninsula, Red Sea.	R. B. S. Sewell, 1916.	One.

At Port Blair the species is abundant at low water in pools on the coral beach; it was found on Ross I., and on the shores of Aberdeen and North Bay, and was never obtained by dredging.

The species has hitherto been known only from the Red Sea.

var. **dubius**, Borradaile.

1915. *Periclimenes* (*Falciger*) *dubius*, Borradaile, *Ann. Mag. Nat. Hist.* (8) XV, p. 211.
1917. *Periclimenes* (*Falciger*) *dubius*, Borradaile, *Trans. Linn. Soc.* (2) *Zool.* XVII, p. 373, pl. liv, fig. 12.



TEXT-FIG. 63.—*Periclimenes elegans*, var. *dubius*, Borradaile.
Second peraeopod of male.

Certain specimens from Madras Harbour differ from typical *P. elegans* only in the proportionately stouter carpus of the second peraeopods in males (text-fig. 63). In adults of this sex the carpus is only 3 times as long as its distal breadth and in females barely 4 times. This is the only difference I can find and I do not regard the two forms as specifically distinct. So far as I can understand from the published account Borradaile's name *dubius* is correctly applied to these specimens.

C 460/1.	Madras Harbour.	S. Kemp, May, 1918.	Six.

Periclimenes (Ancylocaris) holmesi Nobili.

1900. *Anchistia tenuipes*, Holmes (*nec* Borradaile), *Occas. Papers California Acad. Sci.* VII, p. 216.
1904. *Periclimenes tenuipes*, Rathbun, *Harriman Alaska Exped.* X, *Crust.*, p. 34, text-figs. 12*a*, *b*. [p. 5.
1907. *Periclimenes holmesi*, Nobili, *Ann. Mus. Univ. Napoli* (2) XXI,
1921. *Periclimenes tenuipes*, Schmitt, *Univ. California Publ., Zool.* XXIII, p. 39, figs. 24*a*, *b*.

This, the only species of *Periclimenes* known from the Pacific Coast of America, is very closely related to *P. elegans*; in the description which Holmes has given and in the additional notes and figures supplied by Miss Rathbun I am unable to find any differences worthy of note. In view of the widely distant localities in which the two forms have been found, it seems unlikely that they are specifically identical, but this can only be determined by actual comparison of specimens.

P. holmesi is known only from the Californian Coast, extending from Santa Catalina I. to the Gulf of California.

Periclimenes (Ancylocaris) amymone de Man.

1902. *Periclimenes amymone*, de Man, *Abhandl. Senckenb. naturf. Ges.* XXV, p. 829, pl. xxv, figs. 53*a–g*.

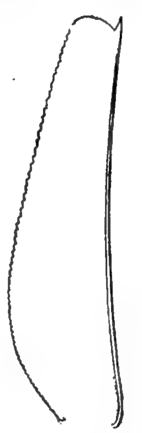
In this species, which I have not seen, the legs are conspicuously stouter than in any of the related species. In the female on which de Man's detailed description is based the carpus of the second peraeopod is only about 2·4 times its distal breadth with the merus 1·6 times its length. In the third pair the merus is only 6 times as long as broad and the propodite is five times as long as the dactylus. The dactylus is short and stout, scarcely more than 3 times as long as its basal breadth. *P. amymone* also differs from all related species in the absence of spinules on the posterior border of the propodite of the last three pairs of legs.

The species is recorded from Ternate.

Periclimenes (Ancylocaris) demani Kemp.

1915. *Periclimenes demani*, Kemp, *Mem. Ind. Mus.* V, p. 279, pl. xiii, fig. 10, text-figs. 27 *a–i*.

This species is related to *P. grandis*, but differs from it and from all other species in the same section of the genus in the structure of the apex of the antennal scale: the spine which terminates the outer margin reaches only to, or to a very small extent beyond the apex of the lamella (text-fig. 64). It also differs from *P. grandis* in having the carpus of the second leg of the male as long as the merus and in the proportionately shorter chela, always less than 1·5 times the length of the carpus and in the longer and more slender legs of the last three pairs. As in *P. grandis* the anterior of the two pairs of spines on the dorsum of the telson is placed in the proximal half of the telson-length.



TEXT-FIG. 64.—*Periclimenes demani* Kemp.
Antennal scale.

C 514/1.	Jack and Una Is., Mergui Archipelago.	'Investigator,' Dec., 1913.	One.

P. demani was hitherto known only from the Chilka Lake in Orissa and from the Adyar R. and Ennur backwater near Madras. In the Chilka Lake it has been found living in water ranging in specific gravity from 1·000 to 1·0265.

Periclimenes (Ancylocaris) lifuensis Borradaile.

1898. *Periclimenes lifuensis*, Borradaile, *Ann. Mag. Nat. Hist.* (7) II, p. 384.
1899. *Periclimenes lifuensis*, Borradaile, in Willey's *Zool. Results*, p. 405, pl. xxxvi, figs. 1*a–c*.

I have seen the type of this species in the Cambridge Museum, but have not dissected it to examine the mandible. It is the only known species of the genus in which the supra-orbital spine is present and the hepatic absent.

The antennal scale is not much narrowed apically; the outer margin is concave and the terminal spine extends beyond the apex of the lamella. The merus of the second peraeopods bears a spine at the distal end of the lower margin. Only one of the posterior legs is in existence; it is very stout, with the propodus only about 4 times as long as broad and with the dactylus simple, strongly curved and partially concealed by thick hairs. The telson bears two pairs of dorsal spines, placed rather close together near the middle of its length.

P. lifuensis is known only from Lifu in the Loyalty Is.

Periclimenes (Ancylocaris) tenuipes Borradaile.

(Plate VIII, fig. 11.)

1898. *Periclimenes tenuipes*, Borradaile, *Ann. Mag. Nat. Hist.* (7) II, p. 384.
1899. *Periclimenes tenuipes*, Borradaile, in Willey's *Zool. Results*, p. 406, pl. xxxvi, figs. 2*a–f*.
1899. *Periclimenes tenuipes*, Nobili, *Ann. Mus. civ. Genova* (2) XX, p. 235.
1904. *Periclimenes borradailei*, Rathbun, *Harriman Alaska Exped.* X, *Crust.*, p. 34.
1907. *Periclimenes borradailei*, Nobili, *Ann. Mus. Univ. Napoli* (n.s.) II, no. 21, p. 5.
1915. *Periclimenes (Falciger) kolumadulensis*, Borradaile, *Ann. Mag. Nat. Hist.* (8) XV, p. 213.
1917. *Periclimenes (Falciger) borradailei* and *kolumadulensis*, Borradaile, *Trans. Linn. Soc.* (2) *Zool.* XVII, pp. 372, 376, pl. lv, fig. 17.

The rostrum varies greatly in length; in the specimens I have examined it is from 1·6 to twice the length of the carapace, while in the large male described by Borradaile as *P. kolumadulensis* it is said to be 2·5 times the length of the carapace. The rostrum is very slender, straight at the base, but with the distal half bent obliquely upwards. It bears from 9 to 12 teeth (nearly always 10 or 11)[1] on the upper border; the posterior tooth is placed on the

[1] Of thirty-two specimens two have 9 dorsal teeth, twelve have 10, seventeen have 11 and one has 12.

carapace, but is not widely separated from the next, which is either above or a little behind the posterior limit of the orbit. In most specimens the upper teeth are arranged in two groups, the five proximal teeth being separated by a marked interval from the four or five distal, with or without a single isolated tooth between the two. On the lower border in the anterior two-thirds there are from 6 to 9 teeth (usually 7 or 8),[1] extending close up to the apex.

The carapace is obtusely angled at the lower limit of the orbit. The antennal spine is strong and is flanked by a short carina; the hepatic is behind it, but on a lower level. There is no supra-orbital spine.

The eyes are large and somewhat depressed, with the cornea wider than the stalk. The ocular spot touches the cornea.

The basal segment of the antennular peduncle bears a short lateral process; the outer margin terminates in a sharp spine which does not reach the middle of the next segment. The second and third segments are slender, but the whole peduncle is not long, scarcely reaching beyond the middle of the antennal scale. The free portion of the shorter ramus of the outer antennular flagellum is extremely short; the fused part is longer than the peduncle and is composed of some 12 to 15 segments. The antennal scale in full grown specimens is from 6·5 to 7 times as long as wide and is very narrow distally. The outer margin is strongly concave and the terminal spine projects far beyond the apex of the lamella.

The third maxillipeds do not reach the end of the antennular segment; the ultimate segment is about two-thirds the length of the antepenultimate.

The mero-carpal articulation of the first peraeopods reaches the end of the antennular peduncle. The carpus is about 1·5 times the length of the merus, and is from 2 to 2·75 times as long as the chela. The fingers are a little longer than the palm and are unarmed.

The second peraeopods in males may outreach the rostrum by the whole of the chela and carpus and a portion of the merus, they are from 5·5 to 7·5 times as long as the carapace. The legs forming a pair are, as a rule, equal and similar in structure. There is a strong spine at the distal end of the merus on the lower side. In the largest male the merus is about 6·5 times as long as wide. The carpus is 1·4 times as long as the merus; it is slender at the base but is suddenly dilated in its distal third, the length being about 7·5 times the distal breadth. On the inner side of the carpus at the distal end there is a small obscure tooth, much as in *Periclimenes agag*. The chela is about 1·25 times the length of the carpus; the palm is 5 times as long as broad and about 1·9 times the length of the fingers. In smaller males the limbs are more slender, with the carpus much less dilated at the distal end. In one such male the merus is 8 times as long as broad and the carpus

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[1] Of thirty-two specimens four have 6 ventral teeth, sixteen have 7, eleven have 8 and one has 9.

13 times as long as broad, 1·5 times as long as the merus and a little longer than the chela. The palm in this specimen is 1·3 times the length of the fingers. In the smallest male in the collection the carpus is as much as 1·4 times as long as the chela.

The series of specimens in the collection comprises a number of individuals which, in the proportions of the segments of the second peraeopods, are intermediate between those described above, indicating quite clearly that the differences are due to progressive growth. The second legs of very large males appear to develop in a phenomenal manner, as in the Hippolytid genus *Saron* and in *Palaemon*.

In ovigerous females the second peraeopods are from 4·5 to 5·7 times as long as the carapace. The carpus is from 1·5 to 1·8 times as long as the merus and from 1·2 to 1·4 times as long as the chela. The palm is about 1·3 times the length of the fingers.

In the second peraeopods of some large males each finger is conspicuously excavate in its proximal half. In other males no trace of this excavation is visible; the fingers meet throughout their length when the claw is closed and are armed only with a series of very small teeth, most conspicuous at the proximal end. Specimens in intermediate stages, with the gape in the fingers poorly developed, are not uncommon. As a rule the fingers in both legs of a pair are similarly formed, but I have seen a specimen in which one chela only possessed gaping fingers, as in the type of Borradaile's *P. kolumadulensis*. In large females the fingers sometimes exhibit a small excavation, similar to that seen in some large males but less well developed.

The last three legs are extremely long and slender, the fifth reaching to or a little beyond the rostrum. The merus of the third pair is from 20 to 26 times as long as wide. The propodus is from 4·5 to 5·5 times the length of the dactylus; it bears some short spinules on its posterior edge and shows traces of subdivision into 5 to 7 subsegments. The dactylus is simple, curved, and with a few setae in the middle of its anterior margin; it is from 6·5 to 7·5 times as long as its basal breadth.

The sixth abdominal somite is about one-third longer than the fifth. The foremost pair of dorsal spinules on the telson are situated in the anterior half of the telson, the second pair rather further from the foremost than from the apex. The intermediate apical spines are very long.

The largest specimen, a male, is about 22 mm. in length.

The species is characteristically coloured when alive. The carapace and abdomen are semitransparent, with a few narrow oblique streaks of white and red on the former and mid-dorsal and lateral red stripes on the latter. On the rostrum, at the junction of the middle and distal thirds, there is a band of dark red pigment; in front of this the rostrum is entirely sulphur yellow, while behind it on the inferior half there is a streak of the same colour. The tip of the telson and the basal portions of the uropodial setae are bright red. The eyestalk has two white longitudinal streaks and some red speckling. On the first legs there is a sharply defined red spot at the distal ends of the ischium, merus and carpus. Between the bases of the first legs there is a bright red sternal spot. On the second legs there is a similar spot at the distal end of the ischium and a large red patch at the end of the merus. The carpus is sulphur yellow throughout, the colour extending on to the base of the chela which is otherwise dull red. The eggs are pale grey, when eyed with a bright blue eyespot.

Borradaile's descriptions of *P. tenuipes* and *P. kolumadulensis* are both inadequate and I suspect that the figures of the former are erroneous in several particulars. Re-examination of the types is necessary before the synonymy given above can be regarded as beyond doubt. From the description I have given it will be seen that the range of variation is very great and that the characters which Borradaile gives in his account of *P. kolumadulensis* are insufficient for the distinction of two species. Seeing that the type-specimen of *P. tenuipes* was damaged it is unfortunate that Borradaile contented himself with a mere record of the additional examples obtained by Prof. Gardiner at Haddumati Atoll.

Two misconceptions appear to have arisen regarding the proper name of this species. Miss Rathbun (*l.c.*, 1904) proposed *P. borradailei* under the impression that the name *tenuipes* was preoccupied by Holmes. Holmes' species was, however, not described until 1900. Nobili (*l.c.*, 1907) has stated that Leach described a species from the Mediterranean under the name *Periclimenes tenuipes* and that Heller erroneously regarded *Brachycarpus biunguiculatus* as synonymous with this form. These statements apparently led Borradaile in 1917 to abandon his *P. tenuipes* in favour of *P. borradailei*.

The paper by Nobili was, I believe, written during the distinguished author's last illness. It is most unfortunate that it should even have been published, for it is evident from internal evidence that it is the product of a disordered mind. The Palaemonid gill-formulae which are given in the paper obviously have no relation to the real facts and the illustrations of the mouthparts of *Brachycarpus* can only be regarded as mythical. Leach does not seem ever to have described *Periclimenes tenuipes* and the species is not referred to by Heller, nor is it a fact, as stated by Nobili, that in his work on the Red Sea Decapoda he himself proposed the name *P. borradailei* for Borradaile's *P. tenuipes*.

P. tenuipes may therefore stand as the name of this species, while for the form described by Holmes Nobili's *P. holmesi* may be employed.

C 461–5/1.	Port Blair, Andamans, 4–8 fms.	S. Kemp, Feb., 1915, Feb., Mch., 1921.	Thirty-five.
5525/9.	Off Ceylon, 34 fms., 6°01' N., 81°16' E.	'Investigator.'	One.

I have also seen two specimens belonging to the Paris Museum from Mahé in the Seychelles (Alluaud coll.). The specimens from Port Blair were all obtained in Ross Channel on a bottom composed mainly of small corals and sponges.

P. tenuipes was originally described from New Britain and has since been recorded by Nobili from Beagle Bay in New Guinea and by Borradaile from Haddumati Atoll in the Maldives and, as *P. kolumadulensis*, from Kolumadulu Atoll in the same group.

Periclimenes (Ancylocaris) longimanus (Dana).

1852. *Anchistia longimana*, Dana, *U. S. Explor. Exped., Crust.* I, p. 579, pl. xxxvii, figs. 6*a*, *b*.

This species, of unknown locality, is easily distinguished from all other known members of the genus by the extraordinary length of the antennular peduncle. It reaches well beyond the antennal scale and the ultimate segment, according to Dana's figure, is 6 times as long as wide.

Periclimenes (Ancylocaris) digitalis, sp. nov.

(Plate VIII, fig. 12.)

The rostrum reaches slightly beyond the end of the antennal scale. It is straight at the base, but a little upturned in its distal third. On the upper border, in the single specimen examined, there are 11 teeth; of these the two hindmost are situated on the carapace behind the orbit and the posterior tooth is separated from the next by a rather considerable interval. The remaining teeth are large and evenly spaced except for the foremost, which is small, placed near the tip, and rather remote from the next of the series. On the lower border there are 2 teeth, placed just in front of the middle of the rostral length.

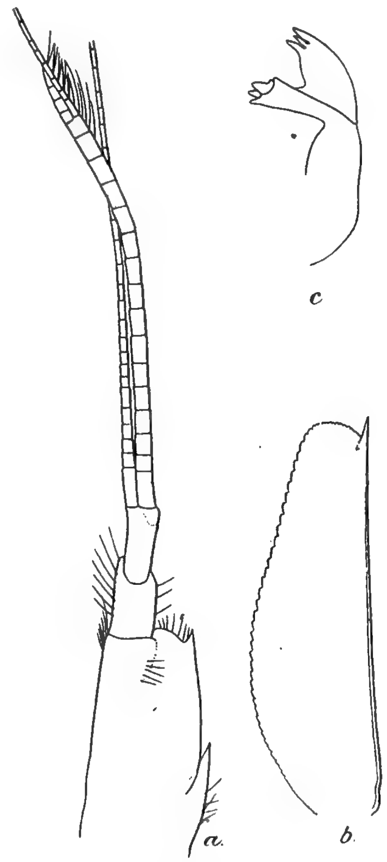
The carapace bears sharp hepatic and antennal spines, the former on a lower level than the latter. The lower limit of the orbit is defined by an acute process and there is a conspicuous ridge close behind the orbital margin and parallel with it. Superiorly this ridge ends in a minute tubercle which is probably a vestige of the supra-orbital spine, inferiorly it ends in the antennal spine. The ridge is almost exactly similar to that found in *Palaemonella vestigialis* but is rather more sharply defined.

The eye is large with the cornea spherical and wider than the stalk. The ocular spot is visible, but is partly confluent with the cornea.

The lateral process of the basal segment of the antennular peduncle (text-fig. 65*a*) reaches barely to the middle of the segment; the terminal spine of the outer margin is short and the margin between this spine and the articulation of the second segment is convex. The outer flagellum is cleft for only a very short distance; the fused basal part comprises 16 segments and is longer than the peduncle. The antennal scale (text-fig. 65*b*) is a little more than 3 times as long as broad; the outer margin is straight or very slightly concave and ends in a strong spine which projects a trifle beyond the end of the lamella.

The exopod of the third maxilliped reaches nearly to the end of the antepenultimate segment, the latter bearing a series of 8 short spines on its outer edge. The ultimate segment is two-thirds the length of the penultimate.

The first peraeopods reach beyond the antennal scale by the chela and fully half the length of the carpus. The carpus is a little longer than the merus and fully 1·4 times the length of the chela. The fingers are longer than the palm and are unarmed.



TEXT-FIG. 65.—*Periclimenes digitalis,* sp. nov.
a. Antennule. *b.* Antennal scale. c. Mandible.

The second peraeopods in the single female examined are equal and very slender, reaching beyond the scale by the chela, carpus and one-third the length of the merus. The merus bears a spine at the distal end of its lower border; it is rather more than 11 times as long as broad and is exactly equal in length with the carpus. The carpus is unarmed and is nearly 9 times as long as its distal breadth. The chela is almost 1·25 times the length of the carpus or merus. The palm is 4·5 times as long as wide and 1·3 times as long as the fingers. The fingers have inturned tips; their cutting edges are entire distally, but in the proximal third are provided with a few small teeth.

The last three peraeopods are all very slender. The fifth reach beyond the scale by the dactylus and more than half the propodus. In the third pair the merus is about 18 times as long as wide. The propodus is entirely devoid of spinules on its posterior margin and is scarcely more than twice the length of the dactylus. The dactylus itself is simple, slightly curved and extremely slender, about 14 times as long as its basal breadth.

The sixth abdominal somite is about 1·5 times as long as the fifth. The telson bears two pairs of dorsal spines, so arranged as to divide its length into three more or less equal parts. The outer margin of the external uropod is ciliated.

The single specimen is an ovigerous female about 22 mm. in length.

In the possession of a post-orbital ridge this species, as already noted, bears a close resemblance to *Palaemonella vestigialis*; the mandible, however, is devoid of a palp (text-fig. 65*c*). In the genus *Periclimenes* it does not appear to have any close allies.

C 404/1.	Port Blair, Andamans, 3–5 fms.	S. Kemp, Feb., 1921.	One, TYPE.

The specimen was caught off Viper I. on a bottom composed of mud and decaying vegetation.

Periclimenes (Ancylocaris) brocki (de Man).

1887. *Anchistia Brockii*, de Man, *Arch. Naturgesch.* LIII, i, p. 548, pl. xxii*a*, figs. 3, 3*a–d*.
1917. *Periclimenes (Cristiger) brocki*, Borradaile, *Trans. Linn. Soc.* (2) *Zool.* XVII, p. 324.

I have examined a specimen from Suvadiva Atoll in the Maldives, determined by Borradaile and have nothing to add to de Man's detailed description. The species was described from Amboina.

Periclimenes (Ancylocaris) rotumanus Borradaile.

1898. *Periclimenes rotumanus*, Borradaile, *Proc. Zool. Soc. London*, p. 1005, pl. lxiv, figs. 5, 5*a*, *b*.
1899. *Periclimenes rotumanus*, Nobili, *Ann. Mus. civ. Genova* (2) XX, p. 235.

I have seen the type of this species in the Cambridge Museum; the second peraeopods are now missing. The species is recorded from Rotuma in the S. Pacific (Borradaile) and Beagle Bay, New Guinea (Nobili).

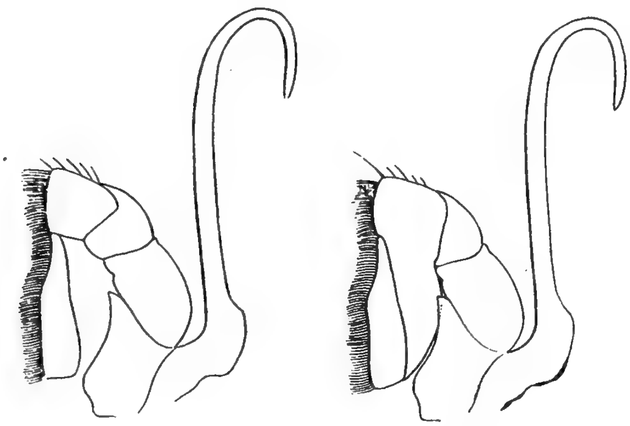
Genus Harpilius Dana.

1852. *Harpilius*, Dana, *U. S. Explor. Exped., Crust.* I, p. 575.
1917. *Harpiliopsis* and *Harpilius*, Borradaile, *Trans. Linn. Soc.* (2) *Zool.* XVII, pp. 379, 380.
1921. *Harpilius*, Tattersall, *Journ. Linn. Soc., Zool.* XXXIV, p. 338.

This genus is very closely related to *Periclimenes*, agreeing with it in all important structural characters and differing only in its more clumsy and depressed form. In habit of body there is, moreover, considerable variation; of the species I have myself examined *H. beaupresi* and *H. depressus* are very strongly depressed, while in *H. lutescens* and *H. gerlachei* this feature is much less pronounced.

In *Harpilius* the distal spine of the basal antennular segment is usually very long, the antepenultimate segment of the third maxilliped is often broadened, the second peraeopods are heavily built with the distal end of the merus flattened or hollowed beneath to accommodate the carpus when the limb is folded, and the last three peraeopods are stout, without spinules on the propodus and with a simple strongly hooked dactylus. The combination of these characters gives the species a very distinct facies, though a parallel to each may be found in the genus *Periclimenes.*

Most if not all the species of the genus are found in association with corals and there can be little doubt that they are specially adapted to life in this environment: the depressed form and stout legs with hooked dactyli are obviously well suited to an existence among the branching stems of a madrepore colony. In general appearance *Harpilius* bears a close resemblance to *Coralliocaris*, the species of which are found in similar situations.



a. b.

TEXT-FIG. 66.—Second maxilliped of *Harpilius lutescens*, Dana.
a. As shown by Dana.
b. With some of the errors corrected.

Tattersall has already questioned the validity of the genus *Harpiliopsis* and I endorse all that he has said. Borradaile's reasons for establishing the new genus are indeed remarkable. Apart from the supposed absence of the arthrobranch on the third maxilliped in *Harpilius*, the difference between this genus and *Harpiliopsis* lies in the form of the second maxilliped. Of *Harpilius* Borradaile has seen no specimens and his description of the appendage is derived from Dana's fig. 4*f* of *H. lutescens.* In his generic description of *Harpilius* he says "second maxilliped .... with last joint posterior to preceding joint" and adds that "the second maxilliped of the type *Harpilius* is so remarkable that no species which does not share this peculiarity can be retained in the genus."

It is, of course, evident at first sight that Dana's figure is erroneous and that the narrowly triangular terminal segment, instead of being attached only by its apex (obviously an impossible arrangement), is joined in normal fashion to the propodus, the free edge of the latter being almost entirely concealed by the overlying ischium and merus. The erroneous division of the propodus into two segments is also seen in the figure of *Oedipus superbus* on the same plate. I give here (text-fig. 66) a copy of Dana's figure, together with another in which the more important errors have been eliminated. The latter does not differ in any noteworthy feature from the normal type.

One of the specimens I have seen I doubtfully refer to *H. lutescens*. This individual has a normal second maxilliped and, as in *H. beaupresi* and *H. depressus*, possesses an arthrobranch on the third maxilliped. In *H. gerlachei*, as Tattersall has pointed out, this gill is suppressed and the species is otherwise peculiar in the absence of the hepatic spine.. Tattersall has suggested that a new genus may be required for the species, but with this I am unable to agree and think that if any change is to be made it should be in the direction of merging *Harpilius* in *Periclimenes*.

Owing to inadequate original description the recognition of Dana's *H. lutescens*, Stimpson's *H. depressus* and of the form which Ortmann called *Anchistia spinigera* is attended with much difficulty, and the possibilities of erroneous identification in this paper are enhanced by the fact that the specimens I have seen are all from the western part of the Indo-Pacific region while the descriptions are based on material found much further to the east.

The species of *Harpilius*, as I understand them, may be separated by the following characters :—

A. Hepatic spine present.

B. Antero-lateral angles of carapace rounded; ischium of second leg with at least one spine situated at distal end of lower border, merus with spine at distal end of upper border, fingers with 1 to 3 large teeth.

C. Antennal spine remote from lower orbital angle and flanked by a carina; hepatic spine on same level as antennal; antepenultimate segment of third maxilliped 3 times as long as broad; ischium of second leg with 3 distal spines, 1 above and 2 below, carpus with dorsal spine, 1 tooth on dactylus and 2 on fixed finger; R. 4–7 : 2–4 ... ... *beaupresi* (Audouin).

C'. Antennal spine close to lower orbital angle, without carina; hepatic spine on much lower level than antennal; antepenultimate segment of third maxilliped 6 times as long as broad; ischium of second leg with 1 distal spine placed inferiorly, carpus without dorsal spine, 2 teeth on dactylus and 3 on fixed finger.

D. Merus and palm of second leg each 3 times as long as broad; posterior pair of dorsal spines of telson placed much nearer to anterior pair than to apex; R. 5–7 : 2–5 ... ... *depressus* Stimpson.

D'. Merus and palm of second leg each 5 times as long as broad; posterior pair of dorsal spines of telson placed midway between anterior pair and apex; R. 7 : 4 ... ... var. *gracilis*, nov.

B'. Antero-lateral angles of carapace rectangular; ischium of second leg unarmed, merus without spine at distal end of upper border, fingers with 5 or more small teeth [antepenultimate segment of third maxilliped about 3 times as long as broad].

C. Hepatic spine remote from frontal margin of carapace; last three legs stout, propodus of third pair 4 times as long as broad, at distal end nearly twice as broad as dactylus; R. 7 : 1-2 ... *lutescens* Dana.

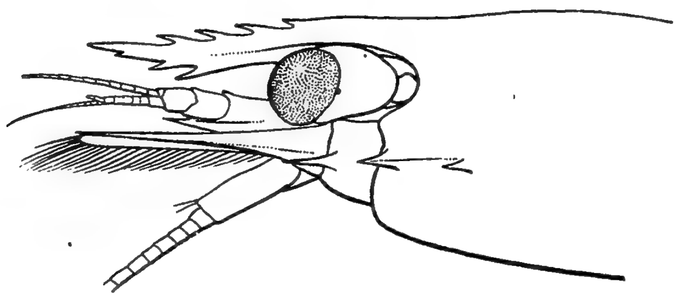
C'. Hepatic spine situated on frontal margin of carapace; last three legs more slender, propodus of third pair 7 times as long as broad, at distal end scarcely broader than dactylus; R. 7-9 : 1-2 ... *consobrinus* de Man.

A'. Hepatic spine absent [ischium of second leg unarmed, merus without spine at distal end of upper border; antepenultimate segment of third maxilliped 3 times as long as broad]; R. 3-5 : 1 ... ... *gerlachei* Nobili.

Harpilius beaupresi (Audouin).

1825. *Palaemon beaupresii*, Audouin, *Explic. somm. des planches de Crust.*, p. 91, in Savigny's *Descr. d'Egypte*, pl. x, fig. 4 (1809).
? 1891. *Anchistia spinigera*, Ortmann, *Zool. Jahrb., Syst.* V, p. 511, pl. xxxvi, fig. 23.
? 1901. *Anchistia spinigera*, Lenz, *Zool. Jahrb., Syst.* XIV, p. 434.
1915. *Harpilius Beaupresii*, Balss, *Denk. math.-naturw. Kl. K. Akad. Wien* XCI, p. 26.
1917. *Harpiliopsis beaupresi*, Borradaile, *Trans. Linn Soc.* (2) *Zool.* XVII, pp. 324, 379, pl. lv, fig. 21.
1921. *Harpilius beaupresi*, Tattersall, *Journ. Linn. Soc., Zool.* XXXIV, p. 389, pl. xxviii, fig. 8.

Borradaile, who gives numerous other references, separates this species from *H. depressus* merely by the proportions of the antepenultimate segment of the third maxilliped. If, however, I have identified Stimpson's species correctly, the two differ in a number of important characters.



TEXT-FIG. 67.—*Harpilius beaupresi* (Audouin). Anterior part of carapace, rostrum, etc.

The principal characters of *A. beaupresi* are the following:—

(i) The rostrum is rather shallow with from 4 to 7 dorsal teeth (usually 4 or 5) and 2 to 4 (usually 2 or 3) ventral. The posterior dorsal tooth is placed on the base of the rostrum in advance of the hinder limit of the orbit. The midrib of the rostrum is continuous with the orbital margin (text-fig. 67).

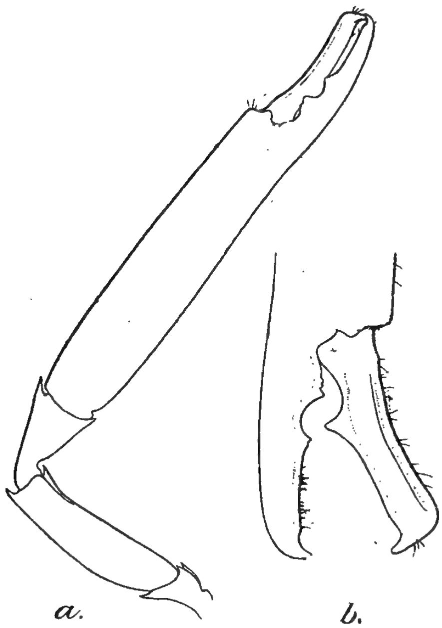
(ii) The antennal spine is remote from the lower orbital angle and is supported by a carina which extends backwards to a point immediately above the base of the hepatic spine. The hepatic and antennal spines are about on a level with one another and the antero-lateral angle of the carapace is rounded.

(iii) The spine on the outer side of the second segment of the antenna is very long. The terminal spine of the antennal scale reaches almost as far forwards as the apex of the lamella.

(iv) The antepenultimate segment of the third maxilliped is broad, scarcely more than 3 times as long as wide.

(v) The first peraeopod is slender, with carpus about 8 times as long as its distal breadth and with fingers more than half as long as the palm.

(vi) In the second peraeopod (text-fig. 68) the ischium bears three distal spines, one above and two, which are smaller, below. The merus has a strong spine at the distal end of its upper border; the lower border ends in a sharp spine on the outer side and in a rounded lobe on the inner side. The carpus has a sharp spine on the upper and outer aspect of the distal margin and an acute process, sometimes spiniform, on its lower side. The outer margin of the dactylus is straight or slightly concave and on the lower surface of the segment there is a sharp longitudinal carina. There is a large triangular tooth on the inner margin of the dactylus a little behind its middle point and at the base a rounded protuberance. The tooth fits between two teeth on the fixed finger, the hindmost of which is broad and frequently exhibits a serrated edge. The palm is about 2·5 times as long as the fingers.



TEXT-FIG. 68.—*Harpilius beaupresi* (Audouin).
a. Second peraeopod.
b. Fingers of same.

(vii) In the third pair of peraeopods the merus is about 3·2 times as long as wide. The propodus is much narrower than the merus, about 6·5 times as long as wide, and at the distal end very little broader than the dactylus.

(viii) The pleura of the fourth and fifth abdominal somites are acutely pointed infero-posteriorly.

(ix) The anterior of the two pairs of dorsal spines on the telson is placed a little behind the middle. The posterior pair is midway between the anterior pair and the apex.

The largest specimen examined is about 16 mm. in length.

Thanks to the excellence of Savigny's figures the identity of this species is beyond all doubt. Richters' *Pontonia* (*Harpilius*) *dentata*, as de Man and Borradaile have suggested, is no doubt synonymous.

Borradaile regards Ortmann's *Anchistia spinigera* as a synonym of *H. depressus*, but while it may be true that the specimens he himself recorded under the former name in 1898 and 1899 belong to Stimpson's species, it does not seem probable that this is also true of those which Ortmann and Lenz have described. Both these authors refer to the presence of three spines at the distal end of the merus of the second leg and this character, so far as I am aware, occurs only in *H. beaupresi*. On the other hand Ortmann states that the dactylus of the second leg bears two teeth and the fixed finger three and this applies to *H. depressus* rather than to *H. beaupresi*. Further information is necessary before the position of Ortmann's species can be decided.

The specimens of *H. beaupresi* in the Zoological Survey of India are from the following localities:—

7240/10.	Aden.	Brit. Mus.	One.
C 407/1.	Tor, Gulf of Suez.	R. B. S. Sewell, 1916.	Eight.
C 408/1.	Port Blair, Andamans.	J. Wood-Mason.	Five.
C 459/1.	Port Blair, Andamans.	S. Kemp, March, 1915.	One.

The specimen from Aden had been determined by Miers as *Anchistia petitthouarsi* (Audouin).

I have also seen specimens belonging to the Paris Museum from Mahé in the Seychelles (Alluaud coll.) and from Massouah, Red Sea (Raffray coll.).

The species has been recorded from numerous localities in the Red Sea (Audouin, Heller, Paulson, Nobili, Balss) from the Chagos Archipelago and the Maldives (Borradaile) and from Pulo Edam near Batavia (de Man). If Ortmann's *Anchistia spinigera* is synonymous the species extends further east to Samoa (Ortmann) and Laysan (Lenz).

Harpilius depressus Stimpson.

1860. *Harpilius depressus*, Stimpson, *Proc. Acad. Sci. Philadelphia*, p. 38.

1898. *Periclimenes spinigerus*, Borradaile, *Ann. Mag. Nat. Hist.* (7) II, p. 383.

1899. *Periclimenes spinigerus*, Borradaile, in Willey's *Zool. Results* p. 405.

1903. *Harpilius depressus*, Rathbun, *Bull. U. S. Fish Comm.* XXIII, iii, p. 920, text-fig. 68.

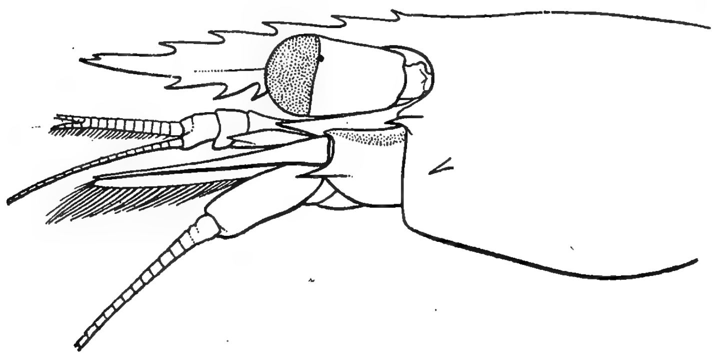
1915. *Harpilius depressus*, Balss, *Denk. math.-naturw. Kl. K. Akad. Wien*, XCI, p. 27.

1917. *Harpiliopsis depressus*, Borradaile, *Trans. Linn. Soc.* (2) *Zool.* XVII, p. 380, pl. lvi, fig. 22.

Harpilius depressus was described by Stimpson from the Hawaiian Is. and I am not altogether certain that the form which occurs on the Indian coast is correctly referred to the same species. The specimens examined differ from the original description in two particulars: there is no difference between the sexes in the form of the third maxilliped and the fingers of the second peraeopod are always more than half the length of the palm. Stimpson's description is very brief and his account of the spines on the segments of the second leg is inadequate. Further information on the form occurring in the Hawaiian Is. is necessary before the name of the Indian form can be regarded as beyond doubt.

The principal characters of the specimens to which I apply the name are the following:—

(i) The rostrum is deeper than in *H. beaupresi* and bears 5 to 7 teeth above (usually 6 or 7) and 2 to 5 below (usually 3 or 4). The posterior dorsal tooth is placed at the base of the rostrum in



TEXT-FIG. 69.—*Harpilius depressus* Stimpson. Anterior part of carapace, rostrum, etc.

advance of the hinder limit of the orbit. The midrib of the rostrum is continuous with the orbital margin (text-fig. 69).

(ii) The antennal spine is placed close to the lower orbital angle and is not supported by a carina. The hepatic spine is placed on a much lower level than the antennal and the postero-lateral angle of the carapace is rounded.

(iii) The spine on the outer side of the second segment of the antenna is very long. The terminal spine of the antennal scale does not reach as far forwards as the distal end of the lamella.

(iv) The antepenultimate segment of the third maxilliped is broad, about 6 times as long as wide.

(v) The first peraeopod is rather stouter than in *H. beaupresi*. The carpus is less than 6 times as long as its distal breadth and the fingers are less than half as long as the palm.

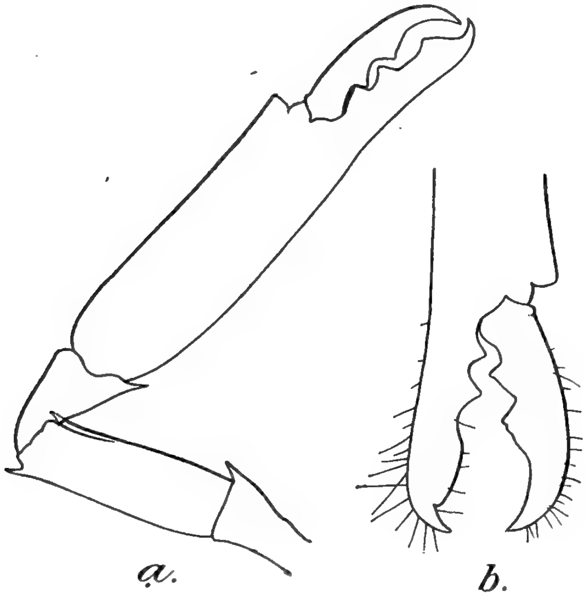
(vi) In the second peraeopod (text-fig. 70) the ischium bears a single spine, which is large and placed at the distal end of the lower border. The merus is closely similar to that of *H. beaupresi*. The carpus has one spine only placed on the lower side.

The outer margin of the dactylus is convex and the segment does not possess the longitudinal carina seen in *H. beaupresi.* There are two large teeth on the dactylus fitting between three on the fixed finger. The teeth on the latter occupy the whole length of the inner margin and the foremost is often broadly rounded. The palm is rather less than twice as long as the fingers.

(vii) In the third pair of peraeopods the merus is rather more than 3·5 times as long as wide. The propodus is much narrower than the merus and is from 5·5 to 6 times as long as wide; at the distal end it is not broader than the dactylus.

(viii) The pleura of the fourth and fifth abdominal somites are acutely pointed infero-posteriorly.

(ix) The anterior of the two pairs of dorsal spines on the



TEXT-FIG. 70.—*Harpilius depressus* Stimpson.
a. Second peraeopod. *b.* Fingers of another specimen.

telson is placed in the middle of its length. The posterior pair is placed very much closer to the anterior pair than to the apex.

The largest specimen examined is about 24 mm. in length.

In life the species was closely and elegantly striped with deep blue on a pale grey ground. There was a narrow mid-dorsal stripe of bright yellow on the third abdominal somite and a similar stripe close to the inferior margins of the first three pleura. The tail-fan was transparent olive-green, the uropods were blotched with blue and with milk-white tips. The chelae of the second legs were finely dotted and suffused with green, with yellowish fingers; the basal segments and the other legs were spotted with blue, the dactyli of the last three pairs being reddish. The eggs were pale brown.

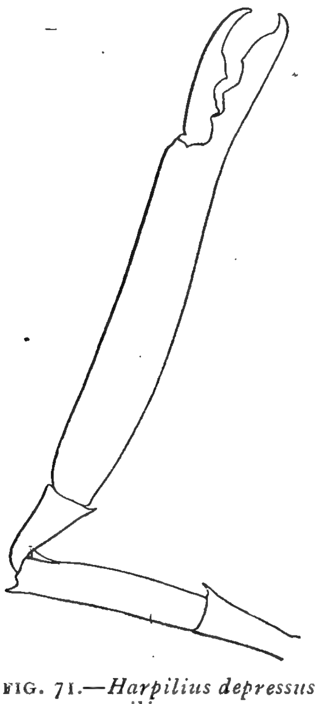
C 410/1. Madras Harbour, 4-5 fms. S. Kemp, May, 1918. Five.

H. depressus was described by Stimpson from the Hawaiian Is. and has since been recorded from that locality by Miss Rathbun. It has also been recorded by Borradaile from Rotuma and the Loyalty Is. (as *P. spinigerus*) and from the Chagos Archipelago, the Maldives, Minikoi and the Seychelles, and by Balss from numerous localities in the Red Sea.

var. **gracilis**, nov.

A single specimen in the collection differs conspicuously from the remainder in its much more slender form. It differs from typical *H. depressus* of the same sex in the following particulars:—

H. depressus, typical form.	*H. depressus* var. *gracilis*.
Antennal scale less than 3 times as long as wide and not longer than carapace.	Antennal scale 3·5 times as long as wide and considerably longer than carapace.
Second peraeopod (text-fig. 70) with both merus and palm about 3 times as long as wide. Palm rather less than twice as long as fingers.	Second peraeopod (text-fig. 71) with merus 5 times and palm 5·5 times as long as wide. Palm 2·5 times as long as fingers.
Third peraeopod with merus about 3·5 times and propodus 5·5 to 6 times as long as wide.	Third peraeopod with merus fully 4·5 times and propodus 7 times as long as wide.
Anterior dorsal spines of telson placed about in the middle of its length; posterior pair much closer to anterior pair than to apex.	Anterior dorsal spines of telson placed much behind the middle of its length; posterior pair almost equidistant between anterior pair and apex.



TEXT-FIG. 71.—*Harpilius depressus* var. *gracilis*, nov.
Second peraeopod

In all other respects the variety closely resembles the typical form. The rostrum is deep in lateral view and reaches nearly to the end of the antennal scale; it bears 7 teeth above and 4 below. The hepatic spine is present and situated on a lower level than the antennal, precisely as in typical *H. depressus*.

The differences in the proportions of the chela are very striking and it is possible that the specimem deserves full specific recognition; of this, however, I find it difficult to be certain with the small number of specimens which are available. It will be noticed that, apart from the attenuated form of certain appendages, the only character by which the variety can be distinguished is the position of the spines on the back of the telson.

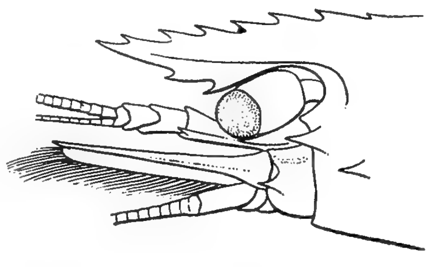
The specimen is 16 mm. in length.

3252/10. Andamans. 'Investigator.' One, Type.

? Harpilius lutescens Dana.

? 1852. *Harpilius lutescens*, Dana, *U. S. Explor. Exped., Crust.* I, p. 576, pl. xxxvii, figs. 4*a-h*.
? 1901. *Harpilius lutescens*, Nobili, *Ann. Mus. Univ. Napoli* (n.s.) I, 3, p. 3.
? 1906. *Harpilius lutescens*, Nobili, *Ann. Sci. nat., Zool.* (9) IV, p. 63.
? 1915. *Harpilius consobrinus*, Balss, *Denk. math.-naturw. Kl. K. Akad. Wien*, XCI, p. 27.
1921. *Harpilius depressus*, Tattersall, *Journ. Linn. Soc., Zool.* XXXIV, p. 389, pl. xxviii, fig. 7.

Dr. Tattersall has very kindly allowed me to examine the specimen from the Red Sea which he recently recorded under the name of *Harpilius depressus.* I find that this specimen is specifically distinct from those which I refer to *H. depressus* and agrees less closely with Stimpson's description. The second leg has one spine at the distal end of the merus on its lower side, but none on the ischium and carpus, and on the inner margin of each of the fingers there is a series of five small teeth. Of *H. depressus* Stimpson says, "Pedes secundi grandes, laeves; ischii, meri, carpique apicibus dentibus spiniformibus armatis; manu carapace duplo longiore, digitis palma dimidia brevioribus, intus forte 2–3-dentatis."



Text-fig. 72.—? *Harpilius lutescens* Dana. Anterior part of carapace, rostrum, etc.

Dr. Tattersall's specimen bears a very close resemblance to *H. consobrinus*, but differs from de Man's exhaustive description in a few points which appear to have specific value. I attribute it with considerable doubt to *H. lutescens*, the identification presupposing a large amount of error in Dana's figures.

The principal characters of the specimen are as follows:—

(i) The rostrum is deep and bears 7 teeth above and 2 below. The posterior dorsal tooth is situated on the carapace behind the orbit. The midrib of the rostrum is not continuous with the orbital margin, but curves round the orbit in the form of a sharp carina some distance behind the margin proper (text-fig. 72).

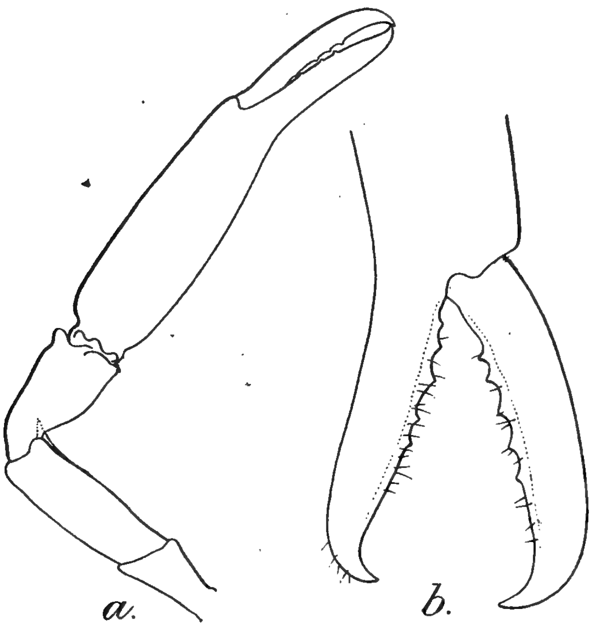
(ii) The antennal spine is placed close to the lower orbital angle and is not supported by a carina. The hepatic spine is situated below the level of the antennal and the antero-lateral angle of the carapace is sharply rectangular.

(iii) The spine on the outer side of the second segment of the antenna is short. The terminal spine of the antennal scale projects well beyond the distal end of the lamella.

(iv) The antepenultimate segment of the third maxilliped is slightly more than 3 times as long as broad.

(v) The carpus of the first peraeopod is about 7·5 times as long as its distal breadth and the fingers are very little shorter than the palm.

(vi) In the second peraeopod (text-fig. 73) the ischium is unarmed. The merus has no spine at the distal end of the upper border; the lower border ends in a spine on the outer side and in a rounded lobe or process on the inner side. The carpus is unarmed. The fingers are bent slightly inwards in relation to the



TEXT-FIG. 73.—? *Harpilius lutescens* Dana.
a. Second peraeopod. *b.* Fingers of second peraeopod.

palm and each bears in the proximal two-thirds of its inner margin a series of 5 small teeth. The palm is less than twice the length of the fingers.

(vii) The last three peraeopods are stout. In the third pair (see Tattersall's fig. 7) the merus is 4 times as long as wide. The propodus is as broad as the merus and is barely 4 times as long as wide.[1] At the distal end the propodus is nearly twice as broad as the dactylus.

(viii) The pleura of the fourth and fifth abdominal somites are not acutely pointed infero-posteriorly.

[1] It is a little too broad in Tattersall's figure.

(ix) The anterior of the two pairs of dorsal spines on the telson is placed a little behind the middle of its length. The posterior pair is midway between the anterior pair and the apex.

The specimen bears a very close resemblance to *H. consobrinus.* The following are the only points of any significance in which it differs from de Man's fully detailed description :—

(i) The carina behind the orbital margin is not mentioned by de Man.

(ii) The hepatic spine is set far back from the frontal margin of the carapace.

(iii) The fused portion of the outer antennular flagellum is composed of 11 segments.

(iv) The carpus of the second peraeopod does not exhibit on its upper side the "scharfe kante" referred to by de Man; this, however, is not shown in his figures. The palm is slightly more than 1·5 times the length of the fingers, whereas in *H. consobrinus* it is less than 1·2 times. Except that there are only 5 teeth on each finger, the second leg agrees closely in all other respects with de Man's descriptions and figures.

(v) The last three peraeopods are much stouter. In *H. consobrinus* the merus of the third leg is 5 times and the propodus 7 times as long as wide. The breadth of the dactylus is scarcely more than half the distal breadth of the propodus, whereas according to de Man's figure the two are almost equally broad in *H. consobrinus.*

(vi) De Man speaks of three pairs of dorsal spines on the telson in *H. consobrinus*, but this is perhaps merely an abnormality.

The specimen differs from Dana's figures in a number of points, particularly in the deeper rostrum and in the much stouter carpus and shorter fingers of the second leg. The figures, as de Man has pointed out, are doubtless erroneous in many respects, but the specimen agrees with them and differs from *H. consobrinus* in the position of the hepatic spine.

The specimen from the Red Sea, which Nobili records without comment as *H. lutescens*, presumably belongs to the same species as that which I have examined. Nobili, however, when writing in 1906, appears not to have been aware that de Man had given the name *H. consobrinus* to the specimens he formerly described as *H. lutescens.* The specimens which Balss has recorded from the Red Sea as *H. consobrinus* also probably belong to this species.

Harpilius lutescens was described by Dana from a specimen obtained at Tongatabu in Polynesia. If my identification is correct its distribution extends westwards to the Red Sea.

Harpilius consobrinus de Man.

1887. *Harpilius lutescens*, de Man, *Arch. Naturgesch.* LIII, i, p. 536, pl. xxii*a*, fig. 1.
1902. *Harpilius lutescens*, de Man, *Abhandl. Senck. naturf. Ges.* XXV, p. 836, pl. xxvi, fig. 54.

Ternate and Noordwachter Is.

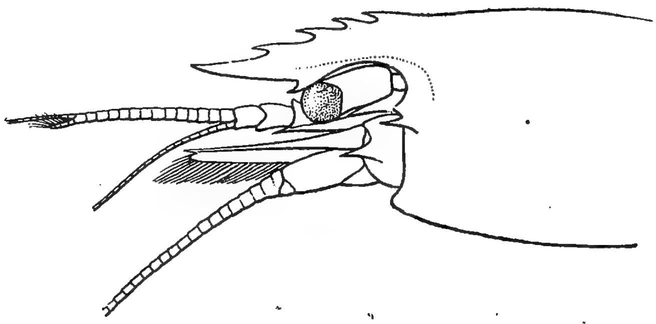
Harpilius gerlachei Nobili.

1905. *Harpilius Gerlachei*, Nobili, *Bull. Mus. Paris* XI, p. 160.
1907. *Harpilius Gerlachei*, Nobili, *Bull. sci. France Belgique* XL, p. 45, pl. iv, figs. 10, 10*a*.
1915. *Harpilius Gerlachei*, Balss, *Denk. math.-naturw. Kl. K. Akad. Wien* XCI, p. 27.
1921. *Harpilius gerlachei*, Tattersall, *Journ. Linn. Soc., Zool.* XXXIV, p. 390, pl. xxviii, fig. 9.

This species is readily distinguished from all other members of the genus by the absence of the hepatic spine of the carapace. It also differs from all, with the possible exception of *H. consobrinus*, in the absence of an arthrobranch on the third maxilliped.

The principal characters of the species are as follows :—

(i) The rostrum is rather shallow and bears from 3 to 5 teeth above, usually 4, and 1 below. The posterior dorsal tooth is placed near the base of the rostrum in advance of the hinder limit of the orbit. The midrib of the rostrum is not continuous with the orbital margin, but curves round the orbit in the form of an ill-defined crest some distance behind the margin proper (text-fig. 74).



TEXT-FIG. 74.—*Harpilius gerlachei* Nobili.
Anterior part of carapace, rostrum, etc.

(ii) The antennal spine is placed close to the lower orbital angle and is not supported by a carina. The hepatic is absent. The antero-lateral angles of the carapace are a little produced, but rounded.

(iii) The spine on the outer side of the second segment of the antenna is short. The terminal spine of the antennal scale projects well beyond the distal end of the lamella.

(iv) The antepenultimate segment of the third maxilliped is a little more than 3 times as long as broad.

(v) The carpus of the first peraeopod is from 5 to 5·5 times as long as its distal breadth and the fingers are little more than half the length of the palm.

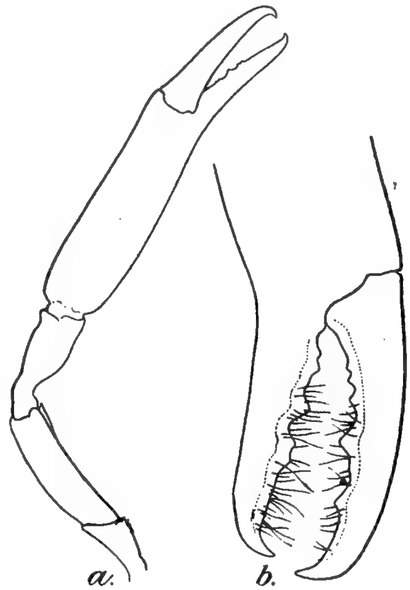
(vi) In the second peraeopod (text-fig. 75) the ischium is unarmed. The merus has no spine at the distal end of the upper border; the lower border ends acutely on the outer side and in a rounded lobe or process on the inner side. The carpus is unarmed.

The fingers are armed in the proximal three quarters of their length with from 3 to 7 teeth, very irregular in their size and distribution. The palm is less than twice the length of the fingers.

(vii) In the third pair of peraeopods the merus is about 3·5 times as long as wide. The propodus is as broad as the merus and is about 4·5 times as long as wide; at the distal end it is very little broader than the dactylus.

(viii) The pleura of the fourth and fifth abdominal somites are not acutely pointed infero-posteriorly.

(ix) The anterior of the two pairs of dorsal spines on the telson is placed behind the middle of its length. The posterior pair is midway between the anterior pair and the apex.



TEXT-FIG. 75.—*Harpilius gerlachei* Nobili.
a. Second peraeopod.
b. Fingers of second peraeopod.

The largest specimen examined is a female about 18 mm. in length.

The telson of one of the specimens is abnormal, bearing 5 teeth on one of the lateral margins and 3 on the other.

C 412-3/1.	Pamban and Kilakarai, Gulf of Manaar.	S. Kemp, Feb., 1913.	Four.

The specimens were all obtained on madrepore coral. Those examined by Nobili were found to the north-east of Arzana I. in the Persian Gulf, "parmi les polypiers." Tattersall's specimens are from a coral reef at Khor Dongonab in the Red Sea and those recorded by Balss are from the Gulf of Suez, the Red Sea and the S. Coast of Arabia.

Genus **Pontoniopsis** Borradaile.

1915. *Pontoniopsis*, Borradaile, *Ann. Mag. Nat. Hist.* (8) XV, p. 207.
1917. *Pontoniopsis*, Borradaile, *Trans. Linn. Soc.* (2) *Zool.* XVII, p. 377.

This genus, of which I have seen no specimens, was erected by Borradaile for a single species, *P. comanthi*, found on crinoids in the Torres Straits. It appears to be very closely related to *Periclimenes* and *Harpilius*, but differs in its depressed and toothless rostrum, which is lanceolate in dorsal view. Supra-orbital and hepatic spines are wanting and the dactyli of the last three legs are simple.

Genus **Dasycaris**, nov.

Rostrum long, laterally compressed, with teeth. Carapace laterally compressed, sculptured, with regions well-defined; antennal and hepatic spines present, each flanked by a strong carina. Antennular peduncle with basal segment greatly narrowed distally; antennal scale well developed. Mandible without palp; inner lacinia of maxillula narrow; all maxillipeds with exopods, the second without podobranch, the third slender. Carpus of first peraeopod not divided into subsegments. Last three pairs of peraeopods with strongly hooked dactylus, without basal protuberance and without accessory claw. Pleura of third, fourth and fifth abdominal somites drawn out inferiorly into long acute processes.

Type and only known species,—*Dasycaris symbiotes*, sp. nov.

This genus is proposed for a remarkable Pontoniine prawn found on Alcyonaria belonging to the genus *Pteroeides*. In most of its characters the genus resemble *Periclimenes*, but the carapace is sculptured, the basal segment of the antennular peduncle is strongly narrowed distally and some of the abdominal pleura are produced inferiorly and end in very sharp spinous processes. The dactylus of the posterior legs appears simple under low magnifications, but when stained and examined under a high power it is seen to possess a pit on the posterior margin, through which a fleshy process can apparently be protruded.

In certain species of *Harpilius* (*H. beaupresi* and *H. depressus*) the pleura of the fourth and fifth abdominal somites are acutely produced infero-posteriorly, though not to the same extent as in *Dasycaris*. In *Harpilius*, however, the carapace is depressed and not sculptured and the basal antennular segment is very broad.

In some respects *Dasycaris* resembles Nobili's little known genus *Coutierea*. The latter, however, is a much more extreme form, with a pterygostomian spine on the carapace and with abnormally developed antennal and supra-orbital spines. In *Coutierea*, moreover, the dactylus of the posterior legs bears a basal protuberance, indicating affinity with *Coralliccaris* and *Conchodytes* rather than with the *Periclimenes* group of genera.

Dasycaris symbiotes, sp. nov.

(Plate IX.)

The rostrum reaches to the end of the second segment of the antennular peduncle in the female, to the end of the third segment in the male. It is straight, very slightly upturned at the tip and is extremely shallow in lateral view. It bears above 5 sharp teeth; of these the three posterior are placed close together, with two situated behind the posterior limit of the orbit, while the foremost is little, if at all, in front of the middle of the rostral length. The lower border is unarmed. Behind the rostrum in the middle of the carapace there is another sharp tooth, widely separated from the posterior of those forming the rostral series; this tooth forms the termination of a sharp carina which commences in the posterior quarter of the carapace.

The lower limit of the orbit is defined by an acute angulation of the frontal margin. The supra-orbital spine is absent. The antennal spine is large, with the hepatic placed behind it on the same level; both spines are supported by strong carinae. The surface of the carapace is uneven; a blunt ridge runs backwards from the lower orbital angle and is separated from the antennal and hepatic spines by a well-marked furrow. There is a similar furrow above this ridge and a large shallow depression on the gastric

TEXT-FIG. 76.—*Dasycaris symbiotes*, sp. nov.

a. Antennule. *c*. Third maxilliped.
b. Antennal scale. *d*. Fingers of second peraeopod.

region. The upper limit of the branchial cavity is defined externally by a groove and an irregular fold.

The eyes are rather slender. The cornea is hemispherical and scarcely wider than the stalk and there is no trace of the ocular spot.

The basal segment of the antennular peduncle (text-fig. 76*a*) is externally concave and is remarkably narrow in its distal third; its least breadth is only one quarter its length excluding the terminal spine. The lateral process does not reach the middle of the basal segment and consists of a comparatively broad plate with an acute termination; it thus differs considerably from that of *Periclimenes* in which the whole process has the form of a simple spine. The terminal spine of the outer margin is very sharp and long, extending beyond the end of the second segment. The second and third segments are broad and the length of the two combined is scarcely more than half that of the basal segment. The free part of the stouter of the two rami composing the outer flagellum is about one-third the length of the fused basal portion, the latter comprising 6 segments. The total length of the shorter ramus is less than that of the peduncle.

The antennal scale (text-fig. 76*b*) scarcely reaches beyond the end of the antennular peduncle. It is only about 2·2 times as long as broad and the outer margin, which is very slightly concave, ends in a spine which reaches almost as far forwards as the broadly rounded apex of the lamella.

The third maxilliped (text-fig. 76*c*) bears a foliaceous epipod. The exopod does not reach the end of the slightly curved antepenultimate segment. The ultimate segment is as long as the penultimate.

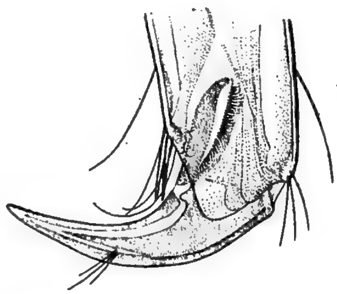
The first peraeopods are slender and reach beyond the antennal scale by the chela and a portion of the carpus. The chela is a little longer than the carpus and the merus a little longer than the chela. The carpus is about 6 times as long as wide. The palm is 4 times as long as wide and is twice as long as the fingers. The fingers bear some short hairs, but their inner margins are unarmed.

In the male specimen the second pair of peraeopods is very unequal; in the female one leg only, apparently the larger of the two, is present.

The larger limb extend beyond the antennal scale by the whole length of the chela and carpus and is covered with minute tubercles. The merus is longer than the ischium and is broadest distally, the lower border ending in a strong tooth. The carpus is very short, scarcely longer than broad; it is little more than one-third the length of the merus and is unarmed. The chela is about 2·75 times the length of the merus; the palm is about 3·5 times as long as wide and is from 2·2 to 2·5 times as long as the dactylus. The dactylus is heavy, with strongly convex outer border (text-fig. 76*d*); at the base of its inner margin it is provided with a large acute tooth which fits into a cavity in the fixed finger. In front of this cavity the fixed finger bears a small tooth. In the distal two-thirds of their length the inner margin of each finger is entire, the margin is, however, a little concave with the result that a small gap is left when the claw is closed. The tips are inturned and cross one another.

In the smaller second leg the tooth at the distal end of the merus appears to be absent and the carpus is nearly twice as long as wide and rather less than half the length of the merus. The chela is 1·65 times the length of the merus, with fingers unarmed and slightly less than half the length of the palm.

The three posterior peraeopods are stout; the third reach beyond the antennal scale by the length of the dactylus. The merus is about 4·5 times as long as broad and is 2·3 times the length of the carpus. The propodus is conspicuously curved, about 6 times as long as broad and 3 times the length of the dactylus; at the distal end of the lower border there are two pairs of spinules. The dactyli have the form of strong hooks and are about 3 times as long as their basal breadth. The dactyli appear simple under low magnifications, but when stained and mounted and viewed under a high power a pit or pore can be detected on the interior side near the base (text-fig. 77). In this pit a fleshy process is lodged and this process is continuous with striated muscle tissue at the base of the dactylus. From the structure of the parts it seems probable that the process can be protruded through the pit. Examination of living material is necessary before the function of the process can be determined accurately; it is possible that it acts as a pad and helps the prawn to retain a grip on the host.



TEXT-FIG. 77.—*Dasycaris symbiotes*, sp. nov Dactylus of third peraeopod, from a stained preparation.

The abdominal somites are smooth. In both sexes the pleura of the third, fourth and fifth somites are produced inferiorly to long sharply pointed processes. In the male the pleura of the first two somites are pointed at their posterior angles, while in the female the pleura of these somites are rounded, with a small pointed projection in the middle of the lower margin of the second. The sixth somite is rather more than 1·5 times the length of the fifth; posteriorly it bears a sharp spine on either side of the base of the telson. The telson is shorter than the uropods and possesses two pairs of dorsal spines; the foremost of these is placed a little in front of the middle point of the telson, while the second pair is rather nearer to the first than to the apex. The terminal telson spines are short.

The female specimen is 13 mm. in length, the male about 9·5 mm.

With the female there is a note by Col. Alcock which reads,—"Transparent grey with dark points on a Pteroeid of exactly similar colour." In *A Naturalist in Indian Seas*, p. 113, Col. Alcock further says,—"Another zoophyte that we often dredged was *Pteroeides elegans* (or a species intimately close to it), one of the sea-pens, of a grey colour profusely marked with little, blackish rings. In its leaves three small species of crustaceans are accustomed to hide, all of whom are coloured and spotted exactly like the living citadel in which they dwell." One of the other crustaceans associated with the *Pteroeides* is an Alpheid, but what the third is I do not know.

1729/7.	$2\frac{1}{2}$ miles E.S.E. of Santapilli Lt., near Vizagapatam, Madras Coast, 15-17 fms.	'Investigator,' Feb., 1890.	One ♀, TYPE.
C 406/1.	3 miles E.S.E. of Kabusa Is., Mergui, 12°44'30" N., 97°55'30" E., 35 fms.	'Investigator,' Oct., 1913.	One ♂, TYPE.

Alcock's notes refer to the female obtained at the first of these localities. The labels of the male do not indicate that it was found in any particular association.

Genus **Thaumastocaris**, nov.

Rostrum well developed, laterally compressed, with large teeth. Carapace laterally compressed, not sculptured. Basal segment of antennule broad; antennal scale well developed. Mandible without palp; inner lacinia of maxillula narrow; all maxillipeds with exopods, the second without podobranch, the third slender. Carpus of first peraeopods divided into a number of subsegments. Last three peraeopods with dactylus biunguiculate, but without basal process. Pleura of abdominal somites rounded inferiorly.

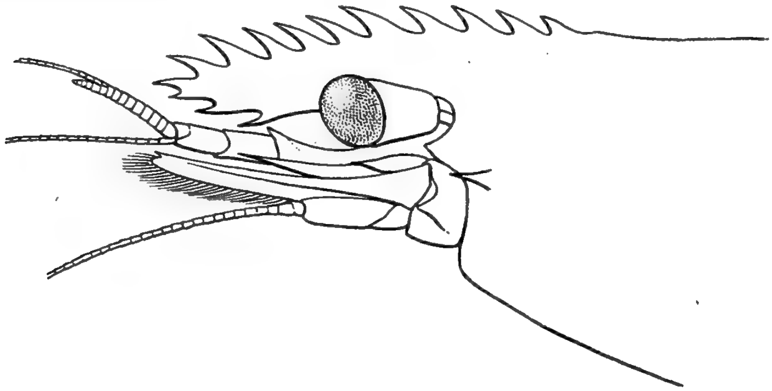
Type and only known species,—*Thaumastocaris streptopus*, sp. nov.

This genus is proposed for a Pontoniine prawn from New Caledonia belonging to the Paris Museum which is remarkable for the fact that the carpus of the *first* pair of peraeopods is divided into a number of subsegments. In this curious feature it differs, I believe, from all Macrura hitherto known.

The carpus of the second peraeopod is frequently segmented in Caridea and the character is of value in distinguishing certain of the families into which the tribe is divided. Much less significance is, however, to be attributed to the occurrence of the same feature in the first peraeopod of *Thaumastocaris*, for it is by this feature alone that it can be distinguished from *Periclimenes*. In *Thaumastocaris* the hepatic spine is absent and the dactylus of the last three legs biunguiculate. In these points it resembles *Periclimenaeus* and I have no doubt that it is in this subgenus or in the closely related *Periclimenes s.s.* that it finds its nearest allies. It is not easy to decide how much importance should be attributed to a unique character such as that on which this genus is founded; it is possible that its affinities would be more clearly shown by regarding it merely as a subgenus of *Periclimenes*.

Thaumastocaris streptopus, sp. nov.

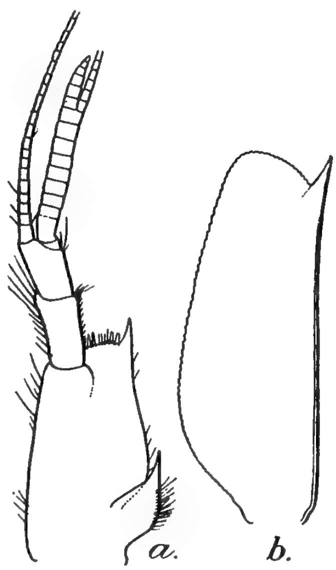
The rostrum (text-fig. 78) reaches to the end of the antennal scale and is deep in lateral view. The upper border is straight and in the single specimen examined bears a series of 10 closely set teeth which increase in size from behind forwards and are all very large; the three posterior teeth are situated on the carapace behind the orbit. The lower border is convex and bears three smaller teeth in its distal half.



Text-fig. 78.—*Thaumastecaris streptopus*, sp. nov. Anterior part of carapace, rostrum, etc.

The carapace is smooth, without trace of areolation or sculpture. The orbital angle is acute; below it there is a sharp antennal spine, but both supra-orbital and hepatic are missing. The eyes are large; the ocular spot is merged in the cornea and the breadth of the cornea is greater than that of the stalk.

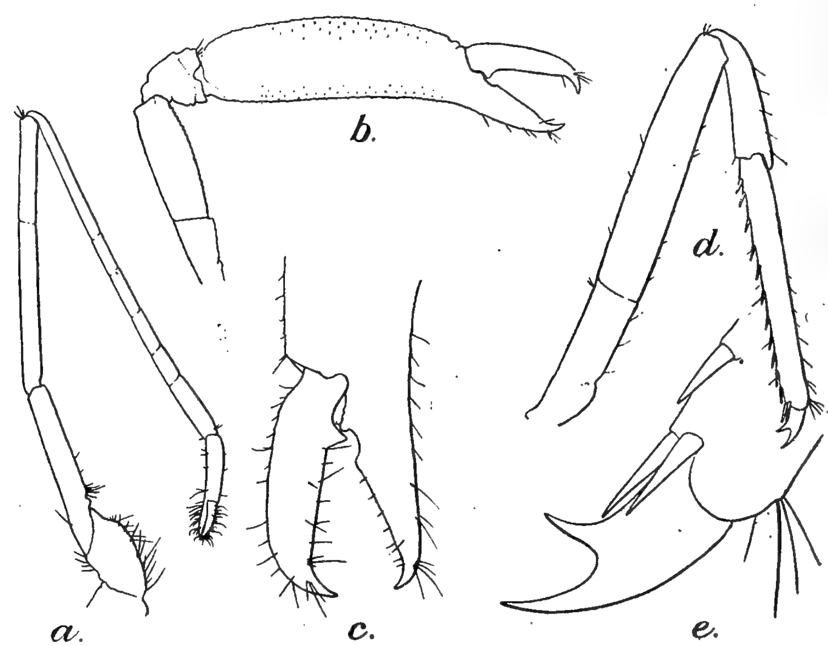
The antennular peduncle (text-fig. 79*a*) extends nearly to the end of the antennal scale. The lateral process does not quite reach the middle of the basal segment; the spine at the outer distal angle is long and the margin between this spine and the articulation of the second segment is a little convex. The free portion of the shorter of the two rami composing the outer antennular flagellum is much shorter than the fused part, the latter comprising 9 segments. The antennal scale (text-fig. 79*b*) is not quite 3 times as long as wide; the outer margin is slightly concave and terminates in a spine which reaches almost to the end of the lamella.



Text-fig. 79.—*Thaumastocaris streptopus*, sp. nov.
a. Antennule.
b. Antennal scale.

The distal endite of the maxilla, as in most Pontoniinae, is divided into two lobes. The third maxilliped extends to the middle of the second antennular segment and is slender. It possesses a small arthrobranch and the exopod does not reach the distal end of the antepenultimate segment. The ultimate segment is less than two-thirds as long as the penultimate.

The first peraeopods (text-fig. 80*a*) are very long and slender: the mero-carpal articulation reaches to the end of the basal antennular segment. The merus is about 14 times as long as wide and is divided by a rather obscure articulation into two subsegments, the distal about two-thirds the length of the proximal. The car-



TEXT-FIG. 80.—*Thaumastocaris streptopus*, sp. nov.
a. First peraeopod. *c*. Fingers of second peraeopod.
b. Second peraeopod. *d*. Third peraeopod.
e. Dactylus of same.

pus is very slender, about 1·35 times as long as the merus and 3·6 times as long as the chela. It is divided by transverse or oblique articulations into six subsegments, the order of which, when arranged according to length is 1, 6, 3, 2, 4, 5. The first subsegment is twice as long as the sixth, the second, third and fourth are subequal and the fifth, which is the shortest, is about 2·5 times as long as wide. The chela is slender, with fingers unarmed and little more than half the length of the palm.

Judging from the size of the basal segments the second peraeopods do not differ greatly in size, but only the left limb (text-fig. 80*b*) is present in the unique specimen. It extends beyond the antennal scale by the greater part of the chela. The merus is rather less than 3 times as long as wide; it is conspicuously tuberculate along its lower border, but does not bear a distal tooth. The carpus is a little longer than broad and is about half the length of the merus. Its surface is somewhat uneven and it bears one obscure tubercle on its upper surface and two beneath. There is an excavation in the anterior margin on the inner side and the border above this excavation is obscurely crenulate. The chela is about 3 times as long as the merus and the fingers are a little less than half the length of the palm. The palm is nearly 3 times as long as wide and is rather closely covered with conspicuous tubercles except on the middle of its inner face. The fixed finger is bent at an obtuse angle to the palm. There is a large triangular tooth at the base of the dactylus which fits into a socket in the fixed finger (text-fig. 80*c*). In the proximal third of the fixed finger there are two teeth separated by a shallow excavation; the anterior of these is blunt and little developed, the posterior is broad and crenulate on the summit. The tips of the fingers are inturned and cross one another when the claw is closed.

The last three peraeopods are stout; the third (text-fig. 80*d*) reach a little beyond the antennal scale, the fifth to the end of the basal antennular segment. In the third pair the merus is 5·5 times as long as wide and the propodus is 5·5 times as long as the dactylus. In the third and fourth pairs the posterior margin of the propodus is thickly furnished with spinules along its entire length; in the fifth pair the spinules are restricted to the distal end. The dactylus (text-fig. 80*e*) is broad and biunguiculate, with the accessory claw large.

The pleurobranchs as in other Pontoniinae are five in number, one being situated above the base of each peraeopod.

The sixth abdominal somite is short; it bears a strong spine on either side of the base of the telson and one at each postero-lateral angle. The telson is flattened above, with two pairs of large dorsal spines. The anterior pair is situated well in advance of the middle, while the posterior pair is midway between the anterior pair and the apex. At the tip of the telson there are as usual 6 spines, the intermediate pair the longest. The median pair is unusually slender.

The species is described from a single male about 24 mm. in length.

The specimen is the property of the Paris Museum. It was obtained in August 1890 at Noumea in New Caledonia by Abbé Cullieret.

Genus **Anchistus** Borradaile.

1898. *Anchistus*, Borradaile, *Ann. Mag. Nat. Hist.* (7) II, p. 387.
1917. *Anchistus*, Borradaile, *Trans. Linn. Soc.* (2) *Zool.* XVII, p. 387.

The genera *Anchistus* and *Pontonia* comprise species which have adopted a more secluded mode of life than any of those contained in the preceding genera. The species of *Anchistus* live in the mantle-cavity of lamellibranch molluscs, those of *Pontonia* in a similar situation or in the branchial sac of ascidians. In both genera the prawns probably enter their hosts when larvae and never leave them throughout the whole period of their lives (*vide* p. 117).

The structural changes which they have undergone in response to this remarkable environment are not great. The species are more or less depressed in habit of body and, except for the occasional presence of the antennal, all the spines of the carapace have disappeared; the second legs are very heavy, frequently unequal, and without spines on the ischium, merus or carpus To each of these characters a parallel can be found in other genera of the family. The only structural feature of unequivocal value is afforded by the inner lacinia of the maxillula, which is very broad and densely covered with hair.[1] In this respect *Anchistus* and *Pontonia* agree with *Conchodytes*—which also lives in lamellibranchs—and differ from all other genera of Pontoniinae in which the maxillula has been described.

The characters available for separating *Anchistus* from *Pontonia* are very slight, though there can be little doubt that the genera constitute two natural groups of species. In *Anchistus* the rostrum is laterally compressed in its distal half and frequently bears small teeth at or near the apex. The two distal segments of the third maxilliped[2] are always slender and are not twisted as in the related genus. The dactylus of the last three legs is either simple and strongly hooked, or is scoop-shaped with the distal part of the anterior border bent inwards, and with an accessory tooth. Minor distinctions are to be found in the last abdominal somite and telson. The former is bluntly produced on either side of the telson and with the postero-lateral corners more or less rounded, whereas these four angles are sharply acute or spinous in *Pontonia*. In *Anchistus* the dorsal spines of the telson are very small and inconspicuous, in *Pontonia* they are usually large.

The distal endite of the maxilla, as in some species of *Pontonia* and most *Periclimenes* is divided into two lobes.

Borradaile recognises five species of this genus and also includes, though with some doubt, Milne-Edwards' *Pontonia armata*. This species can never be identified with certainty from the brief description which has been published, and the same remark also applies to *A. spinuliferus* (Miers). Pesta's *Marygrande mirabilis* is no doubt an *Anchistus*; but the author seems to have confused two distinct species in drawing up his specific description.

I have myself seen four species of *Anchistus*, two of which appear to be undescribed. They are distinguished by the following characters:—

A. Rostrum toothless; antepenultimate segment of third maxilliped very broad, contrasting strongly in width with two distal segments; chela of first leg with its lateral edges

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[1] See Borradaile's figs. 25*e* and 26*e* *loc. cit.*, 1917.

[2] Borradaile distinguishes *Anchistus* from *Pontonia* by the slenderness of these two segments; they are, however, equally slender in some species of *Pontonia*.

produced and bent downwards, the lower surface thus being deeply channelled; dactyli of last three legs simple, less than half as broad at base as distal end of propodus ... *inermis* (Miers).

A'. Rostrum with teeth at or near apex; antepenultimate segment of third maxilliped rather slender, not contrasting strongly in width with two distal segments; chela of first leg normal in form; dactyli of last three legs little narrower at base than distal end of propodus.

B. Dactyli of last three legs normal in form, simple and consisting of a broad basal portion and a slender curved apical claw; basal segment of antennular peduncle with a short tooth at distal end of outer margin [antennal spine present] ... ... *gravieri*, sp. nov.

B'. Dactyli of last three legs scoop-shaped with distal part of upper border reflected inwards, biunguiculate; basal segment of antennular peduncle without terminal tooth.

C. Rostrum more or less pointed with teeth on upper border near apex; antennal spine present; dactyli of last three legs with sharp accessory claw and very minute and inconspicuous spinules ... ... *miersi* (de Man).

C'. Rostrum squarely truncate with teeth only at the apex; antennal spine absent; dactyli of last three legs with short blunt accessory claw and large spinules ... ... *demani*, sp. nov.

Anchistus inermis (Miers).

1884. *Harpilius inermis*, Miers, *Rep. Zool. Coll. H.M.S. 'Alert,'* p. 291, pl. xxxii, fig. B.

1894. *Pontonia pinnae*, Ortmann, *Denk. med.-naturw. Ges. Jena* VIII, p. 16. pl. i, fig. 3.

1906. *Pontonia pinnae*, Nobili. *Ann. Sci. nat., Zool.* (9) IV, p. 65.

1907. *Pontonia pinnae*, Nobili, *Bull. Sci. France Belgique* XL, p. 49, pl. iv, figs. 11–11*b*.

1917. *Anchistus inermis* and *Pontonia pinnae*, Borradaile, *Trans. Linn. Soc.* (2) *Zool.* XVII, pp. 388, 391.

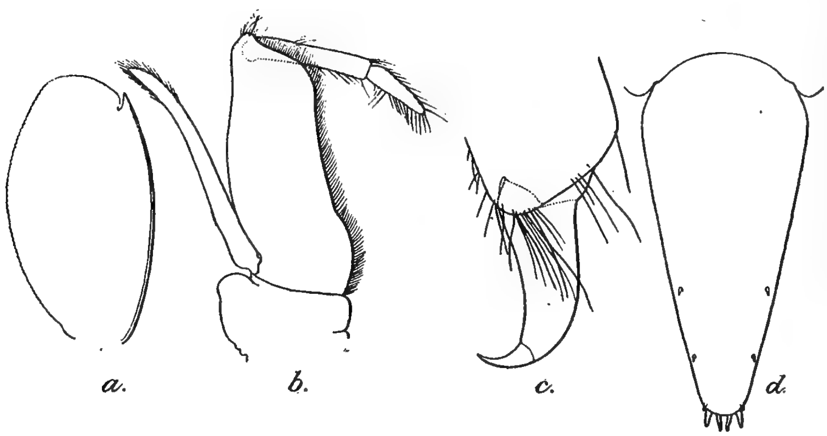
1921. *Anchistus inermis*, Tattersall, *Journ. Linn. Soc., Zool.* XXXIV, p. 391, pl. xxvii, fig. 4.

Other references are given by Borradaile. The principal characters of the species are as follows:—

The rostrum is directed downwards, toothless and with the apex broadly rounded in lateral view. The lower limit of the orbit is defined by an acute projection from the frontal margin of the carapace; the antennal spine is either altogether absent or is represented merely by a minute pointed process. The basal segment of the antennular peduncle is produced distally on its outer side in the form of a convex lobe, the outer margin terminating in a short spine. The fused portion of the outer antennular flagellum comprises 5 segments. The antennal scale (text-fig. 81*a*) is broadly oval and little narrowed anteriorly; the strongly convex outer border terminates in a rather small tooth which does not reach the distal end of the lamella.

The antepenultimate segment of the third maxilliped (text-fig. 81*b*) is longer than the two distal segments taken together and is very broad; its least breadth is more than three times that of the penultimate segment. The lower margins of the basis and ischium of the first peraeopods are heavily fringed with setae. The carpus is a little longer than the merus and nearly twice as long as the chela; the fingers are much shorter than the palm. The structure of the chela, as Tattersall has pointed out, is very peculiar.[1] The edge, both on its outer and inner side, is produced to form a sort of flap which is bent downwards and is thickly fringed with long setae on its margin. The chela is thus deeply hollowed in a longitudinal direction when viewed from below and in a transverse section the lower surface would be semicircular (see Tattersall, *loc. cit.*, fig. 4).

The second peraeopods are unequal, either the right or left limb may be enlarged. In the larger of the two the merus is from 2·0 to 2·4 times as long as broad; the carpus is very short, only one-sixth to one-eighth the length of the chela and the fingers are a little more than half the length of the palm. The dactylus



TEXT-FIG. 81.—*Anchistus inermis* (Miers).

a. Antennal scale. *c.* Dactylus of third peraeopod.
b. Third maxilliped. *d.* Telson.

is strongly convex externally. On the inner margin it bears in its basal half a very large triangular tooth and a rounded knob close to the articulation; when the claw is closed both the tooth and the knob are received into a large socket in the fixed finger. The inner margin of the fixed finger is obtusely produced in the middle and in the basal half, on a crest which borders the socket on its upper side, there are usually from 3 to 6 small denticles, the foremost placed at the summit of the obtuse prominence referred to above. In all well-developed specimens the distal half of each finger is internally concave. The fingers of the smaller limb are similar, but the tooth on the dactylus is usually less well developed.

In the last three peraeopods the propodus is without spinules on its posterior edge. The dactylus (text-fig. 81*c*) is strongly hooked, with the terminal claw bent at right angles to the proxi-

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[1] The character is not sexual as suggested by Tattersall.

mal portion. It is extremely slender, the basal breadth being only about half that of the distal end of the propodus.

The apex of the telson (text-fig. 81*d*) is generally armed with six spines. The two forming the median pair are more slender than the intermediates; the outermost are very short and inconspicuous and are occasionally missing. The dorsal spines are very small and are sometimes absent. When present the anterior pair is placed behind the middle of the telson, with the posterior pair midway between the first pair and the apex.

An exceptionally large female is about 39 mm. in length; the majority of the specimens examined do not exceed 26 mm.

Living specimens vary in colour from pale straw to bright orange yellow. In females the entire body and legs are covered with minute white dots and the eggs are pale straw, yellow, orange or brown. Males are semitransparent and lack the white dots found in the female.

Dr. W. T. Calman has been kind enough to compare certain specimens which I sent him with the holotype of Miers' *Harpilius inermis.* He writes that the type " agrees exactly with your Indian specimens in the form of the chela of the first leg and in the dorsal spinules of the telson (these are very small, near the decurved lateral edge, and easy to overlook), as well as in all other characters that I can see. I think there can be no doubt that your specimens belong to Miers' species.''

Tattersall is doubtless right in his suggestion that Ortmann's *Pontonia pinnae*[1] is synonymous with this species. The only point of difference concerns the proportionate length of the palm and fingers of the second peraeopod as shown in the figure. On this no reliance can be placed, as Ortmann's figures are usually inaccurate. I have examined specimens belonging to the Paris Museum which were obtained at the same locality in the Persian Gulf as those which Nobili recorded as *Pontonia pinnae* and find that they are typical *A. inermis.*

C 415/1.	Port Blair, Andamans.	S. Kemp, Feb., March, 1921.	Thirty-four.
C 441/1.	Andamans.	A. R. S. Anderson.	Nine.
C 442/1.	Paway I., Mergui Archipelago.	'Investigator,' Feb., 1914.	Two.
C 416/1.	Cheval Paar, Ceylon, 6 fms.	T. Southwell, Jan., Feb., 1911.	Four.
C 458/1.	Pamban, G. of Manaar.	S. Kemp, Feb., 1913.	Five.

I have also seen specimens belonging to the Paris Museum from the Pearl banks S.W. of Arzana I. in the Persian Gulf, obtained in *Pinna* (Bonnier and Pérez coll.) and from Vanikoro, in the Santa Cruz group, Polynesia.

The specimens from Port Blair were all obtained in the mantle-cavity of species of *Pinna*, a mollusc which occurs in abundance at low water at Brigade Creek and on the shore south of Viper I.

[1] The specific name used by Ortmann was preoccupied by Lockington in 1879 (see Addendum, p. 287).

Every large *Pinna* which was opened contained a pair of prawns belonging either to this species or to *Conchodytes biunguiculatus*. One pair of *A. inermis* was found in *Pinna nigrina* Lam., one pair in *P. vexillum* Born. and the remainder in *P. bicolor* Gmelin.[1] The specimens from Pamban were also obtained in *Pinna*.

The species was described by Miers from a specimen obtained in *Pinna* at Porte Molle in Queensland. It has been recorded from Shark Bay, W. Australia, in *Pinna* (Miers); from the Monte Bello Is., N.W. Australia, in *Pinna* (Rathbun); from Penang, "taken from the infra-branchial chamber of a large Gastropod"[2] (Lanchester); from Trincomali in Ceylon (Müller); from the Ceylon Pearl banks (Pearson); from the Persian Gulf Pearl banks, in *Pinna* (Nobili)[3]; from Dar-es-Salaam, in *Pinna* (Ortmann)[3]; and, in the Red Sea, from Djibouti (Nobili)[3] and Suakin Harbour, in *Pinna* (Tattersall).

Anchistus mirabilis (Pesta).

1911. *Marygrande mirabilis*, Pesta, *Zool. Anz.* XXXVIII, p. 571, text-figs. 1–5.

1913. *Marygrande mirabilis*, Pesta, *Denk. math-naturw. Kl. K Akad. Wiss. Wien* LXXXIX, p. 675, text-figs. 31, 32.

Pesta appears to have confused two forms when describing this species. The dactylus of the posterior legs is described and figured as simple, but he includes as a variety of the same species a form in which it is biunguiculate (*v.* Pesta, 1913, text-figs. 31*d*, *e*). Judging from the species of *Anchistus* that I have seen it does not seem possible that these two types of dactylus can be found in one and the same species.

The form with simple dactylus is closely related to Miers' *A. inermis*, from which, so far as can be ascertained from Pesta's account, it differs only in the less depressed rostrum with apex more pointed in lateral view. These characters are insufficient and re-examination of Pesta's specimens is necessary before it is possible to reach any definite conclusions regarding the identity of the species. That it is not synonymous with Miers' species may be inferred from the fact that it was found in the mantle-cavity of *Tridacna gigas*, whereas *A. inermis* is apparently always associated with *Pinna*.

Pesta's specimens were obtained at Samoa.

Anchistus gravieri, sp. nov.

The rostrum (text-fig. 82) reaches to the end of the second segment of the antennular peduncle and is directed downwards. In lateral view it is rather deep, but obliquely truncate terminally

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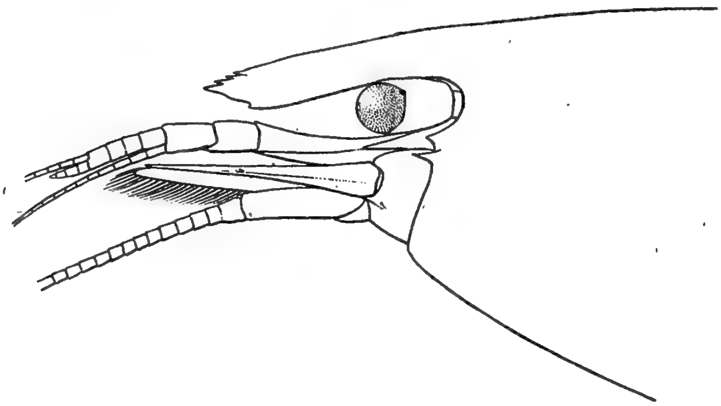
[1] I am indebted to Dr. Baini Prashad for the identification of the species of *Pinna*.

[2] This is, I believe, the only record of a Macruran from a Gastropod and is doubtless an error.

[3] Recorded as *Pontonia pinnae*.

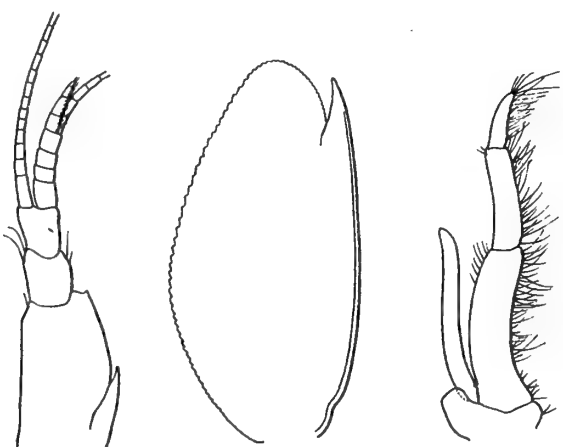
with the apex sharply pointed. On the upper edge close to the tip there are three sharp teeth, placed close together with setae in the interstices. On the lower border there is a small denticle placed



TEXT-FIG. 82.—*Anchistus gravieri*, sp. nov.
Anterior part of carapace, rostrum, etc.

near the distal end beneath the hindmost tooth on the upper edge.

The lower limit of the orbit is acutely produced and there is in addition a strong antennal spine. The cornea is a little narrower

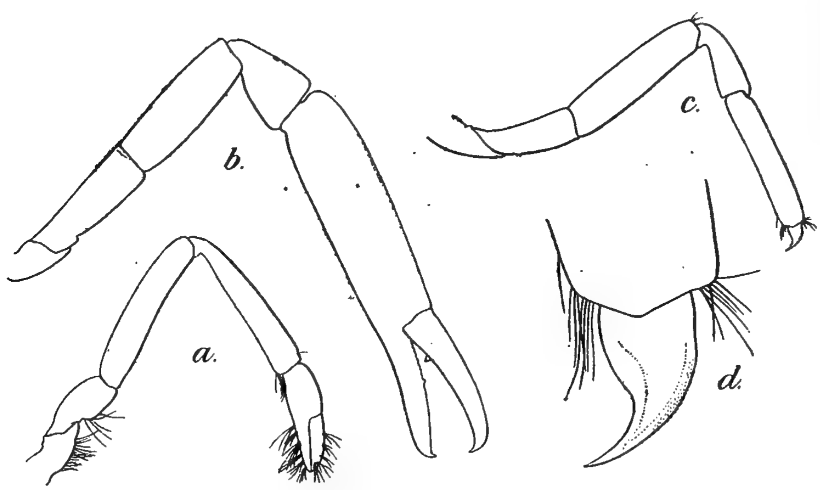


TEXT-FIG. 83.—*Anchistus gravieri*, sp. nov.
a. Antennule. *b*. Antennal scale.
c. Third maxilliped.

than the stalk and the black ocular spot is distinct. The basal segment of the antennular peduncle is produced on the outer side of the articulation of the second segment much as in *A. inermis*, and the outer margin ends in a small tooth (text-fig. 83*a*). The fused portion of the two rami composing the outer antennular flagellum consists of 4 segments. The antennal scale is strongly narrowed distally (text-fig. 83*b*); the outer margin is convex and terminates in a large spine which does not reach as far forwards as the sharply rounded distal end of the lamella.

The antepenultimate segment of the third maxilliped (text-fig. 83*c*) is slender, as in *A. miersi*, and does not contrast strongly in width with the two terminal segments; in length it is slightly greater than these two segments combined.

The first peraeopods (text-fig. 84*a*) reach beyond the antennal scale by the chela and half the length of the carpus. There are a few setae on the lower borders of the basis and ischium. The merus and carpus are equal in length, each 1·5 times as long as the chela. The palm is normal in form, without the curious structure seen in *A. inermis;* the fingers bear tufts of setae and



TEXT-FIG. 84.—*Anchistus gravieri*, sp. nov.

a. First peraeopod. *c*. Third peraeopod.
b. Second peraeopod. *d*. Dactylus of same.

are somewhat spatulate, unarmed and longer than the palm.

In the single specimen examined only the right leg of the second pair is present (text-fig. 84*b*). It reaches beyond the antennal scale by rather more than the length of the chela. The merus is 3 times as long as wide and about 1·5 times as long as the carpus. The carpus is conical, about two-thirds as broad as long and one quarter the length of the chela. The palm is 1·75 times the length of the fingers. In the dentition of the fingers the species resembles *A. inermis*; the dactylar tooth is, however, smaller and the inner edge of the fixed finger is not angulate and bears six small denticles in the proximal half.

The merus of the third leg (text-fig. 84*c*) is 4 times as long as wide, that of the fifth 4·5 times. The propodus in all three is without spinules on its posterior edge. The dactylus (text-fig. 84*d*) is simple and short, broad at the base, and with a slender terminal claw which is bent at an angle of 45° to the main axis of the segment. The telson is similar to that of *A. inermis*.

The single specimen is about 20 mm. in length.

With this species I have associated the name of Prof. Ch. Gravier, to whom I am indebted for the opportunity of examining a most interesting collection of unnamed Pontoniinae belonging to the Paris Museum. *A. gravieri* is distinguished from *A. inermis* (i) by the presence of teeth on the rostrum, (ii) by the strong antennal spine, (iii) by the shape of the antennal scale, (iv) by the slender antepenultimate segment of the third maxilliped, (v) by the form of the chela of the first peraeopod and (vi) by the broad-based dactyli of the last three peraeopods. *A. spinuliferus* can never be recognised with certainty from Miers' wholly inadequate description; it appears, however, to differ from the species described above in its unarmed rostrum. In *A. mirabilis* (Pesta) the rostrum is also unarmed and the proportions of the segments of third maxilliped are different. *A. miersi*, *A. demani* and *A. biunguiculatus* are easily distinguished by the form of the dactylus of the last three legs.

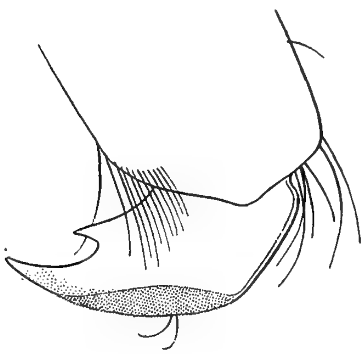
The single specimen examined is from Vanikoro, one of the Santa Cruz Is. in Polynesia, and is the property of the Paris Museum. The label does not indicate that the individual was found in the mantle-cavity of a lamellibranch.

Anchistus miersi (de Man).

1888. *Harpilius Miersi*, de Man, *Journ. Linn. Soc., Zool.* XXII, pl. xvii, figs. 6–10.
1906. *Anchistus miersi*, Nobili, *Ann. Sci. nat., Zool.* (9) IV, p. 63.
1917. *Anchistus miersi*, Borradaile, *Trans. Linn. Soc.* (2) *Zool.* XVII, p. 388, pl. lvi, fig. 25.
1921. *Anchistus miersi*, Tattersall, *Journ. Linn. Soc., Zool.* XXXIV, p. 391.

Borradaile quotes other references. De Man has given an excellent description of this species and I have little to add to what he has said. The types of the species are in the collection of the Zoological Survey of India. In the specimens I have seen there are four or five teeth on the upper border of the rostrum near the apex and one or two very small denticles on the lower side. In a young individual, about 11 mm. in length, an obsolete tooth can be seen at the distal end of the outer margin of the basal antennular segment; but in well-grown specimens no trace of this tooth remains. The antennal scale is anteriorly narrowed, much as in *A. gravieri*.

The second peraeopods vary somewhat in proportions and in the dentition of the fingers. In a specimen from Batavia the carpus, as in the types, is conspicuously longer than broad and the palm is only about 1·5 times the length of the fingers. There are two rather small teeth on the proximal part of the inner margin of the dactylus[1] and 8 or 9 small denticles on the proximal half of the fixed finger. In a specimen from Pulo Condore the carpus is as broad as long and the palm is nearly twice the length of the fingers: there is only one large tooth at the base of the dactylus[1] and 5 denticles on the fixed finger. The distal part of the upper border of the dactylus of the last three legs is bent inwards the segment thus forming a sort of scoop (text-fig. 85). There is a large tooth on the posterior margin. On the reflected part near the tip of the dactylus there are a number of extremely minute spinules, only visible under a high power of the microscope. The lateral margins of the telson are armed with two pairs of very small spines arranged in the same way as in *A. inermis*.



Text-fig. 85.—*Anchistus miersi* (de Man). Dactylus of third peraeopod.

8238/6.	Elphinstone I., Mergui Archipelago.	J. Anderson, March, 1887.	Two, TYPES.
C 418/1.	Port Blair, Andamans.	S. Kemp, Feb., 1921.	One, young.

The specimen from Port Blair, which is only 11 mm. in length, was found in a *Tridacna* on the shore at Aberdeen. It was almost transparent when alive, with large sparsely distributed red chromatophores.

I have also seen specimens belonging to the Paris Museum from Batavia (Reynaud coll.) and from Pulo Condore (Germain coll.). The specimen from the latter locality was found in *Tridacna.*

A. miersi has been recorded from Mangareva in the Gambier Is. in the pearl oyster (Nobili), from Funafuti in the Ellice Is. (Whitelegge), from the D'Entrecasteaux Is., British New Guinea, in *Tridacna squamosa* (Borradaile), from Elphinstone I. in the Mergui Archipelago (de Man), the Maldives (Borradaile), the Seychelles (Borradaile), from the vicinity of Arzana I. in the Persian Gulf, in *Spondylus* (Nobili), from the Red Sea, in *Pinna* (Nobili) and from Suakin Harbour, in *Pinna* (Tattersall).[2] The species has thus been recorded from four different genera of lamellibranchs.

Anchistus demani, sp. nov.

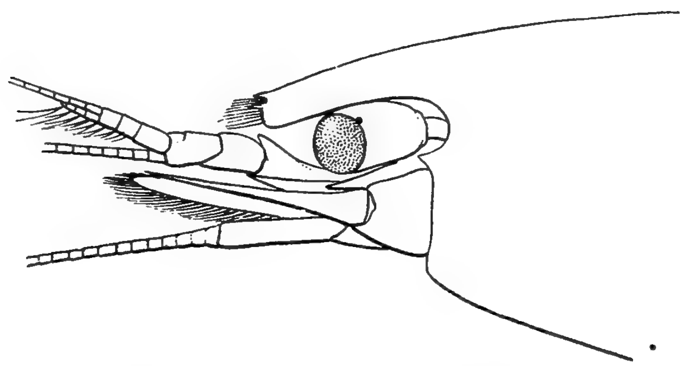
This species is closely related to *A. miersi*, but is distinguished by the following characters :—

[1] In addition to the rounded knob near the articulation.

[2] Tattersall states that Henderson has recorded the species from the coasts of India, but I have not been able to find the reference.

A. miersi (de Man).	*A demani*, sp. nov.
Rostrum apically pointed in lateral view, with 4 or 5 small teeth on upper border near tip and sometimes with 1 or 2 denticles on lower border.	Rostrum squarely truncate at apex in lateral view, the upper end of the truncate margin armed with 2 or 3 small teeth (text-fig. 86).
Antennal spine of carapace present.	Antennal spine of carapace absent.
Dactylus of last three peraeopods scoop-shaped; apex slender and sharply pointed; accessory spine sharp and conspicuous; reflected portion of upper margin with fine microscopic spinules (text-fig. 85).	Dactylus of last three peraeopods scoop-shaped; apex broader and less sharply pointed; accessory spine very blunt and inconspicuous; reflected portion of upper margin entirely covered with rather coarse spinules (text-fig. 88).
Distance between the two pairs of dorsal spinules of telson (when present) about equal to distance between posterior pair and apex.	Distance between the two pairs of dorsal spinules of telson more than twice the distance between posterior pair and apex (text-fig. 87*h*).
Larger, ovigerous females 25 mm. or more in length.	Smaller, ovigerous females 10 mm. in length.

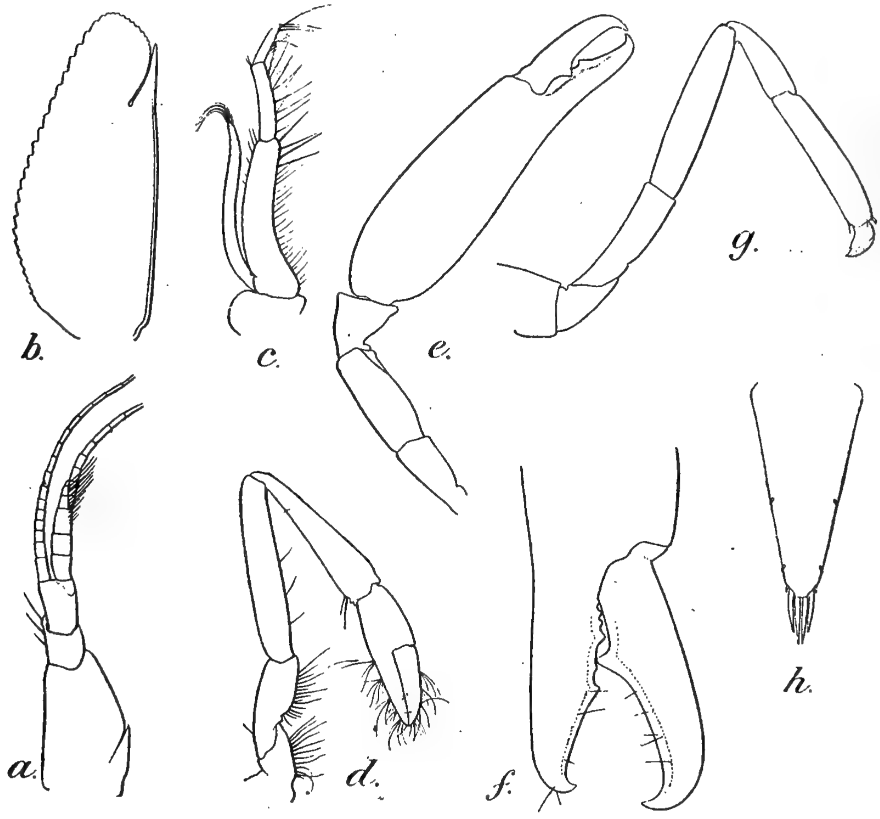
In other respects the species closely resembles *A. miersi*. The distal end of the basal segment of the antennular peduncle (text-



TEXT-FIG. 86.—*Anchistus demani*, sp. nov.
Anterior part of carapace, rostrum, etc.

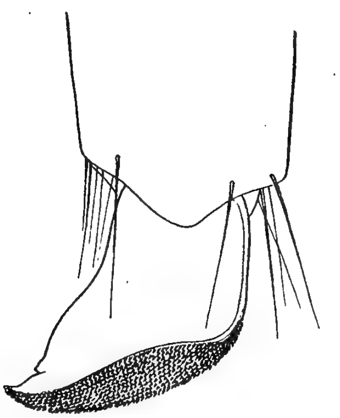
fig. 87*a*) is produced externally beyond the articulation of the second segment and the outer margin does not end in a spine. The fused portion of the outer flagellum is short and is composed of only 3 segments, as against 5 or 6 in *A. miersi*. The antennal scale (text-fig. 87*b*) is strongly narrowed distally and the antepenultimate segment of the third maxilliped (text-fig. 87*c*) is little broader than the distal segments.

In the first peraeopods (text-fig. 87*d*) the carpus is shorter than the merus and about one-sixth longer than the chela, the fingers are longer than the palm. The second peraeopods are unequal. In the larger of the two (text-fig. 87*e*) the merus is 2·5 times as long as broad; the carpus is little more than half the length of the merus and is as broad as long. The palm of the larger limb is 2·5 times the length of the merus and is twice or rather more than twice as long as the fingers. The dactylus (text-fig. 87*f*) bears a large triangular tooth in its proximal third and a knob close to the articulation; the fixed finger has a series of 4



TEXT-FIG. 87.—*Anchistus demani*, sp. nov.

a. Antennule.
b. Antennal scale.
c. Third maxilliped.
d. First peraeopod.
e. Second peraeopod.
f. Fingers of second peraeopod.
g. Third peraeopod.
h. Telson.



TEXT-FIG. 88.—*Anchistus demani*, sp. nov.
Dactylus of third peraeopod.

or 5 small teeth in its proximal half. In the smaller limb the dentition is similar, but the palm is only about 1·5 times as long as the fingers. The merus of the third peraeopod (text-fig. 87*g*) is 5 times, that of the fifth peraeopod 5·5 times as long as broad. As in other species of the genus the propodites in all three pairs are without spinules on their posterior edges.

The three specimens examined are from 9 to 10 mm. in length: one is an ovigerous female.

Two of the specimens, which were found together in a large *Tridacna*, were transparent when alive and dotted all over with pale green chromatophores. The female bore green eggs. The third specimen also found in *Tridacna*, was transparent with red chromatophores; it differs structurally from the other two in the cornea of the eye, which is blacker and distinctly wider than the stalk.

The affinity of this small species with *A. miersi* is clearly shown by the similarity in structure of the dactyli of the last three legs. Borradaile's *Anchistus biunguiculatus* also possesses biunguiculate dactyli, but their detailed structure has not been described. In this species, however, the rostrum is toothless and the fixed finger of the second peraeopod is straight and is much shorter than the dactylus which is strongly hooked at the end. In *A. miersi* and *A. demani* the fingers are of equal length and both have inturned tips.

C 419/1.	Port Blair, Andamans.	S. Kemp, March, 1915.	Two, TYPES.
C 420/1.	Port Blair, Andamans.	S. Kemp, Feb., 1921.	One.

The specimens were all obtained from *Tridacna*, found at low water on the shore at Aberdeen.

Genus **Pontonia** Latreille.

1917. *Pontonia*, Borradaile, *Trans. Linn. Soc.* (2) *Zool.* XXII, p. 389.

This genus comprises species which live either in the mantle cavity of lamellibranch molluscs or in the branchial sac of ascidians.

In structure *Pontonia* closely resembles *Anchistus*, with which it agrees in the very broad and hairy inner lacinia of the maxillula. The species of *Pontonia* are, however, rather more depressed in habit and the rostrum, though it may be dorsally carinate and with a small ventral keel near the tip, is always toothless and never exhibits the strong lateral compression found in the related genus. The two distal segments of the third maxilliped are frequently but not always broad and the plane of their greatest breadth, as in *Conchodytes*, is more or less at right angles to that of the preceding segment. This curious disposition is brought about either by a twisting of the antepenultimate segment or by a torsion at the articulation between the penultimate and antepenultimate segments. The dactylus of the last three legs is simple and not strongly hooked, or biunguiculate, sometimes with a series of spines along the posterior margin. There is a tooth or spine at the distal end of the last abdominal somite on either side of the base of the telson and the postero-lateral angles are acutely produced. The dorsal spines of the telson are usually large.

The antennal spine, as in *Anchistus*, is present or absent. The distal endite of the maxilla is divided into two lobes in the typical species, *P. tyrrhena*, but is slender and undivided in the Indian forms.

Borradaile distinguishes the genus from *Anchistus* by the greater proportionate breadth of the two distal segments of the third maxilliped; they are, however, slender in at least one species of *Pontonia*.[1] His statement in the generic diagnosis that the dactylus of the last three legs is simple is evidently a *lapsus calami*, for it is biunguiculate in *P. tyrrhena* and in the majority of the species.

Nobili[2] has pointed out that Forskål's *Cancer custos*[3] was obtained in a species of *Pinna* in the Red Sea and that the name cannot be applied, as it frequently has been, to the Mediterranean species more properly known as *Pontonia tyrrhena*. On the Indian coasts two Pontoniine prawns are found in *Pinna*, viz. *Anchistus inermis* (Miers) and *Conchodytes biunguiculatus* (Paulson). Both of these, if my identifications are correct, also occur in the Red Sea, but Forskål's description is too indefinite to enable us to decide which was the original of his *C. custos*. Nobili, moreover, is of the opinion that the name *custos* is preoccupied by Forskål's own use of the term on p. 89 of his work in reference to a *Pinnotheres*.

To the genus *Pontonia* Borradaile assigns ten species, but of these Ortmann's *P. pinnae*, as Tattersall has suggested, is synonymous with *Anchistus inermis*, while Parisi has pointed out that *P. nipponensis* de Haan belongs to the genus *Conchodytes*. Two species from the W. Coast of America are to be added to the genus: *P. pinnae* Lockington[4] (*nec* Ortmann), which Borradaile appears to have overlooked, and *P. margarita* Smith[4] which he refers to the genus *Conchodytes*.

Only four species have hitherto been recorded from the Indo-Pacific region, viz. *P. brevirostris* Miers[5] from the Seychelles in "clamp shells," *P. ascidicola* Borradaile[6] from New Britain in a ascidian, *P. minuta* Baker[7] from S. Australia, a species of unknown association, and *P. quadratophthalma*, also of unknown association, recently described by Balss[8] from N.W. Australia.

I have seen only two Indo-Pacific species of this genus, both of which appear to be undescribed. They are related to *P. ascidicola* and were found lodged in the branchial sac of simple ascidians. Dr. Asajiro Oka, who found these specimens when examining the Indian Museum collection of Tunicata, remarks that judging from their size they "must have entered the body of the host as larvae and grown up there to maturity.[9]"

The six Indo-Pacific species of *Pontonia* may be distinguished by the following characters:—

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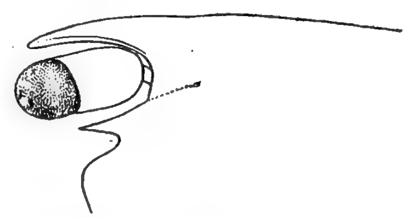
1 *P. okai*, sp. nov.
2 Nobili, *Bull. sci. France Belgique* XL, p. 49 (1907).
3 Forskal, *Descr. Anim.*, p. 94 (1775).
4 See Addendum, p. 287.
5 Miers, *Zool. Coll. H.M.S. 'Alert,'* p. 562, pl. li, fig. B (1884).
6 Borradaile, in Willey's *Zool. Results*, p. 409, pl. xxxvi, figs. 6*a*, *b* (1902).
7 Baker, *Trans. R. Soc. S. Australia* XXXI, p. 189, pl. xxiv, figs. 9–12 (1907).
8 Balss, *K. Svenska Vet.-Akad. Handl.*, LXI, no. 10, p. 15, text-fig. 7 (1921).
9 Oka, *Mem. Ind. Mus.* VI, p. 2 (1915).

A. Dactylus of last three legs simple.[1]
B. Rostrum reaching only to middle of eyes; last two segments of third maxilliped together fully as long as antepenultimate segment ... ... *brevirostris* Miers.
B'. Rostrum twice as long as eyes; last two segments of third maxilliped together much shorter than antepenultimate segment ... ... *minuta* Baker.
A'. Dactylus of last three legs biunguiculate and with a number of spines on its posterior margin.
B. Rostrum well developed; eyes normal in form.
C. Penultimate segment of third maxilliped 4 times as long as wide and more than twice as long as ultimate; carpus of first leg not longer than chela; dactylus of last three legs with 11–13 spines behind biunguiculate apex ... ... *okai*, sp. nov.
C'. Penultimate segment of third maxilliped 2·5 times as long as wide and 1·5 times as long as ultimate; carpus of first leg longer than chela; dactylus of last three legs ? ... ... *ascidicola* Borr.
C''. Penultimate segment of third maxilliped less than twice as long as wide and shorter than ultimate; carpus of first leg not longer than chela; dactylus of last three legs with 4–6 spines behind biunguiculate apex ... ... *anachoreta*, sp. nov.
B'. Rostrum rudimentary; eyestalks flattened with inner margins contiguous, bearing cornea at outer distal angle ... ... *quadratophthalma* Balss.

Pontonia okai, sp. nov.

The rostrum (text-fig. 89) is toothless, broad at the base and very slender at the apex which is acute in both dorsal and ventral views. Dorsally it is carinate throughout the greater part of its length, but there is no suggestion of a ventral keel. It is curved downwards and is a little shorter than the eyes, reaching about to the middle of the basal antennular segment.



TEXT-FIG. 89.—*Pontonia okai*, sp. nov. Anterior part of carapace, rostrum and eye.

The carapace is considerably depressed. It bears only an antennal spine and the lower limit of the orbit is not angulate. The eyes are short, with cornea slightly narrower than the stalk; the ocular spot appears to be absent.

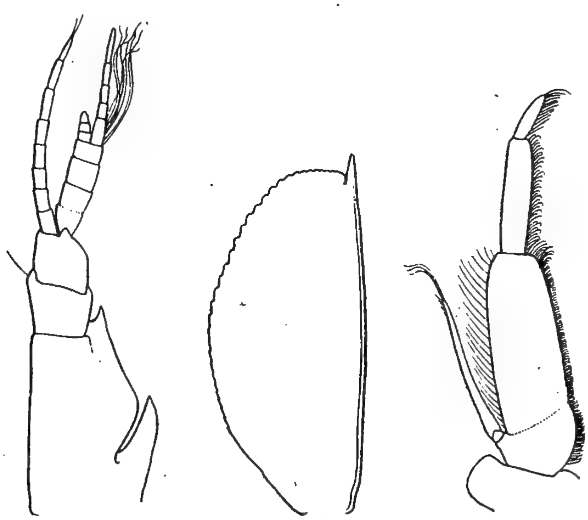
The antennular peduncle (text-fig. 90*a*) is a little shorter than the antennal scale. The basal segment is broad at the base with a large lanceolate lateral process which reaches the middle of its length. The outer margin in front of the process is slightly concave and ends in a stout tooth which reaches beyond the middle of the second segment. The second segment is broader than long, the third about the same length and as broad as long. The free portion of the stouter ramus of the outer flagellum is extremely short and the fused portion comprises 3 or 4 segments. The

[1] In *P. minuta* described as "simple—or perhaps a little bifid at the tip."

terminal segment of the antennal peduncle reaches nearly to the end of the antennular peduncle. The antennal scale (text-fig. 90*b*) is a little more than twice as long as broad; the outer margin is very slightly convex, terminating in a spine which reaches beyond the end of the lamella.

The incisor-process of the mandible ends in 5 teeth and on the inner side near the apex there is a series of 5 or 6 spinules.

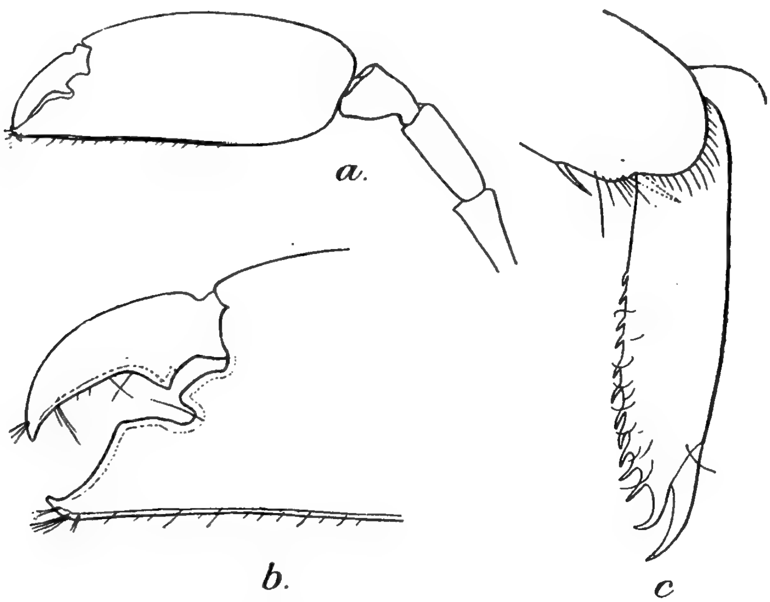
The third maxilliped (text-fig. 90*c*) reaches the end of the scale; the exopod is slender and does not reach the distal end of the antepenultimate segment. The latter is about 2·75 times as long as wide; it contrasts strongly in breadth with the two terminal segments and is rather longer than the two combined. The penultimate segment is slender, rather less than 4 times as long as wide and more than twice as long as the ultimate segment. The inner edges of the three distal segments are thickly fringed with hooked hairs which retain debris.



TEXT-FIG. 90.—*Pontonia okai*, sp. nov.
a. Antennule. *b*. Antennal scale. *c*. Third maxilliped.

The first peraeopod reaches beyond the scale by almost the whole length of the chela. The carpus is about three-quarters the length of the merus and is slightly shorter than the chela; the fingers are about the same length as the palm. There are dense tufts of setae on the fixed finger.

The second peraeopods are very large, unequal and dissimilar. The ischium in both legs bears a short tooth at the distal end of its lower border. In the larger limb (text-fig. 91*a*) the merus is 2·5 times as long as wide; the carpus is shorter than the merus and is very narrow at the base. The chela is swollen and very heavy and bears a few sparse hairs. The palm is about 2·5 times the length of the merus or fingers and is about twice as long as wide. The chela is carinate on its lower edge from the middle of the palm to the tip of the fixed finger. The finger-tips cross one another when the claw is closed; at the base the fixed finger is twice as broad as the dactylus. The dactylus (text-fig. 91*b*) has a very large triangular tooth in the proximal half of its inner margin. There are two large teeth on the fixed finger. The foremost of these is very large and obtuse, the hindmost smaller, more acute and pointing forwards, the two being separated by a deep and narrow notch. When the claw is closed the dactylar tooth partially overlies the posterior tooth of the fixed finger. In the smaller second peraeopod the merus is a little broader, with more strongly convex borders; the palm is only 1·3 times the length of the merus or fingers. As in the larger limb the fixed finger is twice as broad as the dactylus, but the fingers are unarmed on the inner

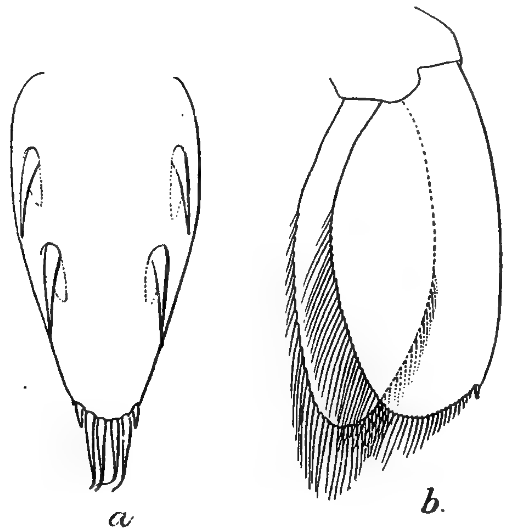


TEXT-FIG. 91.—*Pontonia okai*, sp. nov.
a. Large second peraeopod. *b*. Fingers of same.
c. Dactylus of third peraeopod.

margin except for three very obscure teeth at the proximal end, one on the dactylus and two on the fixed finger.

The last three peraeopods are long and slender. The third pair reaches beyond the scale by half the length of the propodus the fifth by the length of the dactylus. The merus is from 6 to 6·5 times as long as wide; the propodus bears a few spinules on its posterior border and is from 3·7 to 4·3 times as long as the dactylus. The dactylus (text-fig. 91*c*) is straight and slender, more than 4 times as long as wide; it is apically biunguiculate and the large terminal claw appears to be articulated. Behind the two distal claws there is a series of 11 to 13 spines which are short and broad where they begin, in the proximal third of the posterior border, and become longer and more slender as they approach the apex.

Excluding the terminal spines the telson (text-fig. 92*a*) is less than twice as long as its basal breadth; it bears two very large dorsal spines on either side. The median and intermediate apical spines are subequal and much longer than the outer. The outer uropod (text-fig. 92*b*) is shorter than the inner, with the spine that



TEXT-FIG. 92.—*Pontonia okai*, sp. nov.
a. Telson. *b*. Uropods.

terminates the outer border placed close to the distal end.

A single pair of specimens of this species has been examined. The male is about 8·0 mm. is length and the female 8·5 mm.

The species is related to Borradaile's *P. ascidicola*, the description of which is very meagre, but differs conspicuously in the proportions of the two ultimate segments of the third maxilliped. In *P. ascidicola*, also, the carpus of the first leg is longer than the chela and the fingers of the smaller second leg are said to be provided with teeth just as in the larger limb of the pair.

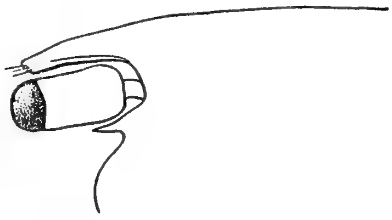
C 421/1.	Off C. Negrais, Burma, 15°25′ N., 93°45′ E., 40–49 fms.	'Investigator,' Nov., 1909.	Two, TYPES.

The specimens were found by Dr. Asajiro Oka when working at the collection of Tunicata belonging to the Indian Museum. He discovered them in the branchial sac of the type-specimen of *Ascidia willeyi*, Oka.

Pontonia anachoreta, sp. nov.

This species is closely allied to *P. okai* and also lives in ascidians. It differs from the description given above only in the following points:—

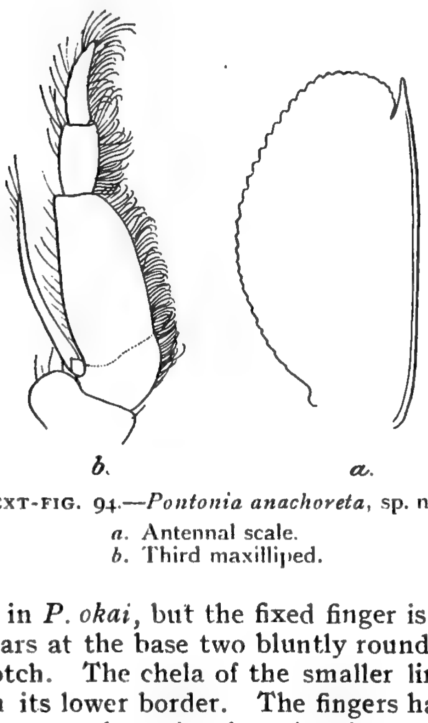
The apex of the rostrum is rather blunt in lateral view and is provided with one or two terminal setae (text-fig. 93).



TEXT-FIG. 93.—*Pontonia anachoreta*, sp. nov. Anterior part of carapace, rostrum and eye.

The antennal scale is rather broader, slightly less than twice as long as wide, and the terminal spine does not extend beyond the apex of the lamella (text-fig. 94*a*).

The antepenultimate segment of the third maxilliped (text-fig. 94*b*) is little more than twice as long as wide and the proportions of the two ultimate segments are conspicuously different. The penultimate segment is about 1·7 times as long as wide and is shorter than the ultimate segment.



TEXT-FIG. 94.—*Pontonia anachoreta*, sp. nov.
a. Antennal scale.
b. Third maxilliped.

The fingers of the first peraeopod are considerably longer than the palm.

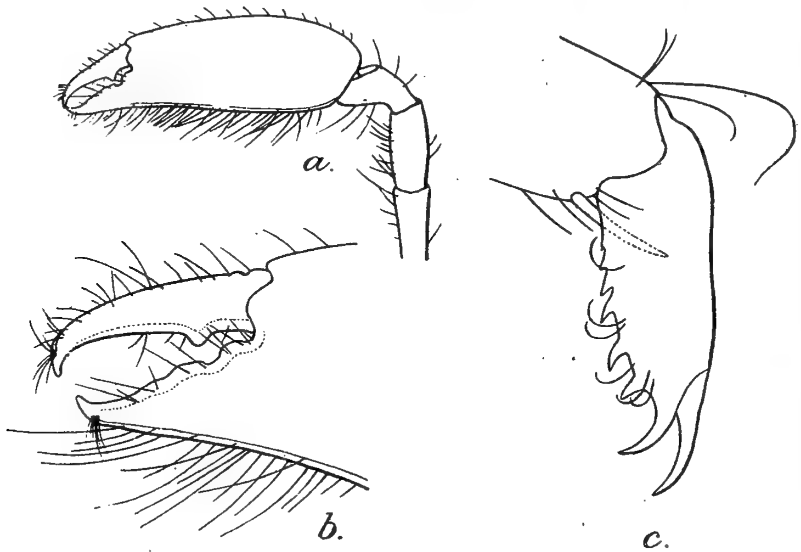
The second peraeopods do not possess a tooth at the distal end of the lower border of the ischium. The chela of the larger limb (text-fig. 95*a*) is sharply carinate on the lower side throughout its length and is here thickly fringed with very long setae. The dactylus (text-fig. 95*b*) has a large tooth, as in *P. okai*, but the fixed finger is unarmed in its distal half and bears at the base two bluntly rounded teeth separated by a broad notch. The chela of the smaller limb is fringed with long setae on its lower border. The fingers have inconspicuous teeth at the base, much as in the related species; their inner margins are, however, concave they gape widely when the claw is closed and their length is almost or quite equal to that of the palm.

The merus of the last three peraeopods is rather stouter, from 5 to 5·5 times as long as broad The dactylus (text-fig. 95*c*) is broader, from 3 to 3·5 times as long as wide and bears only from 4 to 6 spines in addition to the two distal claws. The terminal claw, as in *P. okai*, is apparently articulated.

The telson, excluding the terminal spines, is more than twice as long as its basal breadth, but is otherwise closely similar to that of the related species.

A single pair of specimens has been examined; the female is about 10 mm. in length and the male about 6 5 mm.

In *P. ascidicola*, according to Borradaile's figure the penultimate segment of the third maxilliped is about 2·5 times as long as



TEXT-FIG. 95.—*Pontonia anchoreta*, sp. nov.
a. Larger second peraeopod. *b*. Fingers of same.
c. Dactylus of third peraeopod.

wide and nearly 1·5 times the length of the ultimate segment. It is thus intermediate in form between *P. anachoreta* and *P. okai*.

C 422/1. Off Madras Coast, 20 fms. 'Investigator.' Two, TYPES.

The specimens were found by Dr. Asajiro Oka in an ascidian which he has described under the name of *Polycarpa annandalei*.

Genus **Pontonides** Borradaile.

1917. *Pontonides*, Borradaile, *Trans. Linn. Soc.* (2) *Zool.* XVII, p. 387.

This genus was established by Borradaile for *Pontonia maldivensis*,[1] a species found at Fadiffolu Atoll in the Maldives, which is remarkable for the absence of exopods from all three pairs of maxillipeds.

Periclimenes beaufortensis, Borradaile,[1] from Beaufort in North Carolina, appears from the description to be a related form, but with exopods absent from only the first two pairs of maxillipeds. In both species the rostrum is toothless, but in *P. maldivensis* the segments of the third maxilliped are broad, whereas in *P. beaufortensis* the appendage is described as moderately slender. The dactylus of the last three legs is simple in both species. For the present at

[1] Borradaile, *Ann. Mag. Nat. Hist.* (9) V, p. 132 (1920).

any rate *P. beaufortensis* is in my opinion more suitably accommodated in *Pontonides* than in any other genus.

P. maldivensis is not known to live in any particular association; *P. beaufortensis* was found on Gorgonians.

Genus **Balssia**, nov.

The remarkable species described by Balss under the name of *Amphipalaemon gasti* possesses three pairs of terminal spines on the telson and evidently does not belong to *Amphipalaemon* or to the family Anchistioididae in which, according to Borradaile,[1] that genus is included.

The species is no doubt an aberrant member of the subfamily Pontoniinae and, in the rudimentary character of the exopods of the maxillipeds, resembles *Pontonides*. It differs from this genus, however, in many respects. Both carapace and abdomen are sculptured; the rostral crest extends to the posterior end of the carapace and is armed with large teeth; on either side of the carapace there is a supra-orbital ridge armed with three teeth and further back there are two conspicuous tubercles placed one above the other; mid-dorsally on the first abdominal somite there is a sharp forwardly directed tooth. There is a tubercle on the eye-stalk and a lateral spine on the fifth abdominal somite.

In the sculptured carapace and abdomen *Balssia* bears some resemblance to *Dasycaris*, but it differs in the other points noted above as well as in the rudimentary exopods of the maxillipeds.

Balssia gasti (Balss).

1921. *Amphipalaemon gasti*, Balss, *Mitt. zool. Stat. Neapel* XXII, p. 523, text-figs. 1–8.

Balssia gasti is known from a single specimen only, obtained in the Gulf of Naples on *Corallium rubrum*.

Genus **Coutierea** Nobili.

1901. *Coutierea*, Nobili, *Boll. Mus. Torino* XVI, no. 415, p. 4.

This genus was established by Nobili for Coutière's *Corallio-caris agassizi*,[2] a species based on a single specimen dredged in 94 fathoms in the vicinity of Barbadoes. The genus is readily distinguished from all other Pontoniinae by the remarkable form of the supra-orbital spines, which are broad and connate with the rostrum, concealing the eyes in dorsal view, by the huge antennal spines and by the presence of a pterygostomian spine. In the areolation of the carapace and abdomen *Coutierea* resembles *Dasycaris* and *Balssia*. The two latter genera, however, do not possess the basal protuberance on the dactylus of the last three legs, which is well marked in *Coutierea*, and they differ also in many other respects.

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[1] Borradaile, *Trans. Linn. Soc.* (2) *Zool.* XVII, p 405 (1917).

[2] Coutière, *Bull. Mus. Paris* VII, p. 115, text-figs. (1901).

We know nothing of the oral appendages in this genus. Coutière states that the apex of the telson is armed with only two short spines placed close together and it is thus possible that the genus does not belong to the subfamily Pontoniinae.

Genus **Stegopontonia** Nobili.

1907. *Stegopontonia*, Nobili, *Mem. Accad. Sci. Torino* (2) LVII, p. 360.

This genus was proposed for *S. commensalis*, Nobili, of which a single specimen, found on the Echinoid, *Echinothrix turcarum*, was obtained in Hao Lagoon, Paumotu Group, Polynesia. *Stegopontonia* differs conspicuously from the related genera in the possession of a double basal protuberance on the dactyli of the last three pairs of legs. The rostrum is depressed, toothless, concave above, and wider near the middle than at the base; the only spine on the carapace is the antennal Nobili gives no description of any of the mouth-parts or of the telson.

Genus **Coralliocaris** (Stimpson).

1852. *Oedipus*, Dana, *U. S. Explor. Exped., Crust.* I, p. 572.
1860. *Coralliocaris*, Stimpson, *Proc. Acad. Sci. Philadelphia*, p. 38.
1917. *Coralliocaris* (excluding subgen. *Onycocaris*), Borradaile, *Trans. Linn. Soc.* (2) *Zool.* XVII, p. 381.

Borradaile follows Nobili in recognising two subgenera of this genus, *Coralliocaris* and *Onycocaris*, but the proper position of the two species for which the latter name was proposed (*see* p. 278) appears to me to be very uncertain. I do not think there is any justification for including them in Stimpson's genus.

Thus restricted the genus *Coralliocaris* forms a compact group of species, all of which so far as is known live in association with madrepore corals. In general facies they agree very closely with *Harpilius*, which has adopted the same habitat, but they are at once distinguished by the presence of a very large basal protuberance on the dactylus of the last three pairs of legs.

Coralliocaris is distinguished from *Conchodytes* by a number of well-marked characters. The rostrum is compressed, dorsally carinate and commonly bears teeth. The antennal spine of the carapace is always present, the hepatic present or absent. The inner lobe of the maxillula is slender and the distal endite of the maxilla is narrow and furnished with setae only at the tip. The dactylus of the last three pairs of legs is provided with a single claw and the basal protuberance, in all the species I have examined, is swollen and hoof-shaped.

Borradaile in his synoptic key separates the species of this genus mainly by the number of rostral teeth. In this character, however, there is much variation. Other and better characters will no doubt be found, but at present the descriptions of several species are very imperfect. Miss Rathbun's *C. atlantica*[1] from the

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[1] Rathbun, *Bull. U. S. Fish Comm.* XX, p. 122, fig. 26 (1902).

West Indies does not belong to *Coralliocaris*; the dactylus of the posterior legs is merely a little swollen and without the large basal process characteristic of the genus. The generic position of *C. quadridentata*, Rathbun, and *C. truncata*, Rathbun,[1] both from the Hawaiian Is., also appears to me doubtful. The dactylus of the posterior legs is described as having "an accessory spinule" in the former and "a supplementary spine" in the latter.

Borradaile (*loc. cit.*, 1917, p. 385) erroneously quotes Miss Rathbun's *C. quadridentata* as "*C. tridentata*" and, as the latter name has already been used by Miers, he substitutes "*C. rathbuni*, n. nom." In his key to the species, however, *C. quadridentata* is used.

The four species which I have myself examined may be separated by the following characters:—

A. Hepatic spine absent; first legs not remarkably slender, with fingers little if at all shorter than palm; second legs similar in structure.

  B. Outer margin of dactylus of second leg semicircular; fixed finger with large molar tooth fitting into cavity in dactylus; ultimate segment of third maxilliped more than 3 times as long as wide; R. 4–6 : 1–2 ... *graminea* (Dana).

  B'. Outer margin of dactylus of second leg not convex; fixed finger with 2 or 3 teeth which do not fit into cavities in dactylus; ultimate segment of third maxilliped not more than twice as long as wide.

    C. Rostrum usually with 4 or 5 dorsal teeth and 2 ventral; merus of second leg with a series of small teeth at distal end of upper border, dactylus with outer margin abruptly angulate ... .. *superba* (Dana).

    C'. Rostrum with 1 or 2 dorsal teeth and 1 ventral; merus of second leg unarmed at distal end of upper border, dactylus with outer margin slightly concave ... ... *venusta*, sp. nov.

A'. Hepatic spine present; first legs remarkably slender with palm twice as long as fingers; second legs dissimilar in structure; R. 3–6 : 1–3 ... ... *lucina* Nobili.

Coralliocaris graminea (Dana).

1852. *Oedipus gramineus*, Dana, *U. S. Explor. Exped., Crust.* I, p. 573, pl. xxxvii, figs. 3*a–e*.
1889. *Oedipus gramineus*, Pfeffer,[2] *Jahrb. Hamburg. wiss. Anstalt* II, p. 34.
1909. *Coralliocaris graminea*, Calman, *Proc. Zool. Soc. London*, p. 706.
1915. *Corolliocaris graminea*, Balss, *Denk. math-naturw. Kl. K. Akad, Wien* XCI, p. 26.
1917. *Coralliocaris graminea*, Borradaile. *Trans. Linn. Soc.* (2) *Zool.* XVII, pp. 324, 383.

Other references are given by Borradaile, who—no doubt correctly—includes as a synonym Ortmann's *C. inaequalis*. The more important specific characters are the following:—

The rostrum bears from 4 to 6 teeth on its upper margin and

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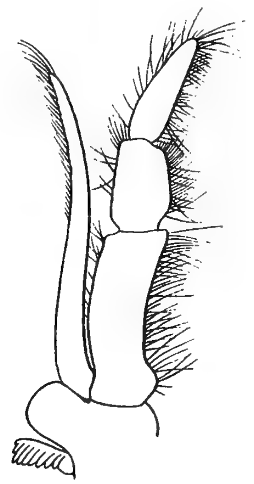
[1] Rathbun, *Bull. U. S. Fish Comm.* XXIII, iii, p. 920, figs. 69, 70 (1906).
[2] I have not seen this paper.

1 or 2 on its lower[1]; as a rule there are 5 above and 2 below. The hepatic spine of the carapace is absent. The third maxilliped (text-fig. 96) is short and stout and does not reach the distal end of the merus of the first peraeopod. The exopod reaches beyond the middle of the last segment. The penultimate segment is about 1·5 times as long as wide; the ultimate segment is about 1·3 times the length of the penultimate and is nearly 3·5 times as long as wide.



TEXT-FIG. 96.—*Corolliocaris graminea* (Dana).
Third maxilliped.

In the first peraeopods[2] the merus is a little shorter than the carpus and much stouter, the greatest breadth of the former being about 1·75 times that of the latter. The chela is half as long as the carpus and the fingers are a little shorter than the palm. The second peraeopods (text-fig. 97) are equal or unequal, but are similar in structure. In full-grown specimens the upper border of the merus is strongly convex in lateral view and ends in one or two small spines. The lower border ends, on the outer side, in a large sharp tooth. The carpus bears a large tooth ventrally and the upper portion of the distal margin is cut into a series of 3 to 6 small teeth. The chela is swollen and its breadth near the proximal end is twice as great as at the base of the fingers.[3] The palm is twice as long as wide and twice as long as the fingers. The fixed finger (text-fig. 97*b*) is provided with a large blunt molar tooth which occupies the greater part of the proximal half of its inner edge and the margin in front of this tooth is strongly sinuous. The outer margin of the dactylus forms an almost perfect semicircle; at the base of its inner margin there is a large cavity to receive the molar tooth of the fixed finger.

An exceptionally large specimen is 23 mm. in length, with chela 16 mm. in length.

Specimens obtained at Port Blair, when alive, resembled Dana's coloured figure. They were pale green throughout, minutely dotted with yellow and dark brown. In ovigerous females there were red streaks on the sides of the abdomen.

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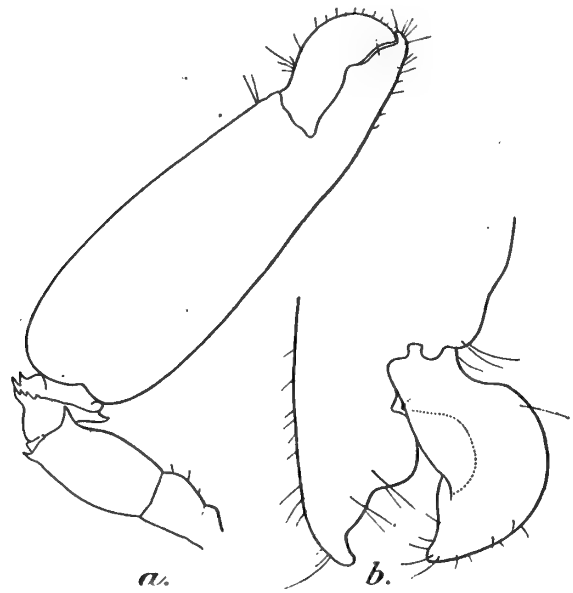
[1] Miers refers to a specimen with only 3 teeth above and none below.

[2] This pair of legs in my specimens reaches beyond the scale only by the length of the chela. In Dana's figure they are much longer, but this is doubtless an error.

[3] The chela is viewed obliquely in text-fig. 97*a* and the full breadth of the palm is not shown.

C. macrophthalma (Milne-Edwards), as redescribed by Nobili,[1] appears to be closely related to this species, agreeing with it in the stout form of the third maxilliped, in the serration of the distal margin of the carpus of the second leg and in the remarkable form of the dactylus in the same limb. The rostrum, however, bears only 1 tooth above and is unarmed ventrally; the chela of the first leg is less than half as long as the carpus and the spine at



TEXT-FIG. 97.—*Coralliocaris graminea* (Dana).
a. Second peraeopod. *b.* Fingers of second paraeopod.

the distal end of the upper border of the merus of the second leg is larger than that at the outer distal angle of the lower border.

235/7.	Port Blair, Andamans.	A. Alcock, Nov., 1888.	One.
C 423/1.	Port Blair, Andamans.	S. Kemp, Feb., 1915.	Fourteen.
C 424/1.	Port Blair, Andamans.	R. P. Mullins, June, 1918.	Seven.
C 425/1.	Pamban, Gulf of Manaar.	S. Kemp, Feb., 1913.	Four.
7239/10.	Seychelles.	H. M. S. 'Alert', Brit. Mus.	One.
1430.	'South Sea.'	Purchased.	One.

I have also seen specimens belonging to the Paris Museum from New Caledonia and Pulo Condore (Harmand coll.).

The species has a wide distribution in the Indo-Pacific region. It has been recorded from the Fiji Is. (Dana), Samoa (Ortmann), the Loyalty Is. (Borradaile), Kagoshima, Japan (Ortmann), Hong

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[1] Nobili, *Ann. Mus Univ. Napoli* (n. s.) I, 3, p. 3 (1901).

Kong (Stimpson), Ternate (de Man), Christmas I. (Calman), Pulo Edam in the Bay of Batavia (de Man), Coetivy (Borradaile), Seychelles (Miers), Zanzibar (Pfeffer), Dar-es-Salaam (Ortmann), Mozambique (Lenz), Red Sea (Balss). The species lives in association with madrepore corals.

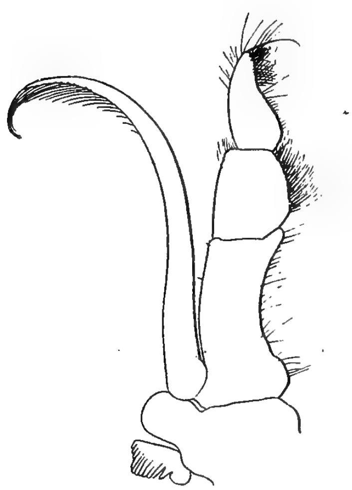
Coralliocaris superba (Dana).

1852. *Oedipus superbus*, Dana, *U. S. Explor. Exped., Crust.* I, p. 575, pl. xxxvii, figs. 2*a–f*.
1915. *Coralliocaris superba*, Balss, *Denk. math.-naturw. Kl. K. Akad. Wiss Wien* XCI, p. 26.
1917. *Coralliocaris superba*, Borradaile, *Trans. Linn. Soc.* (2) *Zool.* XVII, p. 383.
1921. *Coralliocaris superba*, Tattersall, *Journ. Linn Soc., Zool.* XXXIV, p. 390.

Paulson's *Oedipus dentirostris*, as Nobili has pointed out, is a synonym of this species. Borradaile gives a full list of references.

C. superba agrees with *C. graminea* in the absence of the hepatic spine of the carapace, in the stout form of the third maxilliped and in the possession of a series of small teeth at the distal end of the carpus of the second peraeopod. The principal differences are the following :—

(i) The ultimate segment of the third maxilliped (text-fig. 98) is expanded at the base; the inner margin is sinuous, convex proximally and concave distally. The segment is only twice as long as broad and is little if at all longer than the penultimate.



TEXT-FIG. 98.—*Coralliocaris superba* (Dana).
Third maxilliped.

(ii) The carpus of the first peraeopod is scarcely longer than the merus and its breadth at the distal end is little less than that of the merus.

(iii) The merus of the second peraeopod (text-fig. 99*a*) is provided with a series of 4 to 6[1] small teeth on the superior part of its distal margin and the tooth at the outer distal angle of the lower border is large and triangular. There is a series of 7 to 10 small teeth[1] on the upper part of the distal border of the carpus. The chela is less swollen; the palm is usually little less than 3 times as long as wide and is 2·5 to 2·8 times as long as the fingers. The form of the dactylus (text-fig. 99*b*) is entirely different. The outer margin is straight and abruptly angulate in the middle, while

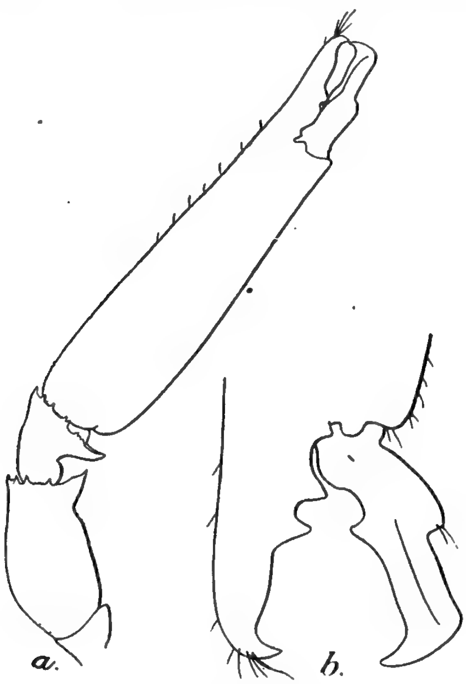
[1] These figures refer to well grown specimens; in young individuals the teeth are less numerous.

on the lower face of the segment in its distal half there is a sharp longitudinal keel. On its inner margin the dactylus bears a single sharp tooth just behind its middle point, which fits between two similar teeth on the fixed finger.

In the specimens I have seen the rostrum bears 4 or 5 dorsal teeth and 2 ventral. The lateral process of the antennule is frequently much longer than in *C. graminea* and sometimes reaches the level of the articulation between the second and third segments.

The largest specimen examined is 21 mm. in length.

In living specimens the carapace and first four abdominal somites, except for a median intrusion from the fifth somite, were



TEXT-FIG. 99.—*Coralliocaris superba* (Dana).
a. Second peraeopod. *b*. Fingers of second peraeopod.

pure white. The antennal scale, antennules, rostrum, all the legs, the last two abdominal somites and the greater part of the tail-fan were pale brown, dotted with very large dark reddish brown chromatophores, specially conspicuous on the antennal scales and large chelae. At the end of the tail-fan there was a narrow band of deep blue, bordered with white. This description agrees very closely with Dana's coloured figure.

236–9/7.	Port Blair, Andamans.	A. Alcock, Nov., 1888.	Four.
C 427/1.	Port Blair, Andamans.	S. Kemp, Feb., 1915.	Nine.
C 428/1.	Port Blair, Andamans.	R. P. Mullins, June, 1918.	Three.

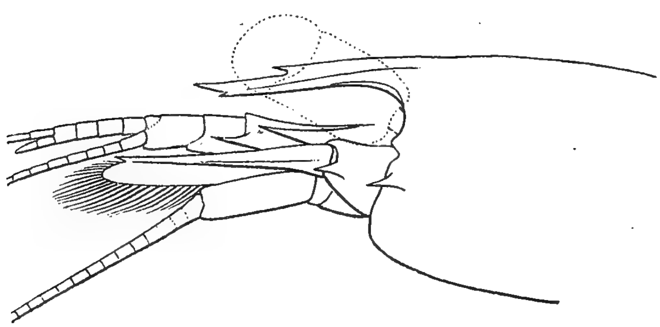
The species is recorded from Tongatabu (Dana), Tahiti (Stimpson), the Bonin Is. (Balss), Christmas I. ? (Calman), the Noordwachter Is. and Pulo Edam in the Bay of Batavia (de Man), the south coast of Arabia (Balss) and from numerous localities in the Red Sea (Nobili, Balss, Tattersall). The species is apparently always found in association with madrepore corals.

Coralliocaris venusta, sp. nov.

The rostrum (text-fig. 100) reaches to the middle or end of the second segment of the antennular peduncle and is directed slightly downwards. In dorsal view it is broad at the proximal end and is dorsally carinate throughout its length; in lateral view it is very slender. In the male there is a single dorsal tooth placed a little in front of the middle point; in the female there are two teeth, the foremost very small, both situated in the anterior third. On the lower border in each specimen there is one small tooth placed close to the apex.

The lower angle of the orbit is acute. There is a strong antennal spine, but the hepatic is absent.

The antennular peduncle reaches to three-quarters the length



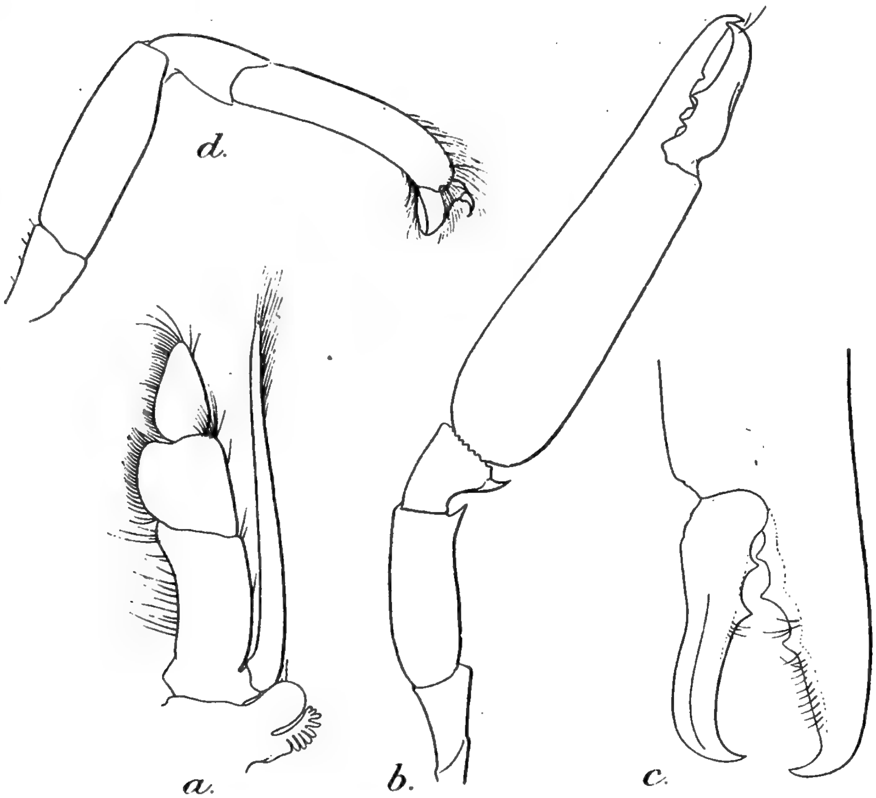
TEXT-FIG. 100.—*Coralliocaris venusta*, sp. nov.
Anterior part of carapace, rostrum, etc., of male.

of the antennal scale. The basal segment is broad. In the female the lateral process extends as far as the articulation between the second and third segments and the terminal spine of the outer margin reaches the middle of the third segment; in the male the spines are shorter. The outer margin of the antennal scale is almost straight, terminating in a spine which does not reach the end of the lamella.

The third maxilliped (text-fig. 101*a*) is short and stout and does not reach the end of the merus of the first peraeopods. The exopod reaches the tip of the endopod. The antepenultimate segment is shorter than the two distal segments combined. The penultimate segment is scarcely longer than broad and is a little longer than the ultimate. The ultimate is much narrower than the penultimate and is rather less than twice as long as broad. The inner edges of the last three segments and the greater part of the lower face of the penultimate are thickly clothed with hair.

The first peraeopods reach beyond the antennal scale by the chela and the greater part of the carpus. The merus and carpus are moderately stout, the latter slightly longer than the former and 1·7 times the length of the chela. The fingers are almost equal in length with the palm.

The second peraeopods (text-figs. 101*b*, *c*) are a little unéqual,



TEXT-FIG. 101.—*Coralliocaris venusta*, sp. nov.

a. Third maxilliped. *c*. Fingers of second peraeopod.
b. Second peraeopod. *d*. Third peraeopod.

but are identical in structure. They extend beyond the scale by the greater part of the chela. The merus is unarmed at the distal end of its upper border, but bears a strong tooth externally at the end of the lower border. The carpus is very short and, as in *C. graminea* and *C. superba*, is provided with a stout ventral tooth. In the female the distal margin of the carpus on its upper and outer aspect is cut into a number of very minute teeth; in the male, which is much smaller, these are not visible. The chela is swollen and is widest near the base. The palm is from 2 to 2·3 times the length of the fingers; in the female it is rather more than 2·5 times as long as wide, in the male nearly 3 times. The fingers have acute inturned tips. The dactylus (text-fig. 101*c*) is longitudinally carinate in the distal two-thirds of its lower surface, much as in *C. superba*, but the outer margin is slightly concave and shows no trace of the abrupt angulation found in that species. At its base the dactylus is narrower than the fixed finger. On its inner margin it bears two rather short teeth, the anterior situated a little behind the middle of its length. When the claw is closed these teeth fit between three on the fixed finger; the foremost of the latter is placed a little in advance of the middle.

The last three peraeopods (text-fig. 101*d*) are stout. The merus is from 2·75 to rather more than 3 times as long as wide. The propodi are strongly curved and the dactyli are provided with a large hoof-shaped basal process and a very slender and strongly curved terminal spine.

The telson is slender with the usual six apical spines. The anterior pair of dorsal spinules, as in the preceding species, is placed in the middle of the telson-length with the posterior pair rather nearer to it than to the apex.

The female, which is ovigerous, is 10·5 mm. in length, the male 6·5 mm.

C. venusta is allied to *C. superba*, but differs in the smaller number of rostral teeth, in the form of the third maxilliped, in the absence of spines at the distal end of the upper border of the merus of the second leg and in the different form of the fingers in the same appendage. Nobili's *C. camerani* [1] from Flamenco I. in the G. of Panama is perhaps also related, but differs in having no tooth at the distal end of the lower border of the merus of the second leg and only a single tooth on the inner margin of the fixed finger.

C 429/1.	N.E. Tholayiram Paar, Gulf of Manaar.	J. Hornell, Feb., 1914.	Two, TYPES.

The specimens were found on a madrepore coral.

Coralliocaris lucina Nobili.

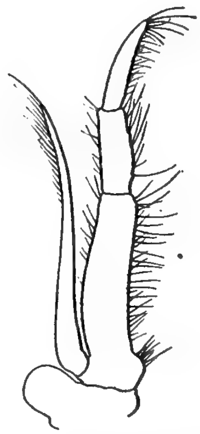
1901. *Coralliocaris lucina*, Nobili, *Ann. Mus. Univ. Napoli.* (n.s.) I, no. 3, p. 5.
1902. *Coralliocaris lamellirostris*, de Man, *Abhandl. Senck. naturf. Ges.* XXV, p. 842, pl. xxvi, figs. 55, 55*a–f*.
1906. *Coralliocaris lucina*, Nobili, *Ann. Sci. nat., Zool.* (9) IV, p. 57.
1915. *Coralliocaris lucina*, Balss, *Denk. math.-naturw. Kl. K. Akad. Wien* XCI, p. 26.
1917. *Coralliocaris superba* var. *japonica*, and *C. lucina*, Borradaile, *Trans. Linn. Soc.* (2) *Zool.* XVII, p. 384, pl. lvi, fig. 23.
1921. *Coralliocaris lucina*, Tattersall, *Journ. Linn. Soc., Zool.* XXXIV, p. 390.

This species is readily distinguished from the three preceding forms by a number of well-marked characters:—

[1] Nobili, *Boll. Mus. Torino*, XVI, no. 415, p. 3 (1901).

(i) The hepatic spine of the carapace is present.

(ii) The third maxilliped (text-fig. 102) is very slender. The penultimate segment is fully 2·5 times as long as wide and is slightly shorter than the ultimate segment, the latter being about 5 times as long as wide. The exopod does not nearly reach the end of the endopod.



TEXT-FIG. 102.—*Coralliocaris lucina* Nobili.
Third maxilliped (arthrobranch omitted).

(iii) The first peraeopods are extremely slender. The carpus varies from 1·8 to 2·5 times the length of the chela. The fingers are only half as long as the palm.

(iv) The second peraeopods are unequal and dissimilar in structure. There is a tooth externally at the distal end of the lower border of the merus, but no terminal spine on the upper border. The carpus does not possess the large ventral tooth found in the preceding species and the superior part of the distal margin is entire. In the larger chela the palm is slender and from 3·5 to 4 times the length of the fingers. The fingers are twisted, so that the chela opens almost vertically instead of horizontally. As in *S. superba* the dactylus is longitudinally carinate on its outer face and is abruptly angulate in the middle of its outer margin. On the inner margin of the dactylus there are 2 or 3 teeth placed near the middle and, when the claw is closed, the cutting edge of the dactylus fits between two slightly oblique crests on the fixed finger, that nearest the base bearing 2 or 3 small teeth. In the smaller chela the fingers are about two-thirds the length of the palm. The fingers have straight unarmed inner margins, but each is externally excavate, so that the whole chela, when viewed from the outer side is spoon-shaped.

In the specimens I have examined there are from 3 to 6 teeth (usually 4 or 5) on the upper border of the rostrum and from 1 to 3 (nearly always 2 or 3) on the ventral border. De Man describes the apex of the telson as armed with 16 to 18 spines—a remarkable feature not known in any other Pontoniid. In most of my specimens only the usual 6 terminal spines are to be found, but I have seen an individual in which there are 9.

The largest specimen examined is about 16 mm. in length.

When alive the species is transparent, with colourless chelae and with the carapace and abdomen longitudinally streaked and speckled with bright red.

It is possible, as de Man has suggested, that this species is the same as Stimpson's *C. lamellirostris*. The description of the latter is, however, very defective, so that it seems best to retain Nobili's name. The specimens which Borradaile referred to *C. superba* var. *japonica* doubtless belong to this species; his figures agree very closely with specimens I have examined. The only discrepancy is that Borradaile has apparently omitted to notice that his specimens are distinguished from *C. superba* by the presence of the hepatic spine.

8985/6.	Rutland I, Andamans.	'Investigator,' Nov., 1887.	One.
C 430/1.	Port Blair, Andamans.	S. Kemp, Feb., 1915.	Fourteen.
C 431/1.	Port Blair, Andamans.	J. Wood-Mason.	Three.
C 432/1.	Cheval Paar, Ceylon.	T. Southwell, Nov., 1910.	One.
C 433/1.	Red Sea.	Mus. Zool. Napoli.	Two, CO-TYPES.

The species has been recorded from Ternate (de Man), from the S. Coast of Arabia (Balss) and from numerous localities in the Red Sea (Nobili, Balss, Tattersall). Borradaile (*loc. cit.*, p. 324) has recorded the species under the name of *C. japonica* from the Maldives, the Chagos Archipelago and Saya de Malha. Like other species of the genus, *C. lucina* appears to be associated with madrepore corals.

Genus **Onycocaris** Nobili.

1906. *Coralliocaris* subgen. *Onycocaris*, Nobili, *Ann. Sci. nat., Zool.* (9) IV, p. 60.

Nobili has proposed *Onycocaris* as a new subgenus of *Coralliocaris* for the reception of two species, *C. aualitica* and *C. rhodope*, both obtained at Djibouti in the Red Sea. In *C. aualitica* the dactylus of the last three pairs of legs bears a large accessory claw and is denticulate and slightly swollen at the base. In *C. rhodope* the accessory claw is very short, scarcely larger than the denticulations which exist on either side of it and the basal part is not swollen.

I have already expressed the view that those two remarkable species cannot be included, even under a distinct subgeneric heading, in Stimpson's *Coralliocaris*, and with the information we at present possess it appears to me to be impossible to arrive at any satisfactory conclusion regarding their true position. I have been obliged to omit *Onycocaris* from my synoptic key to the genera of the subfamily.

Nobili, as usual, has failed to give any description of the mouth-parts and the two species seem to differ so widely from one another that it may be doubted whether there is any real generic affinity between them. In *O. aualitica* the spine at the distal end of the antennal scale is wanting and the outer margins of the uropods are said to be finely denticulate. These characters do not occur in *C. rhodope*, nor so far as I am aware in any other species of the subfamily.

Genus **Conchodytes** Peters.

1917. *Conchodytes*, Borradaile, *Trans. Linn. Soc.* (2) *Zool.* XVII, p. 392.

The species of this genus live, probably without exception, in the mantle cavity of lamellibranch molluscs. In the possession of a basal protuberance on the dactyli of the last three legs they resemble *Coralliocaris*, but they are easily distinguished by a number of well-marked characters. The rostrum is depressed and toothless, without a dorsal carina. The lower angle of the orbit is produced, but neither antennal nor hepatic spines occur on the carapace. The inner lobe of the maxillula is very broad and the distal endite of the maxilla is broad and furnished with setae along the whole length of its inner margin. The dactylus of the last three pairs of legs is provided with two curved claws and the basal protuberance is flat, not swollen and hoof-shaped as in *Coralliocaris*.

Borradaile recognises five species of this genus, but one of them, *C. margarita* (Smith),[1] belongs in my opinion to the genus *Pontonia*, in which it was originally described. *Pontonia nipponensis*, which Parisi has recently shown to be a true *Conchodytes*, must be added to the genus. If my identification is correct *C. biunguiculatus* is represented in the collection I have examined. This species was described by Paulson from an abnormal specimen in 1875 and has not since been rediscovered.

The host of *C. nipponensis* is unknown; *C. biunguiculatus* lives in *Pinna*, while, *C. tridacnae* and *C. meleagrinae* are usually associated with the genera of molluscs to which their specific names refer. All the species are closely related to one another and it is difficult to find valid characters for their separation. This is especially true of *C. tridacnae* and *C. meleagrinae* which are perhaps not specifically distinct. The former is apparently restricted to *Tridacna*; the latter is generally found in *Meleagrina* but according to Borradaile sometimes also occurs in *Tridacna*.

The four Indo-Pacific species may be separated by the following characters:—

A. Basal process of dactylus of last three legs with a small tooth on proximal side; posterior of the two pairs of spines on back of telson situated about midway between first pair and apex.

- *B*. Antepenultimate segment of third maxilliped less than twice as long as broad; fixed finger of second leg with foremost tooth very broad and low, occupying greater part of distal half; lateral spines of telson tip situated at apex ... ... *biunguiculatus* (Paulson).
- *B'*. Antepenultimate segment of third maxilliped rather more than twice as long as broad; fixed finger of second leg with foremost tooth small and triangular; lateral spines of telson tip shifted forwards on to dorsal surface, not nearly reaching apex ... ... *nipponensis* (de Haan).

[1] See Addendum, p. 287.

A′. Basal process of dactylus of last three legs without tooth; posterior of the two pairs of spines on back of telson situated much nearer to apex than to first pair.
  B. Rostrum reaching end of scale; outer distal angle of basal antennular segment rounded; carpus of first leg as long as or longer than merus ... *tridacnae* Peters.
  B′. Rostrum not reaching end of scale; outer distal angle of basal antennular segment acute; carpus of first leg conspicuously shorter than merus ... *meleagrinae* Peters.

The two last-named species, as Borradaile has suggested, are perhaps not specifically distinct from one another.

Conchodytes biunguiculatus (Paulson).

1875. *Pontonia biunguiculata*, Paulson, *Crust. Red Sea*, p. 111, figs. 1, 1*a*–*n*.
? 1893. *Pontonia tridacnae*, Henderson, *Trans. Linn. Soc.* (2) *Zool.* V, p. 438.
? 1905. *Conchodytes meleagrinae*, Pearson, *Ceylon Pearl Oyster Rep.* IV, p. 77.
? 1906. *Conchodytes meleagrinae*, Nobili, *Ann. Sci. nat., Zool.* (9) IV, p. 77 (part).

The specimen figured by Paulson possesses a large protuberance on the outer side of the dactylus of the right second peraeopod, but this, as Nobili has suggested, is probably an individual abnormality. If this be conceded there is little doubt that the specimens which I record here are correctly identified.

TEXT-FIG. 103.—*Conchodytes biunguiculatus* (Paulson).
a. Third maxilliped. *c*. Dactylus of third peraeopod.
b. Fingers of second peraeopod. *d*. Telson.

The characteristic features of the species are the following:—

(i) The rostrum is sharply pointed in dorsal view and falls short of the apex of the antennal scale, usually not reaching the end of the antennular peduncle.

(ii) The outer margin of the basal segment of the antennular peduncle terminates in an acute point.

(iii) The antepenultimate segment of the third maxilliped (text-fig. 103*a*) is broad; its greatest breadth is more than half its length and at the distal end it is conspicuously wider than the penultimate segment. The latter is rather less than twice as long as wide and is a little longer than the ultimate segment.

(iv) The carpus of the first peraeopods is about equal in length with the merus.

(v) There is one tooth on the dactylus of the second peraeopod (text-fig. 103*b*) and two on the fixed finger, all of which are rounded and, as a rule, finely serrate. The anterior tooth of the fixed finger has the form of a very broad and gently convex lobe.

(vi) The last three peraeopods are comparatively slender. In the third pair the merus is from 3·5 to 4 times and the propodus from 4·5 to 5 times as long as broad. The terminal claw of the dactylus (text-fig. 103*c*) is bent at an angle of about 45° to the main axis of the segment and the basal protuberance bears a short tooth on its proximal side.

(vii) The dorsal spines of the telson (text-fig. 103*d*) are very large, fully one-sixth of the total length (terminal spines excluded). The distance between the posterior pair and the apex is equal, or almost equal, to the distance between the two pairs. The lateral apical teeth are comparatively large and are situated at or very near the distal end[1]; the intermediate pair is conspicuously stouter than the median.

Large females sometimes reach a length of 35 mm.; males do not exceed 25 mm.

Living specimens are semitransparent and colourless or pale yellowish when alive. Females are closely sprinkled with minute white dots, with the eggs and ovary very dark brown.

4910/10.	Andamans.	A. R. S. Anderson.	Thirty-five.
C 434/1.	Port Blair, Andamans.	S. Kemp, Feb., March, 1921.	Twenty-five.

The specimens I have myself found were all obtained in *Pinna bicolor*, Gmelin,[2] a mollusc which is common at low water in Brigade Creek and on the shore south of Viper I. The same lamellibranch also harbours *Anchistus inermis*, a prawn which is almost identical with *Conchodytes biunguiculatus* in colouration. Practically every large *Pinna* which was opened contained a pair of either the *Conchodytes* or the *Anchistus*, but the two species were never discovered in the same mollusc.

The species was described by Paulson from the Red Sea. I think it probable that the specimens from *Pinna* recorded by Nobili and Pearson from the Red Sea and from Cheval Paar in the G. of Manaar, under the name *C. meleagrinae*, belong to this species. The only other record of a *Conchodytes* from *Pinna* is that of

[1] They are placed further forwards in Paulson's figure than in any specimen I have seen.

[2] I am indebted to Dr. Baini Prashad for the identification of this species.

Miers,[1] who refers to a dried and imperfect specimen obtained in this mollusc at Keppel I., Port Curtis, Queensland.

Conchodytes nipponensis (de Haan).

1849. *Pontonia nipponensis*, de Haan, in Siebold's *Fauna Japonica, Crust.*, p. 180, pl. xlvi, fig. 8 (*Hymenocera niponensis* on plate).

1914. *Pontonia nipponensis*, Balss, *Abhandl. math.-phys. Kl. K. bayer. Akad. Wiss.*, Suppl. Bd. II, p. 53, fig. 33.

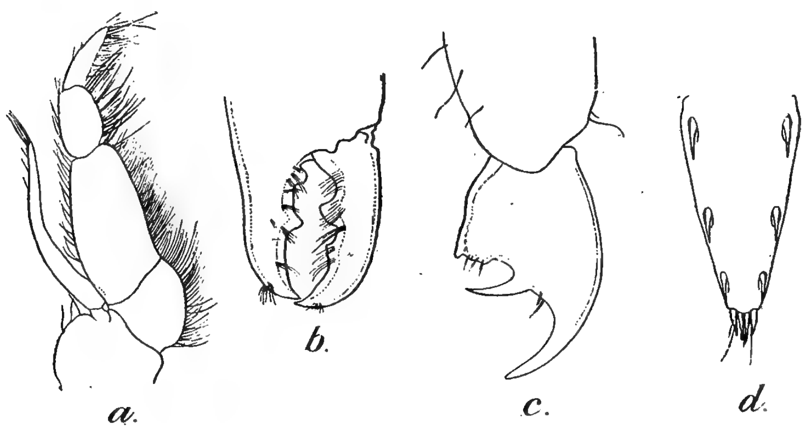
1917. *Pontonia nipponensis* Borradaile, *Trans. Linn. Soc.* (2) *Zool.* XVII, p. 391.

1919. *Conchodytes nipponensis*, Parisi, *Atti Soc. ital. Sci. nat.* LVIII, p. 75, text-figs. 5, 6.

The principal characteristics of this species are the following :—

(i) The rostrum is sharply pointed in dorsal view ; it falls short of the apex of the antennal scale, reaching to the base or middle of the second segment of the antennular peduncle.

(ii) The outer margin of the basal segment of the antennular peduncle terminates in an acute point.



TEXT-FIG. 104.—*Conchodytes nipponensis* (de Haan).
a. Third maxilliped. *b.* Fingers of second peraeopod. *c.* Dactylus of third peraeopod. *d.* Telson.

(iii) The antepenultimate segment of the third maxilliped (text-fig. 104*a*) is comparatively narrow ; its greatest breadth is less than twice its length and at the distal end it is not much wider than the penultimate segment. The penultimate segment is about 1·6 times as long as wide and is equal in length with the ultimate.

(iv) The carpus of the first peraeopods is equal to or slightly longer than the merus.

(v) In the single specimen examined there is a large tooth, which is apically serrate, in the proximal half of the dactylus (text-fig. 104*b*) and, in front of it, another tooth,[2] much lower but more sharply pointed. There are two teeth on the fixed finger,

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[1] Miers, *Zool. Coll. H. M. S.* '*Alert*,' p. 291 (1884).

[2] Parisi in his description states that there is only one dactylar tooth.

ohe at the base which is small, rounded and serrate and another situated in the middle of the finger which is triangular and fits between the two dactylar teeth. The latter is not serrate and is very different from the low broad-based lobe found in *C. biunguiculatus*.

(vi) The last three peraeopods are slightly stouter than in the preceding species. In the specimen examined the merus of the third pair is 3·1 times and the propodus about 4 times as long as wide. The dactylus (text-fig. 104*c*) is similar to that of the preceding species and bears a short tooth at the proximal end of the basal protuberance.

(vii) The dorsal spines of the telson (text-fig. 104*d*) are very large, rather more than one-sixth of the total length (terminal spines excluded). The outermost pair of distal spines is shifted forwards on to the dorsal surface of the telson and, though they are very large, their tips do not reach the apex. There are thus in this species three pairs of dorsal spines and two at the tip. The intermediate pair of dorsal spines is situated just behind the middle of the telson and the distance between them and the apex is greater than that which separates them from the anterior pair. Of the two pairs of spines at the apex the outer are slightly stouter than the inner.

The single specimen examined is a male 16 mm. in length. Parisi notes that one of his examples was 23 mm. in length.

C. nipponensis is easily distinguished by the unusual position of the outermost terminal spines of the telson. The character is evidently not an individual abnormality as it is shown in Parisi's figure and referred to in his description. Except for the somewhat shorter rostrum the anterior parts of my specimen agree precisely with Balss' figure.

C 435/1.	Misaki, Japan.	N. Annandale, 1915 (Misaki Lab.).	One.

Although this species is here recorded for the fourth time, we are still without information as to the mollusc in which it lives.

The species is known only from Japan. De Haan gives no definite locality for his specimens: those recorded by Balss and Parisi were from Sagami Bay.

Conchodytes tridacnae Peters.

1917. *Conchodytes tridacnae*, Borradaile, *Trans. Linn. Soc.* (2) *Zool.* XVII, p. 393.

The specimens that I refer to this species agree in the following points:—

(i) The rostrum in dorsal view is rather bluntly pointed and reaches to or a little beyond the end of the antennal scale.

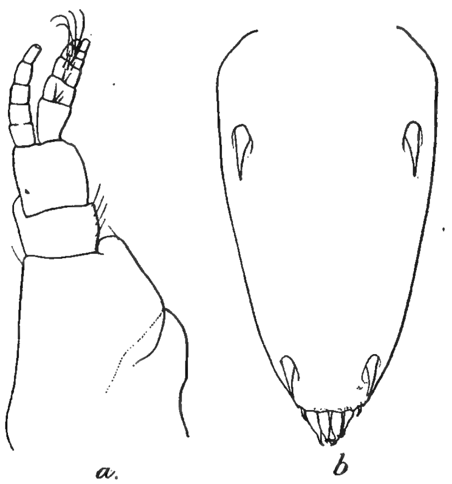
(ii) The outer margin of the basal segment of the antennular peduncle (text-fig. 105*a*) is distally rounded and not acutely produced as in the other Indo-Pacific species of the genus.

(iii) The antepenultimate segment of the third maxilliped is about 2·5 times as long as wide and at the distal end is not much wider than the next segment. The penultimate segment is about twice as long as wide and is considerably longer than the ultimate segment.

(iv) The carpus of the first peraeopods is equal to or longer than the merus.

(v) There is a rounded tooth which is frequently serrate on the inner margin of the dactylus just behind its middle point. On the fixed finger there are two teeth, both of which are frequently low and inconspicuous. The proximal tooth is sometimes serrate; the distal tooth is small, never broad at the base as in *C. biunguiculatus*, and is occasionally acute.

(vi) The last three peraeopods are stout. In the third pair the merus is from 2·5 to 3 times and the propodus from 2·75 to 3 times as long as wide. The terminal claw of the dactylus is bent at right angles to the main axis of the segment and its basal protuberance is rounded, without a tooth on the proximal side.



TEXT-FIG. 105.—*Conchodytes tridacnae* Peters.
a. Antennule.
b. Telson.

(vii) The dorsal spinules of the telson (text-fig. 105*b*) are small, only about one-ninth the total length (terminal spines excluded). In females the distance between the posterior pair and the apex is usually from one-third to one quarter;[1] in males from one-third to two-fifths the distance between the anterior and posterior pairs. The outermost terminal spines are very small and are placed at the apex; the intermediate spines are not conspicuously stouter than the median.

The largest Indian specimen is a female 27 mm. in length; a female from the Torres Straits is 34 mm. in length. In an extremely young individual, about 7·5 mm. in length, the accessory spine on the dactylus of the last three peraeopods is not developed.

Specimens obtained at Port Blair were semitransparent when alive. In females the carapace and abdomen were thinly sprinkled with small white chromatophores, with similar red chromatophores on the rostrum and anterior parts of the carapace. The

[1] The only exception is a large female from the Torres Straits in which the distance between the posterior teeth and the apex is slightly more than half that separating the two pairs.

eggs and ovary were orange or orange-red. In males the white chromatophores were usually absent and the red less numerous.

C 436–7/1.	Port Blair, Andamans.	S. Kemp, March, 1915; Feb., 1921.	Thirteen.
C 438/1.	Cherbaniani Reef, Laccadives.	'Investigator,' Oct., 1891.	Four.
7421/10.	Torres Straits.	Brit. Mus.	One.

All the specimens were found in *Tridacna*. At Port Blair they were obtained on the shores of Aberdeen and North Bay in molluscs chiselled out of solid coral rock. The prawn was comparatively scarce and was found in only a small proportion of shells that were opened.

C. tridacnae is apparently found only in *Tridacna*, but in view of Borradaile's statement that *C. meleagrinae* sometimes occurs in this genus of molluscs it is difficult to determine the distribution of the species with accuracy from the numerous published records. The species is in all probability widely distributed in the Indo-Pacific region.

Conchodytes meleagrinae Peters.

1917. *Conchodytes meleagrinae*, Borradaile, *Trans. Linn. Soc.* (2) *Zool.* XVII, p. 393.

The question of the validity of this species and of the characters by which it may be separated from the very closely allied *C. tridacnae* has been discussed by Borradaile. I have myself seen only four specimens of *Conchodytes* from *Meleagrina* and two of these are in bad condition. They differ from *C. tridacnae* in two of the characters mentioned by Borradaile: the rostrum does not reach the end of the antennal scale and the carpus of the first peraeopod is conspicuously shorter than the merus. The third maxilliped is, however, similar in length to that of the related species and does not nearly reach the end of the scale.

The specimens also differ from *C. tridacnae* in the following points: (i) the outer margin of the basal segment of the antennular peduncle terminates acutely; (ii) the ultimate segment of the third maxilliped is a little longer, about equal in length with the penultimate; (iii) the last three peraeopods are rather more slender—the merus of the third pair is from 3·2 to 3·5 times and the propodus from 3·5 to 4·3 times as long as wide; (iv) the dorsal spinules of the telson are proportionately a little longer and the posterior pair is placed further forwards, the distance between the posterior pair and the apex being, in both sexes, slightly more than half the distance which separates the two pairs.

These characters combined with those derived from the proportionate length of the rostrum and the carpus of the first leg are sufficient, if constant, to justify the retention of two distinct species.

The specimens I have examined are all small, the largest being only 21 mm. in length.

C 439/1.	Port Blair, Andamans.	S. Kemp, Feb., 1915.	Two.
C 440/1.	Andamans.	A. R. S. Anderson.	Two.
1417.	Upolu, Samoa.	Purchased.	One.

All the specimens from the Andamans were found in *Meleagrina* and it is from this genus of molluscs that the species has generally been recorded. Borradaile notes, however, that it sometimes occurs in *Tridacna*. There is no note of the mollusc in which the Samoan specimen was found. The species is probably one of wide distribution in the Indo-Pacific region.

Genus **Typton** Costa.

1917. *Typton*, Borradaile, *Trans. Linn. Soc.* (2) *Zool.* XVII, p. 394.

Borradaile gives a full list of references to this genus and to the two species which belong to it. *Typton* is readily distinguished from all other Pontoniinae except *Paratypton* by the rudimentary character of the antennal scale.

In *T. spongicola*, which is found in sponges in the Mediterranean and western parts of the English Channel, the rostrum is spine-like and toothless and there is a pair of very long supra-orbital spines. In *T. bouvieri*, which is known only from Djibouti in the Red Sea, the rostrum is short, with 2 or 3 teeth on its upper edge, and there are no supra-orbital spines. In both species the dactylus of the three posterior legs is biunguiculate, but without a basal process.

Genus **Paratypton** Balss.

1914. *Paratypton*, Balss, *Zool. Anz.* XLIV, p. 83.
1915. *Paratypton*, Balss, *Denk. math.-naturw. Kl. K. Akad. Wien* XCI, p. 27.

This genus agrees with *Typton* and differs from all other Pontoniinae in the rudimentary condition of the antennal scale. It differs from *Typton* in a number of characters, of which the most important are (i) the complete absence of the rostrum, (ii) the absence of exopods from the second and third maxillipeds and (iii) the simple dactylus of the last three peraeopods. The distal endite of the maxilla is well developed in *Typton*, but quite rudimentary in *Paratypton*.

The only known species of the genus, *P. siebenrocki* Balss, is recorded from the Red Sea, the south coast of Arabia and Samoa. It appears probable from its structure that it is parasitic or symbiotic in its habits, but of this nothing is known.

ADDENDUM.

Prof. Ch. Gravier has recently sent me for examination a number of Macrura from the Gulf of California collected by M. L. Diguet. Among them I find two species of *Pontonia* which I identify as *Pontonia margarita* Smith [1] and *Pontonia pinnae* Lockington [2] (*nec* Ortmann). Of the former there are numerous specimens, obtained "dans l'huitre perlière"; of the latter a single pair obtained in *Pinna rugosa*.

Miss Rathbun,[3] when describing *Pontonia californiensis* remarks.—"This is the only *Pontonia* described from the west coast of North America, the *P. margarita* of Smith being a *Conchodytes*." These statements call for correction, for *P. margarita* is in my opinion correctly placed in the genus *Pontonia* and *P. pinnae* was recorded by Lockington in 1879 from the Gulf of California. Schmitt,[4] in his valuable treatise on Californian Decapoda mentions only *P. californiensis* and Borradaile,[5] who also appears to have overlooked Lockington's species, follows Miss Rathbun in referring *P. margarita* to the genus *Conchodytes*.

In *P. margarita* the dactylus of the last three legs is broader than usual, with the two claws strongly curved; it thus bears a strong resemblance to *Conchodytes* but lacks the large basal process which is characteristic of that genus.

P. margarita and *P. pinnae* are closely allied forms, but may be distinguished by the following characters:—

P. margarita Smith.	*P. pinnae* Lockington.
Basal breadth of rostrum about half its length.	Basal breadth of rostrum about equal to its length.
Eyes larger, almost reaching antennal spine when extended laterally.	Eyes smaller, not nearly reaching antennal spine when extended laterally.
Large chela with palm scarcely more than one and a half times as long as broad.	Large chela with palm twice as long as broad.
Dactylus of last three legs very broad, with accessory claw strongly curved and directed slightly backwards.	Dactylus of last three legs less broad with accessory claw almost straight and directed obliquely forwards.
Spines on dorsum of telson large; posterior pair almost equidistant between anterior pair and apex.	Spines on dorsum of telson small; posterior pair much nearer to apex than to anterior pair.
Size smaller, 20-28 mm.	Size larger, 36-42 mm.
Lives in *Margaritophora fimbriata*.	Lives in *Pinna rugosa*.

In the specimens of *P. pinnae* which I have examined the carapace is much more strongly arched in lateral view than in *P. margarita* and in the ovigerous female the rostrum projects downwards at an angle of 45°.

P. californiensis Rathbun, which I have not seen, appears to be easily distinguished from both the above species by the very

[1] Smith, in Verrill, *American Naturalist* III, p. 245 (1869).
[2] Lockington, *Bull. Essex Inst.* X, p. 163 (1879).
[3] Rathbun, *Harriman Alaska Exped.* X, p. 34 (1904).
[4] Schmitt, *Univ. Calif. Publ., Zool.* XXIII, p. 38 (1921).
[5] Borradaile, *Trans. Linn. Soc.* (2) *Zool.* XVII, p. 394.

slender rostrum, the shorter carpus of the first leg, the form of the fingers of the second leg (which gape and are devoid of large teeth) and by the position of the spines on the telson. In all three species the dactylus of the last three legs is biunguiculate.

P. californiensis is known only from Santa Cruz I, California; *P. pinnae* only from the Gulf of California [1] and *P. margarita* from the Gulf of California and the Gulf of Panama.

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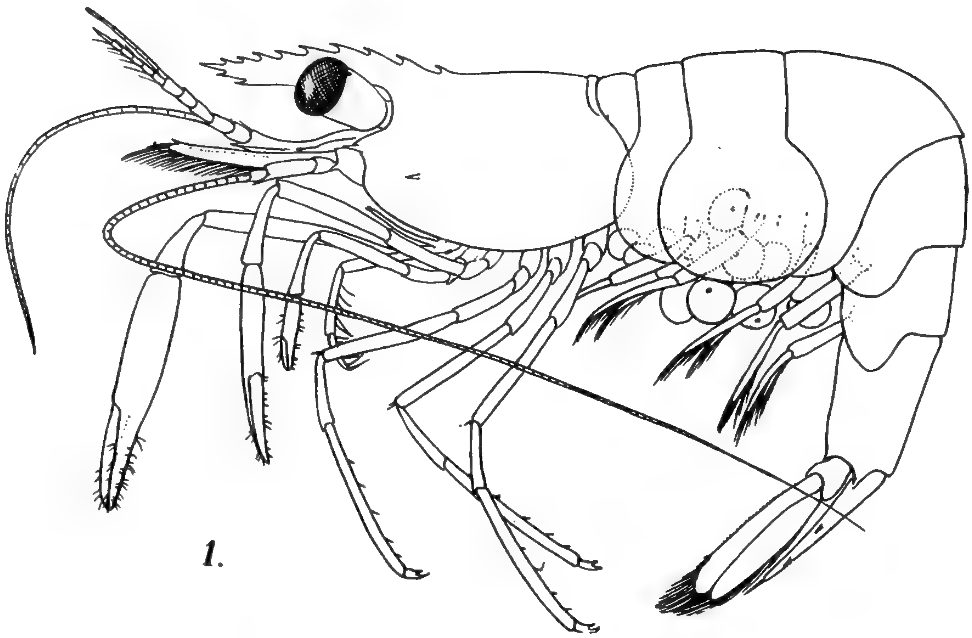
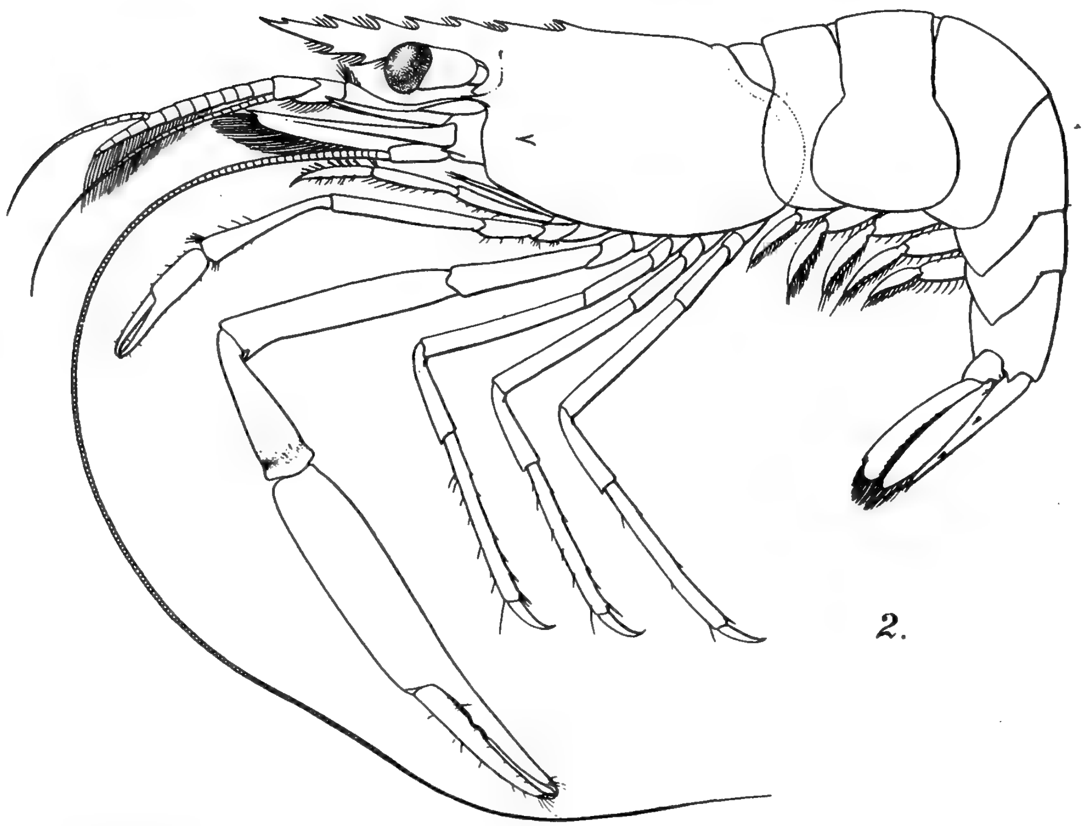
[1] The specimens I have seen are from Los Angeles Bay, one of the original localities.

Explanation of Plate III.

Fig. 1.—*Periclimenes* (*Periclimenes*) *impar*, sp. nov., from a specimen about 10 mm. in length.

Fig. 2.—*Palaemonella vestigialis*, sp. nov., from a specimen about 18 mm. in length.





G. M. Woodward & A. Chowdhary del.

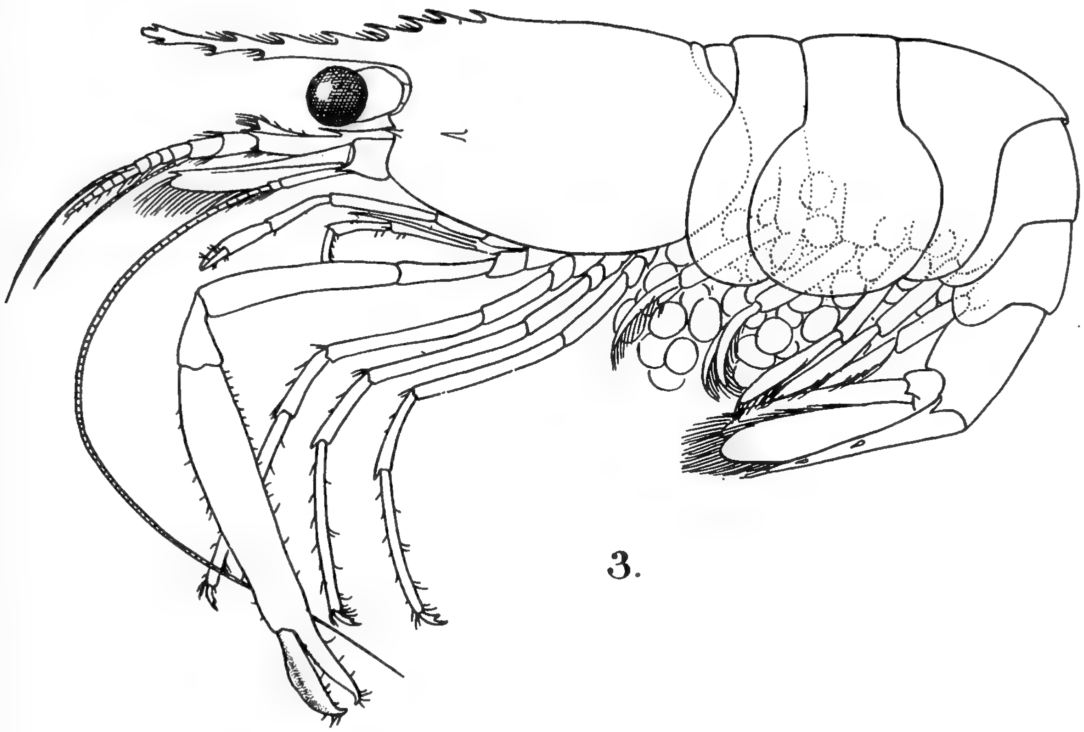
Fig. 1. *Periclimenes impar*, sp. nov.

Fig. 2. *Palaemonella vestigialis*, sp. nov.

EXPLANATION OF PLATE IV.

FIG. 3.—*Periclimenes* (*Periclimenes*) *latipollex*, sp. nov., from a specimen about 16 mm. in length.

FIG. 4.—*Periclimenes* (*Periclimenes*) *lanipes*, sp. nov., from a specimen about 13 mm. in length.



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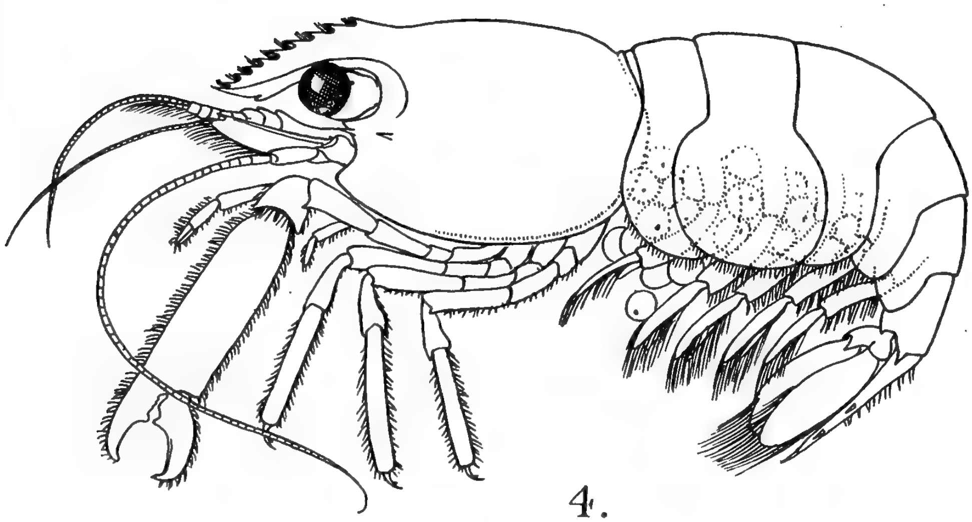


4.

G. M. Woodward del.

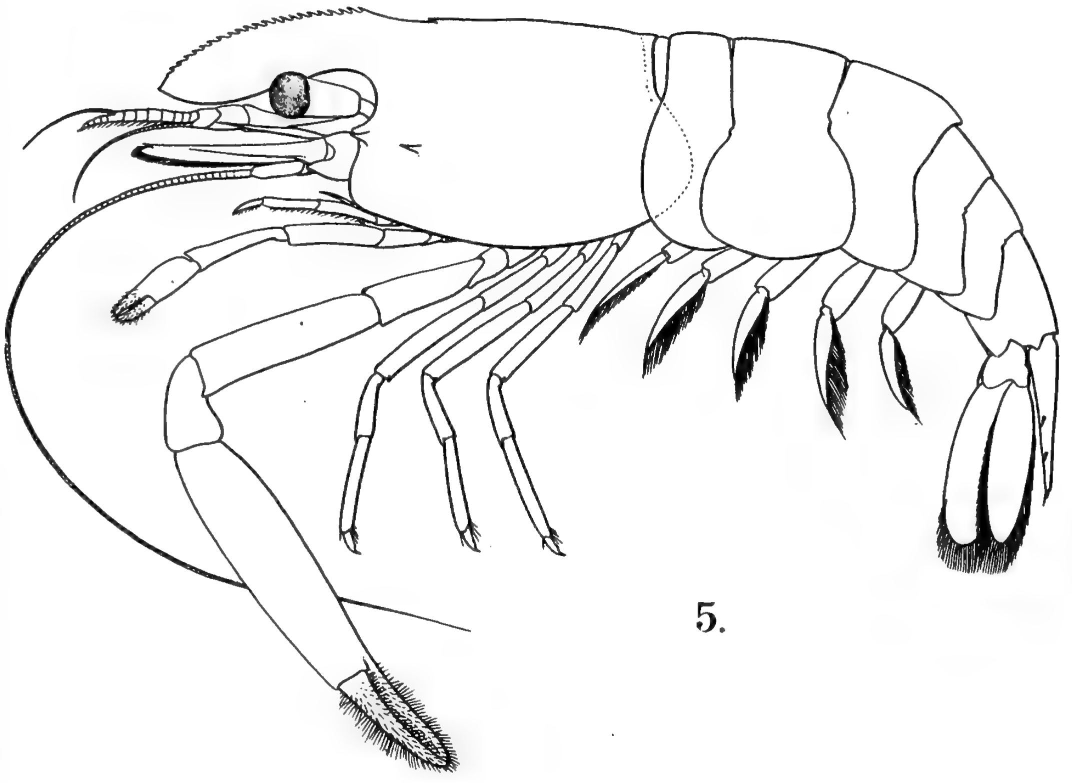
Fig. 3. *Periclimenes latipollex,* sp. nov.

Fig. 4. *Periclimenes lanipes,* sp. nov.

Explanation of Plate V.

Fig. 5.—*Periclimenes* (*Periclimenes*) *rex*, sp. nov., from a specimen about 21 mm. in length.

Fig. 6.—*Periclimenes* (*Periclimenes*) *investigatoris*, sp. nov., from a specimen about 15 mm. in length.



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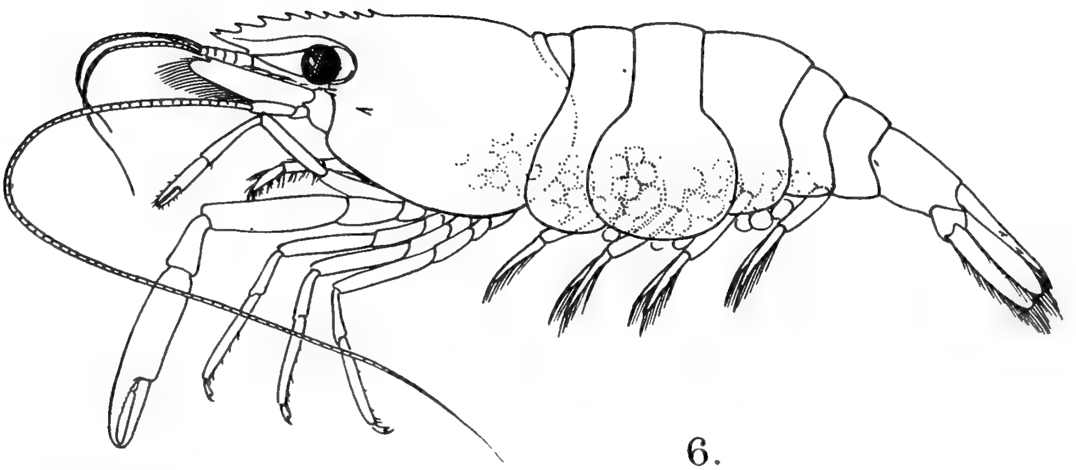


6.

G. M. Woodward & A. Chowdhary del.

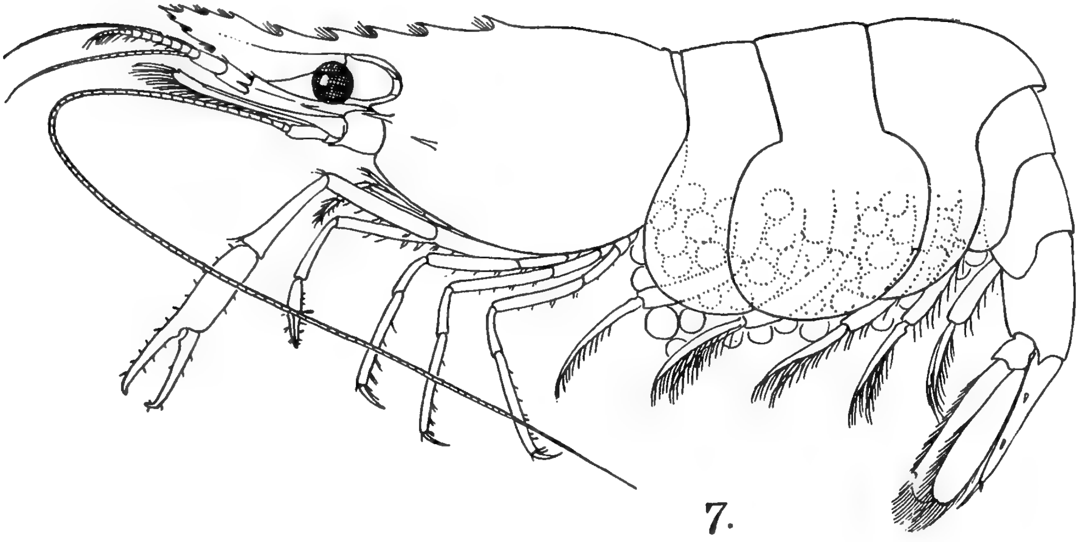
Fig. 5. *Periclimenes rex,* sp. nov.

Fig. 6. *Periclimenes investigatoris,* sp. nov.

Explanation of Plate VI.

Fig. 7.—*Periclimenes* (*Ancylocaris*) *seychellensis* Borradaile, from a specimen about 18 mm. in length.

Fig. 8.—*Periclimenes* (*Ancylocaris*) *brevicarpalis* Schenkel, from a specimen about 28 mm. in length.



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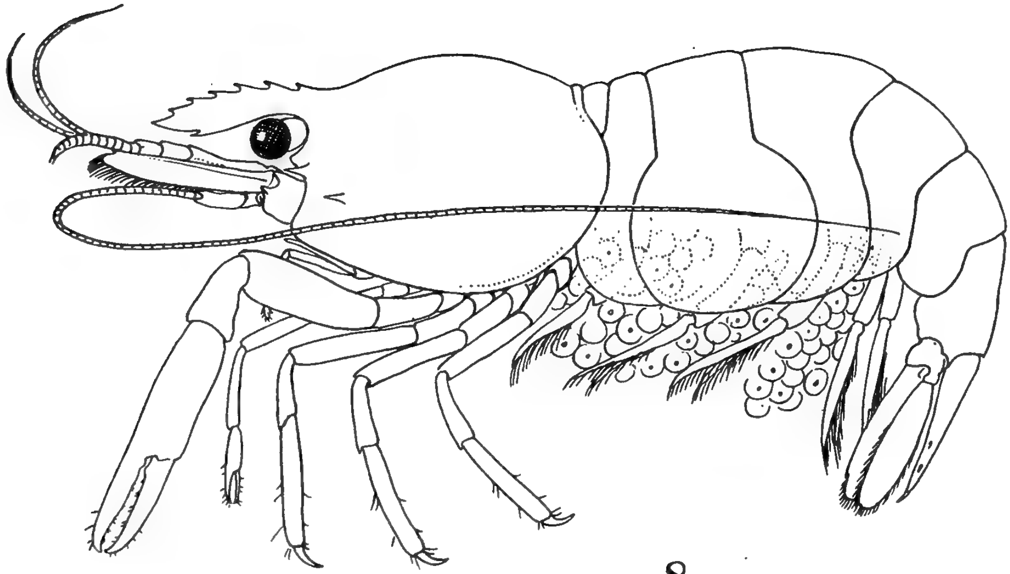


8.

G. M. Woodward del.

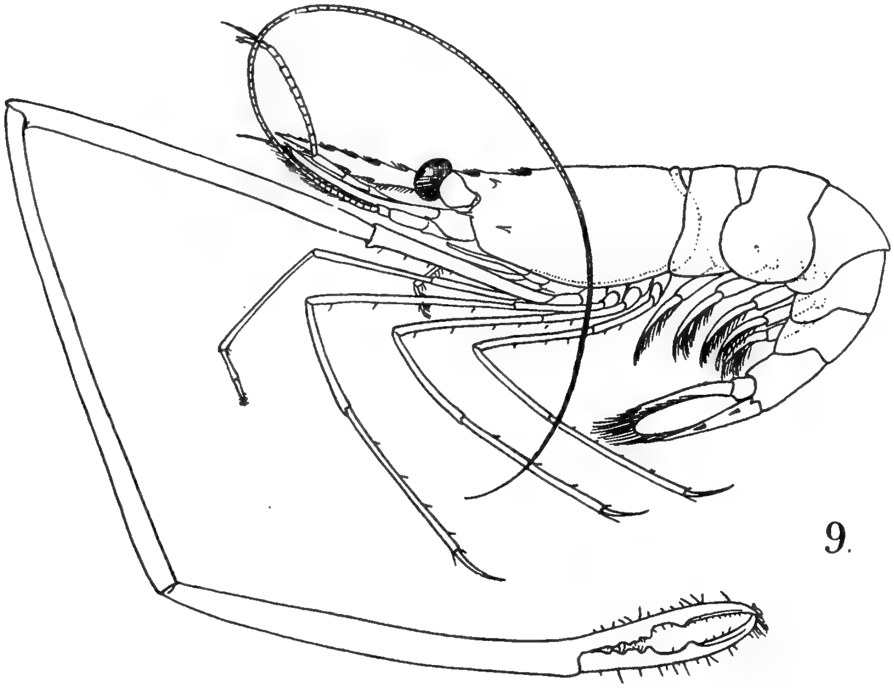
Fig. 7. *Periclimenes seychellensis* Borradaile.

Fig. 8. *Periclimenes brevicarpalis* Schenkel.

Explanation of Plate VII.

Fig. 9.—*Periclimenes* (*Ancylocaris*) *agag*, sp. nov., from a specimen about 16 mm. in length.

Fig. 10.—*Periclimenes* (*Ancylocaris*) *grandis* (Stimpson), from a specimen about 20 mm. in length.



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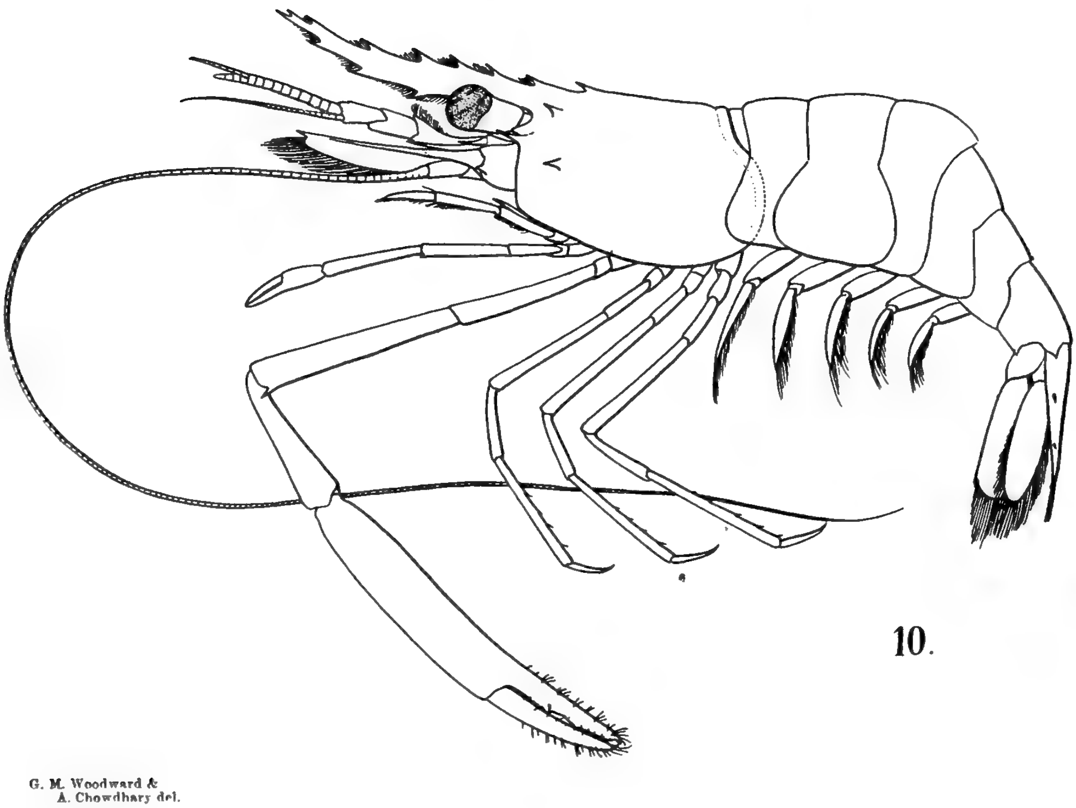


10.

G. M. Woodward &
A. Chowdhary del.

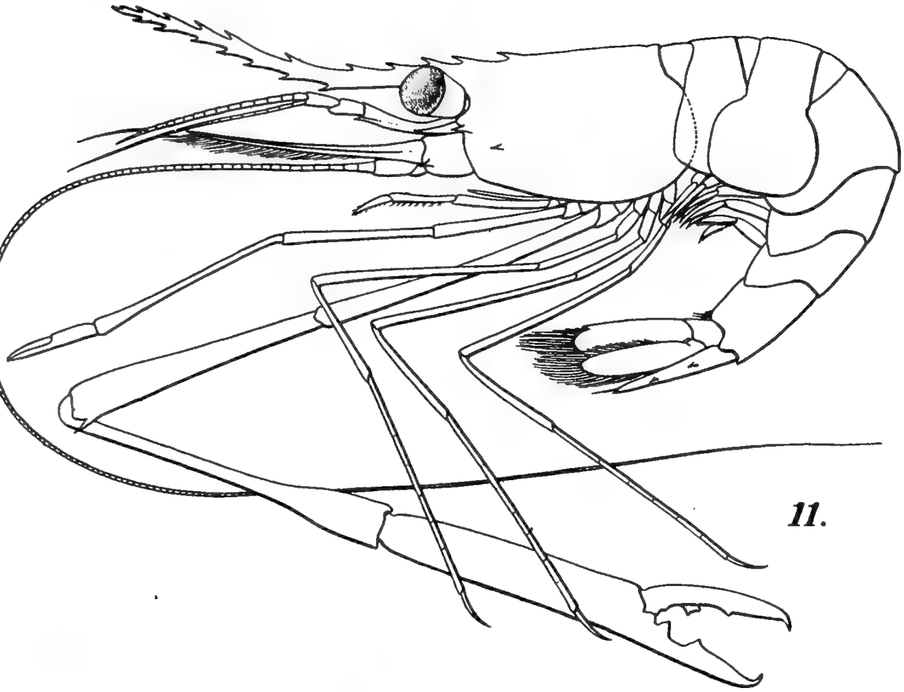
Fig. 9. *Periclimenes agag*, sp. nov.

Fig. 10. *Periclimenes grandis* (Stimpson).

Explanation of Plate VIII.

Fig. 11.—*Periclimenes* (*Ancylocaris*) *tenuipes* Borradaile, from a specimen about 22 mm. in length.

Fig. 12.—*Periclimenes* (*Ancylocaris*) *digitalis*, sp. nov., from a specimen about 22 mm. in length.



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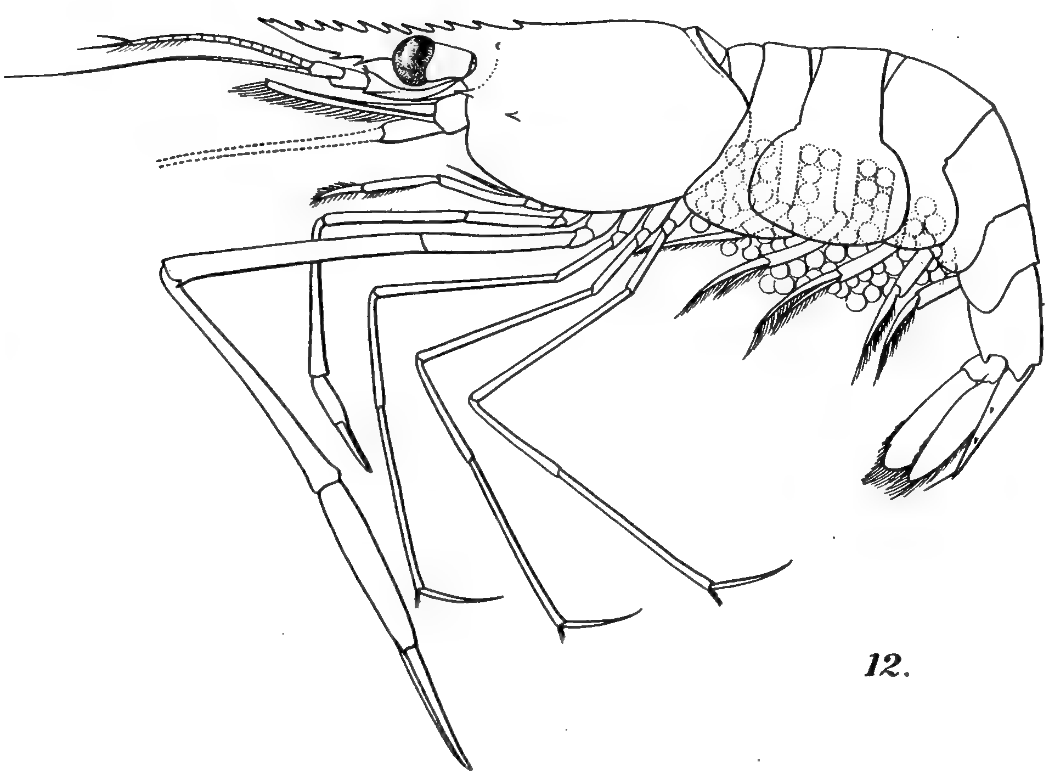


12.

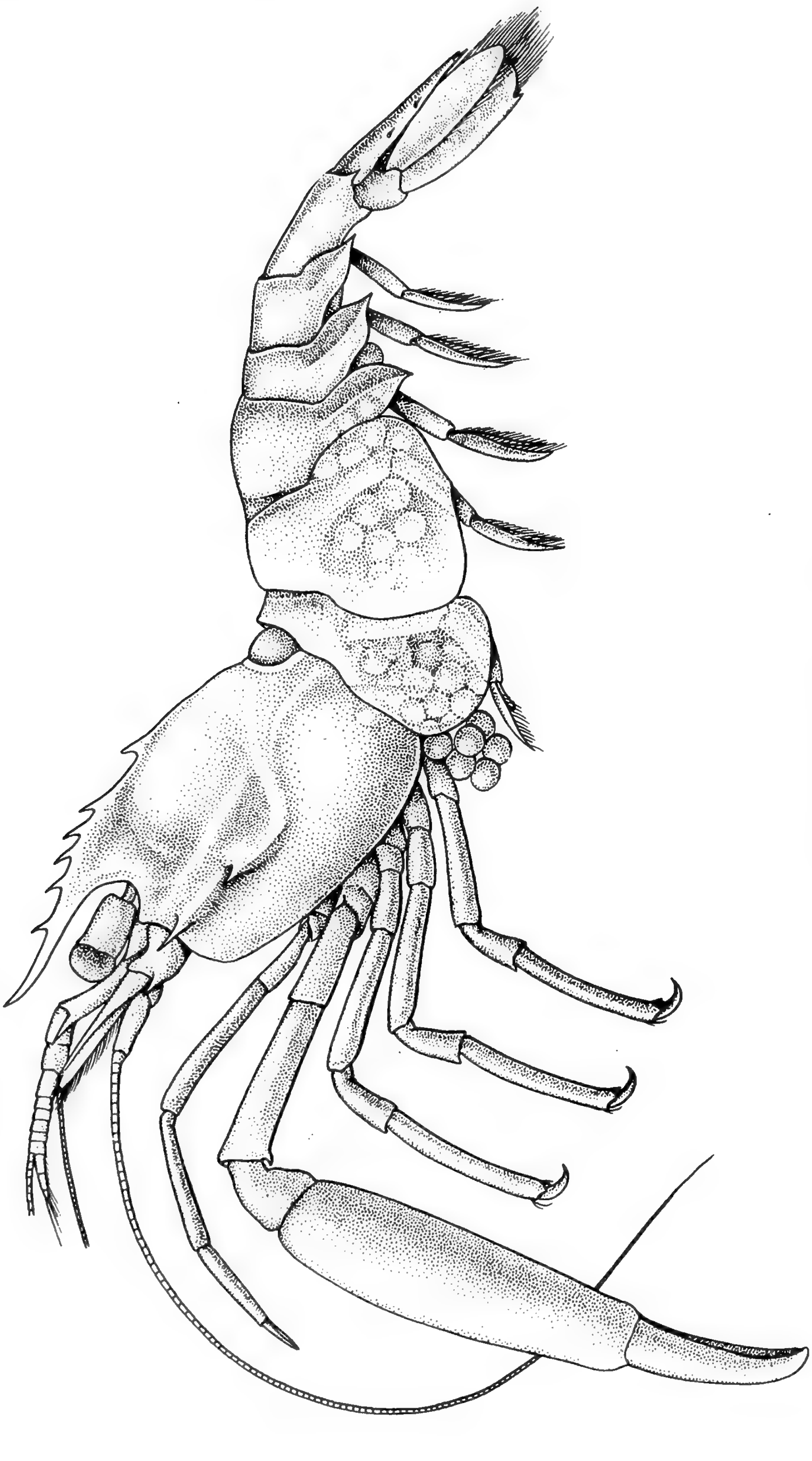
A. Chowdhary del.

Fig. 11. *Periclimenes tenuipes* Borradaile.

Fig. 12. *Periclimenes digitalis*, sp. nov.

Explanation of Plate IX.

Dasycaris symbiotes, gen. et sp. nov., from a specimen about 13 mm. in length.



A. Chowdhary del.

Dayscaris symbiotes, gen. et sp. nov.

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THE FAUNA OF AN ISLAND IN THE CHILKA LAKE.

CONTENTS OF PART II.

THE HETEROMERA OF BARKUDA ISLAND.

By K. G. BLAIR, *B.Sc., F.E.S.*

(Published by permission of the Trustees of the British Museum.)

The outstanding feature with regard to the Heteromerous fauna of Barkuda Island[1] is the preponderance of S. Indian forms. A few species have a wider distribution in India and the East, but the majority of those here recorded are known only from the southern part of the peninsular and from Ceylon. The most notable exceptions are: *Allecula humeralis*, sp. nov., of which the British Museum possesses two specimens, one each from Assam and Siam; but it may prove to be that this species occurs much more widely though rarely in India; and *Artactes gravelyi*, sp. nov., belonging to a genus of essentially more eastern distribution.

One species, *Gonocephalum lewisi*, sp. nov., is known hitherto from Ceylon only, but further collecting will probably prove its occurrence more generally in S. India.

Family TENEBRIONIDAE.

Hyperops latus Kraatz.

Kraatz, *Revis. Tenebrion.*, 1865, p. 235.

1 ex., 3·vi·20, 'under stones and dry leaves'; 2 ex., 15–22·vii·16 (*F. H. Gravely*); 3 ex., 18·viii·20 'at foot of *nim* tree and on dry bark of same'; 4 ex., 16–20·ix·19 (*E. Brunetti*).

Described from 'India orientali' the species is represented in the British Museum by specimens from Ceylon, the Nilgiri Hills, Malabar and Madras.

Stenosis kraatzi Reitt.

Reitter, *Deutsch. Ent. Zeits.* XXX, 1886, p. 102.

7 ex., 15–22·vii·16 (*F. H. Gravely*); 1 ex., 13–18·iv·20 (*N. Annandale*).

Described from 'India Or.'

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[1] The first instalment of papers on the fauna of this island appeared in vol. xxii, of the *Records*, pp. 313-421 (1921).

Pseudoblaps barkudensis, sp. nov.

Oblong, rather strongly convex, black, moderately nitid, with the antennae and legs piceous. Head densely and strongly punctured, moderately convex between the eyes, with a deep sulcus bordering the latter; clypeal suture obsolete, marked only by a feeble depression. Antennae extending slightly beyond middle of thorax, with a fine golden pubescence, 3rd joint about twice as long as wide, scarcely longer than the 4th, the rest successively shorter and wider, 10th twice as wide as long. Thorax transverse, widest in the middle, the sides arcuate, the base scarcely wider than the apex, all angles subrectangular, lateral margins rather wide and thickened, anterior margin fine and widely interrupted in the middle; disc evenly convex, strongly punctured throughout. Elytra less than 1½ times as long as together wide, widest behind the middle, shoulders rounded, with the lateral carina prominent near the base but soon concealed (viewed from above) by the convexity of the outer interstices; striae impressed with rather large punctures not very closely placed, intervals convex, rather finely punctate; the striae combine towards the apex as follows: 4th and 5th, 3rd and 6th, 2nd and 7th, 1st and 9th, the 8th ending about the level of the 4th and 5th. Length 11 mm.

5 ex., 15–22·vii·16; 4 ex., 3–19·viii·19; 1 ex., 4–19·x·19 (*F. H. Gravely*).

All the specimens appear to be female. The species resembles *P. javanus* Wied., but is smaller, more nitid and more convex, with the striae uniting differently towards the apex.

Pachypterus indicus, sp. nov. (F. Bates, M.S.)

Elongate, oblong, piceous brown, clothed above with moderately long sub-erect hairs the surface usually concealed with an earthy indument. Head short, transverse, strongly declivous and scarcely visible when the insect is viewed from above; eyes transversely oval, almost divided by the canthus; antennae slender, scarcely thickened towards apex, and reaching almost to the base of the thorax. Thorax feebly transverse, widest in front of the middle, the sides rounded and finely denticulate, anterior angles rectangular, posterior angles obtuse but distinct; disc convex, densely rugose punctate with feebly developed setigerous tubercles. Elytra elongate ovate, scarcely as wide as the thorax, becoming feebly wider from the base to behind the middle, the shoulders obtuse; striae moderately distinct, intervals feebly convex, set with setigerous granules throughout; epipleura suddenly reduced just beyond base of last ventral segment. Femora rather thick, clavate densely rugose-punctate, tibiae slender, feebly sinuate, with the inner apical angle produced, anterior tibiae not carinate along outer side, the exterior apical angle acute but scarcely produced.

The male has the first three joints of the anterior tarsi feebly expanded, and a shallow but marked median depression on the first three abdominal segments. Length 8½–10 mm.

1 ex., 15–22·vii·16 and 6 ex., 25·vii–4·viii·17 (*F. H. Gravely*).

This species is represented in the British Museum by specimens from 'Bengale' from the Bates' collection which bear the MS. name I have adopted, and by two labelled 'Berhampur' from the Atkinson collection. A specimen from the Bates' collection is taken as the type.

The species is intermediate in many respects between *P. elongatus* Muls., and *Amblysphagus pachyderus* Fairm., the thorax not having the sharp granules of the former, with the sides much more finely crenulate, while the latter has the sides of the thorax entire and the posterior angles rounded. It is doubtful whether *Amblysphagus* Fairm., can stand as a distinct genus.

Mesomorphus villiger Blanch.

Blanchard, *Voy. Pole Sud.* IV, 1853, p. 154, pl. 10, fig. 15.

2 ex., 17·x·20, 'at light' (*N. Annandale*).

Widely distributed in the tropics of Asia and recorded also from tropical Africa.

Mesomorphus rugulosus Chat.

Chatanay, *Bull. Paris. Mus.* 1917, 4, p. 6.

2 ex., 15–22·vii·16 (*F. H. Gravely*); 3 ex., 25·vii–4·viii·17 (*N. Annandale*); 5 ex., 3–19·viii·19 (*F. H. Gravely*); 3 ex., 13·ix·20, 'with termites' (*N. Annandale*); 2 ex., 4–19·x·19 (*F. H. Gravely*).

Further specimens have been received from the Kheri Forest, U.P., India, on 'Sal,' *Shorea robusta* (*H. G. Champion*) and from Java. The species was described from Indo-China and Burma, so that it appears to be rather widely distributed in tropical Asia.

Anemia coriaria Fairm.

Fairmaire, *Ann. Soc. Ent. Belg.* XL., 1896, p. 21.

3 ex., 27·x·20, 'at light' (*N. Annandale*).

Described from S. India the species is said to extend as far as Assam and Tibet. It is also found in Ceylon.

Gonocephalum strigatum F.

Fabricius, *Ent. Syst. Suppl.* 1798, p. 41.

2 ex., 15–22·vii·16 (*F. H. Gravely*); 5 ex., 27·x·20, 'at light' (*N. Annandale*).

Common in S. India and Ceylon.

Gonocephalum lewisi, sp. nov.

Small, oblong, piceous or reddish piceous with the antennae and tarsi ferruginous, usually covered with an earthy indument concealing the sculpture. Head transverse, moderately flat, with prominent ridges overhanging the inner margin of the eyes, canthus wider than the eyes, its anterior border sinuate, the ends of the clypeal suture angularly emarginate. Antennae rather slender, the last four joints enlarged to form a well marked though loose club. Thorax rather strongly convex with well defined expanded margins of fairly even width and rather wider than the canthus; the disc, when cleaned, is fairly smooth and shining, rather sparsely set with well-developed setigerous granules; the sides are rounded, straight or very feebly sinuate before the posterior angles, which are sharp and a little less than a right angle; the anterior angles are acute and forwardly prominent. Elytra as wide as thorax at base, thence becoming slightly wider to behind the middle, humeri obtuse but almost rectangular, the lateral carina visible from above till well behind the middle; the striae are set with coarse deep punctures, the intervals being convex, scarcely wider than the striae, smooth, with minute setigerous granules two or three deep across each. Legs moderately stout, anterior tibiae feebly arcuate, gradually expanded from base to apex, the outer side finely denticulate, the external apical angle acute, reaching almost to the apex of the 4th tarsal joint. Length 5–6 mm.

4 ex., 27·x·20, 'at light' (*N. Annandale*).

Also Ceylon, Colombo (*G. Lewis*), 1884 (types).

Closely allied to *G. strigatum* F., which it resembles in the structure of its legs and antennae, it is at once distinguished by the setigerous granules of the elytral intervals forming two or more series throughout; in *G. strigatum* they are mainly uniseriate.

Gonocephalum planatum Walk.

Walker, *Ann. Mag. Nat. Hist.* (3) II, 1858, p. 284.

1 ex., Sept. 19 (*N. Annandale*).

Described from Ceylon, this species has a wide range in India and the Malay region.

Gonocephalum sp.

1 ex., 27·x·20, 'at light' (*N. Annandale*).

Gonocephalum depressum F.

Fabricius, *Ent. Syst. Suppl.*, 1798, p. 41.

2 ex., 15–22·vii·16, and 19 ex., 25·vii–4·viii·17 (*F. H. Gravely*).

A common species throughout India.

Caedius malabaricus Fairm.

Fairmaire, *Ann. Soc. Ent. Belg.* XXXVIII, 1894, p. 22.

1 ex., 3·vi·20, 'under stone and dry leaves'; 1 ex., 16–20·ix·19 (*E. Brunetti*); 2 ex., 27·x·20, 'at light' (*N. Annandale*).

This species occurs also in Ceylon and in Tenasserim.

Leichenum canaliculatum F.

Fabricius, *Ent. Syst. Suppl.*, 1798, p. 42.

1 ex., 3–19·viii·19 (*F. H. Gravely*).
Occurs in S. India and Ceylon.

Byrsax cornutus F.

Fabricius, *Ent. Syst.* I, 1792, p. 88.
B. horridus, Walk., *nec* Oliv.

15 ex., 15–22·viii·16 (*F. H. Gravely*).
Also found in Ceylon and S. India.

Platydema velutinum Walk.

Walker, *Ann. Mag. Nat. Hist.* (3) II, 1858, p. 283.

16 ex., 15–22·vii·16 (*F. H. Gravely*).
Described from Ceylon; the British Museum possesses besides a series from the Andaman Islands, but no specimens from the mainland of India.

Alphitobius laevigatus F.

Spec. Ins. I, 1787, p. 90.

1 ex., June 1920 (*N. Annandale*).
A cosmopolitan species more generally known as *A. piceus* Ol.

Setenis furva Gebien.

Gebien, *Entom. Mitteil.* VIII, 1919, p. 11, pl. i, f. 9.

22 ex., 15–22·vii·16 (*F. H. Gravely*).
Ceylon and S. India.

Derosphaerus cancellatus Fairm.

Farimaire, *Ann. Soc. Ent. Belg.* XL, 1896, p. 27.

1 ex., 3–19·viii·19, and 1 ex., 4–19·x·19 (*F. H. Gravely*).
S. India.

Anthracias curvicorne Chevr.

Chevrolat, in Guér. *Icon. Règne Anim.*, 1844, p. 119, pl. 30, fig. 6 *a–c*
(= *Toxicum oppugnans* Walk.)

7 ex., 15–22·vii·16 (*F. H. Gravely*).
Ceylon and S. India.

Lyprops curticollis Fairm.

Fairmaire, *Ann. Soc. Ent. Belg.* XL, 1896, p. 28.

62 ex., June 1920 (*N. Annandale*); 1 ex., 3·vi·20, 'under stone and dry leaves'; 13 ex., 15–22·vii·16; 3 ex., 3–19·vii·19 (*F. H. Gravely*); 3 ex., 19·viii·20, 'at base of tree under earth' (*C. Dover* and *S. Ribeiro*); 2 ex., 16–20·ix·19 (*E. Brunetti*); 3 ex., 27·x·20, 'at light' (*N. Annandale*); 8 ex., vii·14 (Chilka Survey).

Ceylon and S. India.

"This is by far the commonest beetle on the island. In the rainy season it is to be found literally in thousands under stones and particularly behind pictures, under articles of furniture, and in dark corners in the bungalow. In winter a few individuals can always be discovered under stones. It is the species I have referred to (*Rec. Ind. Mus.* XXII, p. 318) as being mutilated by the ant *Phidole rhombinoda* and stored by it as provender in a limbless but living condition." [*N. Annandale.*]

Artactes gravelyi, sp. nov.

Shortly oblong, nitid, black, with the elytra metallic and iridescent. Head and thorax finely, not very closely, punctate, the latter about twice as wide at the base as at the apex, the median part of the base projecting considerably behind the basal angles, the sides with a strong marginal sulcus continued as a fine line along the anterior margin. Elytra striate-punctate., the punctures somewhat irregular in size, not very closely placed, and the intervals flat; shoulders rounded, the lateral carina strongly prominent almost to apex; colour shining black with a faint aeneous tinge, with a patch formed of concentric iridescent bands behind the shoulders, and another externally at the apex; these bands of colour have a connecting strip of the same along the 6th interval leaving an external lateral patch blackish. Underside black, antennae, palpi and tarsi reddish. Length 8 mm.

1 ex., 15–22·vii·16 (*F. H. Gravely*).

This is of interest as being the first species of *Artactes* to be recorded from India proper, the genus being essentially Indo-Malayan. *A. gravelyi* is at once distinguished by its black head and thorax and comparatively sombre colouration.

Camarimena renardii Fairm.

Fairmaire, *Ann. Soc. Ent. Belg.* XXXVIII, 1894, p. 25.

4 ex., 15–22 vii·16 (*F. H. Gravely*).

This insect, with which Fairmaire's description agrees tolerably well, is allied to *C. rugosistriata* mihi, but more elongate, the thorax less markedly narrower than the elytra, the striae of the latter more even, the punctures regularly crenulating the intervals; the femora much more strongly clavate, etc.

C. renardii was described from Konbir, Chota Nagpur.

Hoplobrachium dentipes F.

Fabricius, *Spec. Ins.* I. 1787, p. 326.
Helops ebeninus Walk.
Hoplobrachium asperipenne Fairm.

1 ex., 15–22·vii·16 and 1 ex., 3–10·viii·19 (*F. H. Gravely*).

Described originally as '*Helops dentipes*' from Coromandel, later as *Helops ebeninus* Walk., from Ceylon, this species appears to be identical with *Hoplobrachium asperipenne* Fairm., from Madagascar. The British Museum possesses a considerable number from Ceylon and Southern India, and it is probable that the Madagascar record is erroneous or accidental. An old specimen in the Museum purporting to come from Mauritius is noted as of doubtful locality, some of the insects to which its Register No. applies being S. African species, while others are from Ceylon.

Strongylium annandalei sp. nov.

Subopaque, black. Head and thorax coarsely and densely punctate, eyes moderately approximate, separated by a space about equal to the length of the third joint of the antennae. These entirely black, 3rd joint equal to 4th, and equal to 1st and 2nd together, joints 5 to 11 a little shorter and thicker, with larger punctures and more opaque. Thorax as wide as head, feebly transverse, anterior margin straight, the border scarcely thickened in the middle, lateral margins rounded in the middle, slightly sinuate towards base and apex, carinate throughout, anterior angles rounded, posterior angles acute. Elytra wider than thorax, parallel, shoulders rounded, lateral carina invisible from above; striae with large deep squarish punctures, each of which has a small tubercle in the middle of each side, intervals convex, subopaque, with fine scattered punctures. Underside more nitid but strongly punctate throughout, prosternum with a conical projection behind the coxae, last segment of abdomen (♂) with a feeble median depression, subtruncate at apex. Legs moderately nitid, densely punctate, anterior femora somewhat thickened about middle, all tibiae slender, feebly sinuate within, tarsi slender, clothed beneath with yellow hairs, claw-joint of anterior tarsi slightly longer, that of posterior tarsi slightly shorter than the rest together. Length 12–14 mm.

2 ex., 25·vii–4·viii·17 (*N. Annandale*); 1 ex., 15–22·vii·16 (*F. H. Gravely*), also 1 S. India and Ceylon in Brit. Mus. (type).

Probably allied to *S. marseuli* Lew., from Japan, but more cylindrical in form, with the antennae and legs less slender, the elytral intervals convex, not carinate, etc. Similar punctures in the elytral striae are also found in certain W. African species, e.g. *S. borchmanni* Geb., *Arch. f. Naturgesch.*, 1920 (1921), Abt. A, 6 Heft, p. 174, fig.

Family CISTELIDAE.

Allecula humeralis, sp. nov.

Elongale, black, subopaque, with the legs and underside piceous. Head densely, rather finely, punctate, eyes separated by a space equal to the width of one of them, bordered internally by a slight furrow which is not produced downwards towards the clypeus. Antennae slender, joints 3–11 subequal, 5th to 10th slightly thickened within towards apex. Thorax feebly transverse, slightly rounded at sides base and apex bisinuate, all angles obtuse, subrectangular; disc evenly convex, rather strongly but irregularly and not densely punctate. Elytra attenuate in posterior third, strongly punctate-striate, intervals convex, lateral carina at extreme base visible from above forming a rounded prominence in front of the humeral callus. Underside more nitid, epimera of prothorax densely and coarsely punctured towards sides leaving a shining smooth place above coxae, meso- and metasterna also coarsely but less densely punctured towards sides, abdomen and median part of thorax densely and finely punctured and pubescent. Femora densely and finely punctured and pubescent, slightly thickened beyond middle, tibiae more coarsely and less densely punctured.

Male with a tooth on anterior tibiae within at about ⅓ from base, slightly emarginate beyond this to apex. Length 12–14 mm.

1 ex., ♀, Oct. 1919 (*N. Annandale*); also 1 ♀ Assam, Patkai Mts. (*Doherty*); 1 ♂, Siam, Xieng Khong (*R. V. de Salvaza*) (type).

Allied to *A. sericans* Fairm., from the Philippine Is. and when viewed obliquely from in front exhibiting a greyish sericeous sheen on the elytra much less pronounced than in *A. sericans*. In the latter species the marginal sulci of the eyes are produced downwards, the lateral carina of the elytra is not prominent in front of the shoulder and the prothoracic epimera are impunctate.

Family ANTHICIDAE.

Anthicus floralis var. **quisquilius** Thoms.

Thomson, *Skand. Col.* VI, 1864, p. 380.

1 ex., 3–19·viii·19 (*F. H. Gravely*).

A common species of practically cosmopolitan distribution.

Family MORDELLIDAE.

Mordellistena daturae, sp. nov.

Elongate, narrow, testaceous, clothed with a moderately dense pubescence of the same colour. Antennae slender, 3rd and 4th joints shorter than 2nd; together as long as 4th, 4th to 11th equal in length, slightly expanded and rounded on inner side. Posterior angles of pronotum distinctly rounded. Pygidium slender, twice as long as hypopygium. Posterior tibiae with three strongly oblique comb-ridges, extending nearly half way across the outer side of the tibia, 1st tarsal joint with three shorter oblique ridges, 2nd with two, 3rd without ridges. The inner spur of the posterior tibiae is nearly as long as the 1st tarsal joint, about 4 times as long as the outer spur. Length (including pygidium) 3 mm.

2 ex., 3–19·viii·19, 'from Datura flowers' (*F. H. Gravely*); 1 ex., 25·vii–4·viii·17 (*N. Annandale*).

From *M. defectiva* Walk., from Ceylon it differs in its rather smaller size and paler colour, in the posterior angles of the pronotum being distinctly rounded instead of subrectangular, in the length of the tibial spurs of the posterior pair of legs, and in the number of oblique ridges on the posterior tibiae and tarsi. In *M. defectiva* there are 5 of these ridges on the tibiae and 4, 3, and 2, respectively, on the first three tarsal joints; while the inner tibial spur is only about half as long as the 1st tarsal joint and about twice as long as the outer spur.

Family MELOIDAE.

Mylabris pustulata Thunb.

Thunberg, *Dissert. Nov. Ins. Spec*, VI, 1791, p. 113, fig. 13.
M. humeralis Walk.

3 ex., 13–18·iv·14 (*N. Annandale*); 1 ex., 3–19·viii·19 (*F H. Gravely*); 2 ex., 17·ix·19 (*E. Brunetti*); 1 ex., Oct. 1920 (*N. Annandale*); 9 ex., 25·vii–4·viii·17 (*N. Annandale*).

A common species in S. India and Ceylon.

Sybaris testaceus F.

Fabricius, *Ent. Syst.* I, 2, 1792, p. 85.

1 ex., 16·ix·19 (*E. Brunetti*).

Borchmann, in Junk's *Coleopt. Catal.* pars 69, 1917, retains this species in *Lytta*, but it and the closely allied *L. nigrifinis* Walk. (=*L. usta* Fairm.) both have the upper branch of the claws pectinate, and must be removed to *Sybaris*.

THE FREE-LIVING THYSANURA OF BARKUDA ISLAND.

By CEDRIC DOVER, *F.E.S.*

Only four free-living species of Thysanura have been collected on the island ; *Japyx indicus* is found among decaying vegetation and under fallen branches at the base of fig-trees in the jungle, an *Acrotelsa* and a Machilid are common both in the house and among dried water-weeds on the shore of Barkuda, while *Ctenolepisma* is also probably common in the bungalow though only two specimens have been collected. These fish-insects are all common species, but as little is known of the distribution of even the commonest Thysanurans, it is hoped that this note will have some value.

Several termitophilous and myrmecophilous species also occur ; these are now being worked out by Professor Silvestri of Portici.

Family JAPYGIDAE.

Japyx indicus Oudm.

Barkuda, several examples, 15–22·vii·16 (*Gravely*).

Silvestri in a report on the Thysanura in the Indian Museum [1] records specimens of this species from Peradeniya in Ceylon. We also have specimens from Misty Hollow, 2200 feet, on the western side of the Dawna Hills (*Gravely*, 22–30·xi·11), from Farm Caves near Moulmein [2] (*Gravely*, 17·xi–4·xii·11), Lower Burma ; and from the pass between Chaibassa and Chakradharpur in Chota Nagpur. Lefroy [3] records a species of *Japyx* found among decaying vegetation and soil from Pusa in Bihar and Nagpur, and says that it is probably common throughout the plains. Judging from his figure and brief description, and the fact that Dr. Gravely has taken specimens near Nagpur I think that Lefroy's species is probably *Japyx indicus*. It would seem that this is the common Japygid of the Indian plains and that it will eventually be found throughout Peninsular India, Burma, and Ceylon. These interesting insects by reason of their small size, larva-like shape and peculiar habits do not generally attract the attention of the ordinary collector and this seems to be the reason why little is known about them.

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[1] *Rec. Ind. Mus.* IX, p. 52, fig. 1 (1913).

[2] *Cf.* Annandale and Gravely, *Journ. Asiat. Soc. Beng.* (n.s.) IX, p. 405 (1913).

[3] *Indian Insect Life*, p. 44, fig. 2 (Calcutta : 1909).

Family MACHILIDAE.

A species similar to *Machilontus gravelyi* Silvestri[1] is fairly common in the house and on the shore of the island. It appears to be most abundant in August.

Family LEPISMATIDAE.

Acrotelsa collaris Fabr.

Barkuda, several examples, 15-22·vii·16; 25·vii–4·viii·17; (*Annandale* and *Gravely*).

This species is represented in the collection of the Zoological Survey of India from: Stilbrook Garden, Coonoor, Nilgiri Hills; Bangalore, 3000 feet, Mysore State (*Annandale*, 14·x·10); Rambha, Lake Chilka (*Annandale*, ix·13); Khurda Road, Orissa (*Gravely*, "at light," 13·xi·12); Barkul, 0–1000 feet (*Gravely*, "in bungalow," xi·12 and 1–3·viii·14), and Balugaon to Barkul in Orissa (*Gravely*, "from nest of *Stegodyphus sarasinorum*," 1·viii·14); Peradeniya, Ceylon (27·vi·10); Sasan, Kathiawar (*Agharkar*, 5–7·xii·12), Valvan and Kas, 3700 feet in the Satara District, Bombay Presidency; Pass between Chakradharpur, Chota Nagpur (*Gravely*, 2–4·iii·13); Allahabad, United Provinces (*Imms*, "in bungalow," 19·viii·07 and 2·iv·10); Calcutta (*Gravely*, "among old paper," 19·xi·10; *Annandale*, "in entomological room of museum," 29·vi·12 and 21·iv·14; *Annandale*, "museum wall," 1·xi·10; "museum compound," 11·xi·11; *Gravely*, "in house," 1·vi·12); Tollygunj near Calcutta (*Gravely*, xii·16); Ross I., Andamans (*Paiva*, "under flower pot," 26·iii·11); Municipal Office, Darjiling, 6000–7000 feet (*Carmichael collection*, 29·vi·14); Simla, 7000 feet, W. Himalayas (*Annandale*, 12–13·v·13).

Acrotelsa collaris has a very wide distribution, having been recorded from the West Indies, Sa Guayra, Curaçao, Maracaibo, Dahome, the Seychelles, Java, Ceylon and Madagascar, and also occurs in most parts of India. We have no records of this species from Burma though it probably occurs there and also in Malaya. In 1906 the late Mr. Paiva wrote[2] that "it may be quite common in houses among old books, etc., but very few specimens have been collected in Southern Asia." Further investigation seem to show that this is one of the commonest fish-insects in houses in Peninsular India, and the above list of localities where it has been collected prove that Paiva's remarks are no longer applicable to this Lepismatid. Lefroy[3] states that *Lepisma saccharina* is apparently the Himalayan species, but as the Indian Museum has no specimen of this cosmopolitan fish-insect from the Himalayas, though fairly extensive collections of Thysanura have been made there, and I can find no record of it from India in the

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[1] *Zool. Anz*, XL, p. 6 (1912).
[2] *Journ. Asiat. Soc. Beng.* (n. s.) II, p. 346 (1906).
[3] *Indian Insect Life*, p. 45 (Calcutta: 1909).

literature I am inclined to doubt that it occurs in India at all. But further observations must be made before a definite opinion can be expressed.

Ctenolepisma longicauda Esch.

Barkuda, two examples, 15–22·vii·16 (*Gravely*).

The Indian Museum has specimens from Bangalore, 3000 feet (*Annandale*, 16·x·10); Marikuppam, 2500 feet, S. India (22·x·10); Kulattupuzha, western base of Western Ghats, Travancore (*Annandale*, "on wall of bungalow," 19·xi·08); Waltair, Madras Presidency (*Kemp*, v·10); Calcutta (*Annandale*, "museum house," vii·11 and 11·i·12); Allahabad (*Imms*, 14·viii·10); Sarah, Nepal Terai (24·ii·08); near Bhowali, Kumaon, 5200 feet, W. Himalayas (*Imms*, "in house," viii·09); base of Dawna Hills, Amherst District, Lower Burma (*Annandale*, 1·iii·08). This species is also recorded by Silvestri[1] from Peradeniya in Ceylon, Siliguri in N. India and Darjiling, but I cannot find the specimens from these localities in the Museum collection. *C. longicauda* appears to be widely distributed in British India and often occurs in company with *Acrotelsa collaris*.

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[1] *Rec. Ind. Mus.* IX, p. 57 (1913).

THE DRAGONFLIES OF BARKUDA ISLAND.

By F. C. Fraser, *Major, I.M.S., and* C. Dover, *F.E.S.*

The Odonate fauna of the island, though rich in individuals, contains only about thirty species, most of which belong to the Libellulinae. A strong hint is given for the reason of the preponderance of the latter by the remarkable number of species belonging to the modern group Trameini in which the development of the wings and the art of flying has reached its greatest perfection. Insects possessed of such powerful flight as these find no difficulty in crossing over from the mainland, so that it seems improbable that many of them breed on the island. A few, however, pass their larval stages in a small pond on Barkuda in which sedges grow in abundance on the sides, making it eminently suitable for breeding purposes, especially for species of such genera as *Tramea*, *Pantala*, *Macrodiplax* and *Tillarga*.

The absence of some very common plains species is noticeable. For instance, there is only a single representative of the genus *Trithemis*; *T. aurora* and *T. festiva* not being included in the collection though they must abound on the neighbouring mainland.

Only seven species of Coenagrioninae have been taken on the island, one of these being an interesting *Enallagma,* represented by a single female, which has been described as *E. insula* Fraser. Three of these seven species, e.s. *Ceriagrion coromandelianum*, *Agriocnemis pygmaea* and *Pseudagrion microcephalum,* breed in the pond on the island, the latter also breeding in large numbers at the edge of the lake. It seems, however, that the larger numbers of the individuals cross over from the mainland. *Pseudagrion microcephalum* and *Ischnura senegalensis* are known to indulge in comparatively long flights and during the month of September vast numbers may be seen crossing the strip of sea separating Bombay Island from the neighbouring island and mainland. Vessels entering the Bay there are visited by numbers of these insects so that it is quite possible that a number of species are carried in a similar way across to Barkuda from the Ganjam Coast.

Dr. Annandale's observations respective of individual species prove that insular habits do not differ markedly from continental. Thus: *Lathrecista asiatica*, *Potamarcha obscura* and *Aethriamanta brevipennis* are found in jungle, usually perched on the ends of bare and prominent twigs; *Zyxomma petiolatum* flies only at dusk, skimming in rapid evolutions, low over the surface of the water; *Brachydiplax sobrina* rests on sedge at the edge of the lake; *Brachythemis contaminata* regales itself on the hosts of Amphipods (*Orchestia platensis*) which are found on islets of decaying vegetation; and lastly *Diplacodes trivialis* flies low over the ground settling on waste places. This similarity of habits is a further proof that the Odonate fauna is largely dependent on immigration from the mainland.

Anisoptera.

Family LIBELLULIDAE.

Subfamily *LIBELLULINAE*.

Potamarcha obscura Karsch.

Berl. ent. Zeitschr. XXXIII, p. 370 (1890); Ramb. (*Orthetrum*, p. 38. n. 29) (*Lib. obscura*), *Ins. Neur.*, p. 64 (1842); Ramb., (*Lib. congene*), *loc. cit.*, p. 70 (1842); Kirby, *Cat. Odon.*, pp. 38 and 180 (1890).

Barkuda, 2 examples, 3·iii·19 (*Annandale*, "caught in jungle"); 4–19·ix·19 (*Gravely*).

A comparatively rare species sometimes seen perched on the ends of bare and prominent twigs in the jungle.

Lathrecista asiatica asiatica Fabr.

Lib. asiatica, Ent. Syst. Suppl., p. 283 (1798); Kirby (*Orthetrum asiaticum*), *Cat. Odon.*, p. 36 (1890); Ris, *Cat. Coll. Selys (Lib.)*, 1908.

Barkuda, 1 example, 6·ix·19 (*Annandale*).

This specimen, a female, was the only one taken on Barkuda.

Brachydiplax sobrina Ramb.

Lib. sobrina, Ins. Neur., p. 114 (1842); Kirby, *Cat. Odon.*, p. 17 (1890).

A single male of this species has been taken, but the specimen has unfortunately been lost.

Diplacodes trivialis Fabr.

Ent. Syst. Suppl., p. 284 (1798); Ramb. (*Lib. trivialis*), *Ins. Neur*; p. 115 (1842); Uhl. (*Lib. phalerata*), *Proc. Acad. Nat. Sci. Phil.*, p. 30 (1858); Brauer (*Diplax trivialis*), *Novara*, p. 104 (1866). Kirby (*Trithemis trivialis*), *Cat. Odon.*, p. 18 (1890).

Barkuda, many examples, 5·viii·19 (*Annandale*, "resting on creeper on wall"); 12·viii·19 (*Annandale*, "in jungle"); 14·viii·19 (*Annandale*, "flying low over bare ground, 10 a.m."); 25·viii·19 (*Annandale*, "common on the shore of the lake and also in waste places"); 27·ix·19 (*Annandale*, "from shore"); 3·x·19 (*Annandale*, "caught in verandah of house"); 4–19·x·19 (*Gravely*); 24·x·19 (*Annandale*, "at light") 8·iv·20 (*Annandale* and *Dover*, "common on shore"); 11–15·xii·19 (*Annandale*).

This is one of the commonest dragonflies on the island at all seasons. It generally flies low over the ground, settling in waste places, and probably for this reason is most abundant on the shores of the island. Dr. Annandale tells us that it often falls a prey to spiders that build their webs on the ground.

Brachythemis contaminata Fabr.

Lib. contaminata, Ent. Syst. II. p. 382 (1793); Ramb., *Ins. Neur.*, p. 99 (1842); Kirby, *Cat. Odon.*, p. 21 (1890).

Barkuda, many examples, 25·viii·19 (*Annandale*, "at edge of pond on wet day"); 3·ix·19 (*Annandale*); 27·ix·19 (*Annandale*, "on shore"); 4–19·x·19 (*Gravely*, "flying low over edge of lake; female apparently ovipositing").

A common species found mainly on the shore of the island, where it feeds voraciously on Amphipods. It also flies at dusk.

Crocothemis servilia servilia Drury.

Lib. servilia, Ill. Ex. Ent. I, t. 47, f. 6 (1773); Ramb., *Ins. Neur.*, p. 80 (1842); Fabr. (*Lib. ferruginata*), *Spec. Ins.* I, p. 521, n. 11 (1781); Kirby, *Cat. Odon.*, p. 21 (1890).

Barkuda, many examples, viii·19 (*Annandale*, "caught in jungle"); 4–19·x·19 (*Gravely*); 24–28·x·19 (*Annandale*, "at ligth"); 15·xii·19 (*Annandale*); 8·iv·20 (*Annandale* and *Dover*).

A fairly common species. In *Mem. Ind. Mus.* V, p. 180, 1915, Dr. Laidlaw records a male from Barkuda (17·vii·14) which he stated had a deformed wing, and abnormal venation. He hopes to figure it at some future date. The specimen is, we believe, still with him.

Orthetrum pruinosum neglectum Ramb.

Lib. neglectum, Ins. Neur. p. 86 (1842); Selys (*Lib. neglectum*), *Ann. Mus. Genov.* XXVII, p. 463 (1889); Burm. (*Lib. pruinosa*), *Handb. Ent.* II, p. 858, n. 63 (1839); Brauer (*Lib. pruinosa*), *Verh. zool.-bot. Ges. Wien*, XV, p. 1013 (1865); Selys (*Lib. pruinosa*), *loc. cit.* (1889).

Barkuda, 1 example, 9·x·19 (*Annandale*).

This specimen, a male, was the only one ever taken. It was captured in the jungle.

Orthetrum sabina Drury.

Lib. sabina, Ill. Ex. Ent. I, t. 48, f. 4 (1773); Ramb., *Ins. Neur.*, 47 (1842); Kirby (*Orth. sabina*), *Trans. Zool. Soc. Lond.* XII, pp. 261, 263, 301 (1889); Fabr. (*Lib. gibba*), *Ent. Syst. Suppl.*, p. 284 (1798); Schneid. (*Lib. ampullacea*), *Stett. ent. Zeit.* VI, p. 110 (1845); Selys, *Rev. Odon.*, p. 288 (1859); Selys (*Lepthemis sabina* var. *africana*), *Ann. Soc. Ent. Belg.* XXXI, p. 22 (1887).

Barkuda, many examples, viii·19 (*Annandale*, "in jungle"); 3·ix·19 (*Annandale*, "in jungle"); 4–19·x·19 (*Gravely*); 23·x·19 (*Annandale*); 11–15·xii·19 (*Annandale*).

Not an uncommon species in the jungle from August to December, 1919. The species was comparatively rare in 1920.

Trithemis pallidinervis Kirby.

Sympetrum pallidinervis, Trans. Zool. Soc. Lond. XII, p. 327, t. 55, f. 4 (1889); Ris (*Trithemis pallidinervis*), *Cat. Coll. Selys* (1908).

Barkuda, 1 example, viii·19 (*Annandale*, "caught in jungle"). A male specimen.

Neurothemis tullia tullia Drury.

Lib. tullia, Ill. Ex. Ent. II, t. 46, f. 3 (1773); Fabr. (*Lib. equestris*), *Spec. Ins.* I, p. 523, (1781); Burm., *Handb. Ent.* II, p. 855 (1839), Ramb., *Ins. Neur.*, p. 72 (1842.). Fabr. (*Lib. lineata*), *Ent. Syst.* II, p. 375 (1793); Ramb., *loc. cit.*, p. 73 (1842); Kirby, *Cat. Odon.*, p. 8 (1890); Ris, *Cat. Coll. Selys* (1908).

Barkuda, 1 example, 6·ix·19 (*Annandale*, "on jungle path"). A male specimen.

Pantala flavescens Fabr.

Lib. flavescens, Ent. Syst. Suppl., p. 285 (1798); Hagen (*Pantala flavescens*), *Neur. N. Amer.*, p. 141 (1860); *Steit. ent. Zeit.* XXVIII, p. 215 (1867); Beam. (*Lib. viridula*), *Ins. Afr. Amer.*, p. 69, t. 3, f. 4 (1805); Ramb., *Ins. Neur.*, p. 38 (1842); Burm. (*Lib. analis* et *terminalis*), *Handb. Ent.* II, p. 852, nos. 23 et 24 (1839).

Barkuda, many examples, 4–19·x·19 (*Annandale* and *Gravely*); 12·viii·19 (*Annandale*, "caught in jungle"); 6·ix·19 (*Annandale*, "flew into verandah on wet and stormy evening and after rustling round lamp, settled on white wall").

This is one of the commonest dragonflies on Barkuda throughout the hot season and wet weather, disappearing almost entirely by the end of October.

In its season it hovers in clouds over the island at a considerable height, but in September it flies lower. It probably does not breed on the island to any great extent, but females have occasionally been observed ovipositing in the pond. Dr. Annandale has noticed that it hangs on to the twigs of trees and bushes at night, as a rule in considerable numbers on a single bush or tree. The body hangs vertically downwards; the first two pairs of legs are bent upwards close to the head and clasp the twig, while the hind pairs are stretched downwards and backwards before they do so. *Pantala flavescens* was once observed hawking a small butterfly.

Tramea limbata similata Ramb.

Libellula similata, Ins. Neur., p. 36 (1842); Kirby (*Tramea similata*), *Cat. Odon.*, p. 3 (1890); Desj. (*Tramea limbata*), *Rapport Soc. Maurice*, I (1832); *Bull. Soc. Ent. France*, IV, p. 4 (1835); Kirby, *Trans. Zool. Soc. Lond.* XII, p. 318 (1889); *id.*, *Cat. Odon.*, p. 4 (1890).

Barkuda, many examples, 1·ix·19 (*Annandale*, "hovering over jungle and resting on bark of trees"); 17·ix·19 (*Annandale*, "hovering over pond, 9 a.m.; also observed in the evening"); 27·ix·19 (*Annandale*); 11·ix·19 (*Dover*, "taken *in copula* while hovering over pond").

Not an uncommon species on Barkuda.

Tramea basilaris burmeisteri Beauv.

Lib. basilaris, Ins. Afr. Amer., p. 171, t. 2, f. 1 (1805); Ramb., *Ins. Neur.*, p. 35 (1842); Burm. (*Lib. chinensis*), *Handb. Ent.* II, p. 852, n. 27 (1839); Kirby (*Tramea basilaris*), *Trans. Zool. Soc. Lond.* XII, pp. 258 and 268 (1889); *id.*, *Cat. Odon.*, p. 3 (1890); Ris, *Cat. Coll. Selys, Lib.* (1908).

Barkuda, many examples, 27·ix·19 (*Annandale*); 23·x·19 (*Annandale*); 25·x·19 (*Annandale*, "caught in verandah of house") 4-19·x·19 (*Gravely*). Rarer than the preceding form.

Tholymis tillarga Fabr.

Lib. tillarga, Ent. Syst. Suppl., p. 285 (1798); Ramb., *Ins. Neur.*, p. 39 (1842); Kirby, *Cat. Odon.*, p. 1 (1890).

Barkuda, many specimens, 6·ix·19 (*Annandale*, "flew into verandah on wet and stormy evening and after rustling round lamp settled on white wall"); 27·ix·19 (*Annandale*); 9·x·19 (*Annandale*); 4–19·x·19 (*Gravely*, "caught in jungle").

A moderately common species. It frequently flies at and after dusk.

The larvae of this species have been described by Fraser in *Rec. Ind. Mus.* XVI, p. 460, 1919.

Rhyothemis variegata variegata Joh.

Lib. variegata, Amoen. Acad. VI, p. 412 (1764); Linn., *Syst. Nat.* I (2), p. 904 (1767); Ramb., *Ins. Neur.*, p. 44 (1842); Drury (*Lib. arria*), *Ill. Ex. Ent.* II, t. 46, f. 1 (1773); Fabr. (*Lib. indica*), *Spec. Ins.* I, p. 521 (1781); Donov., *Ins. China, Neur.*, f. 2 (1798); *Guer.*, *Icon. R. Anim., Ins.*, t. 60, f. 1 (1829); Fabr. (*Lib. histrio*), *Mant. Ins.* II, p. 237 (1787); Oliv. (*Lib. celestina*), *Enc., Meth.* VII, p. 569 (1792); Kirby (*Rhyothemis variegata*), *Cat. Odon.*, p. 5 (1890); Ris, *Cat. Coll. Selys, Lib.* (1908).

Barkuda, many examples, 20·viii·19 (*Dover*); 31·viii·19 (*Annandale*, "fluttering over jungle"); 6·ix·19 (*Annandale*, "caught in jungle"); 27·ix·19 (*Annandale*); 8·iv·20 (*Annandale* and *Dover*).

A fairly common species at all seasons. The females are usually more abundant than the males. It is generally found flying low in a fluttering manner over jungle and often settles on the ground or on low herbage.

It bears a distinct superficial resemblance to an ant-lion.

Zyxomma petiolatum Ramb.

Ins. Neur., p. 30, t. 2, f. 4*d* (1842); Kirby, *Trans. Zool. Soc. Lond.* XII, pp. 258, 301 (1889). *id.*, *Cat. Odon.*, p. 35 (1890); Ris, *Cat. Coll. Selys, Lib.* (1908).

Barkuda, four specimens, 11·viii·19 (*Annandale*, "a few observed nightly about dusk flying round and round pond a few inches above surface of water"); 6·x·19 (*Dover*, "flying round pond at dusk").

A moderately common species generally found flying round the pond on Barkuda, but stray specimens have also been observed in the day. Only four examples were captured because this dragonfly is a difficult one to catch.

Aethriamanta brevipennis brevipennis Ramb.

Lib. brevipennis, Ins. Neur., p. 114 (1842); Kirby (*Aethriamanta brevipennis*), *Trans. Zool. Soc. Lond.* XII, pp. 262, 283 (1889); *id.*, *Cat. Odon.*, p. 24 (1890); Ris, *Cat. Coll. Selys, Lib.* (1908).

A single male only has been taken on the island.

Macrodiplax cora Brauer.

Diplax cora, Verh. zool.-bot. Ges. Wien. XVIII, pp. 20 (1887) ; Kirby, *Cat. Odon.*, p. 23 (1890); Ris, *Cat. Coll. Selys, Lib.* (1908).

Barkuda, many examples, 25·vii–4·viii·17 (*Annandale*) ; 3–19·x·19 (*Annandale* and *Gravely*, "one specimen caught in verandah of bungalow").

A common species.

Urothemis signata signata Burm.

Lib. signata, Handb. Ent. II, p. 858, n. 60 (1839) ; Ramb., *Ins. Neur.*, p. 112 (1842) ; Kirby (*Urothemis sanguinea*), *Cat. Odon.*, p. 23 (1890); Ris, *Cat. Coll. Selys, Lib.* (1908).

Barkuda, one example, viii·19 (*Annandale*).

This specimen, taken in the jungle, was the only one ever captured.

Family AESCHNIDAE.

Subfamily *AESCHNINAE.*

Anax guttatus Burm.

Aeschna guttatus, Handb. Ent. II, p. 840 (1839); Brauer (*Anax gutattus*), *Reise d. Novara, Neur.*, p. 62 (1866) ; Hagen, *Verh. zool.-bot. Ges. Wien*, XVII, p. 39 (1867) ; Ramb. (*Anax magnus*), *Ins. Neur.*, p. 188 (1842); Brauer, *loc. cit.*, p. 62 (1866).

Barkuda, many examples, 4–19·x·19 (*Gravely*) ; 23·x·19 (*Annandale*, "caught in verandah of bungalow") ; 4·viii·19 (*Annandale*) ; 28·viii·19 (*Hora*, "flying over pond") ; 25·viii·19 (*Annandale*, "drowned in pond after heavy rain; inside eaten out by water beetles").

In Dr. Laidlaw's recent account of this species[1] he places the Barkuda specimens under his "series A," which he believes to be fairly typical examples of the true *A. guttatus* Burm. The length of the abdomen varies from 55 to 58 mm. (Laidlaw gives the length as 15 mm.) of the hindwing from 50 to 51 mm. The venation is rather variable, but the antenodal nervures range only from 15 to 17 and the postnodals from 7 to 9, the hypertrigones being almost constantly traversed by 3 nervures.

With reference to the habits of this species Dr. Annandale has a note in Laidlaw's account, and he also gives us the following note on the colouration of a male specimen. "Head, including eyes, sclerites of thorax, first abdominal segment, anterior triangular area on dorsum of second abdominal segment bright leaf-green with darker reflections on the eyes; mouth parts yellowish-green edged with black ; first abdominal segment and a triangular area on the second also edged with black ; lateral region and posterior part of dorsum of second abdominal segment bright china-blue, also sides of dorsum of third segment ; sides of latter segment shining white ; these markings are most conspicuous in

[1] Laidlaw, *Rec. Ind. Mus.* XXII, p. 82, 1921.

flight; remainder of abdomen purplish-black fading to purplish-brown on the ventral surfaces, with paler markings orange or yellow. Legs black; femora brownish at base. A large yellow patch on hindwing."

Four of the specimens in our collection from the island were hatched in captivity from larvae found in the pond, one being nearly three months in its strange surroundings before this event took place.

Fraser has recently carried out prolonged breeding experiments with this insect and finds that they prey readily on one another in preference to all other food. As larvae were found in great numbers in two tanks, it is probable that this cannibalism goes on freely under natural conditions and must contribute largely to cutting down the numbers of the insect.

Fish also were found to be attacked, the eyes being the invariable point of attack. One fish so attacked and partially eaten was over 2 inches in length. Tadpoles were found to be immune and lived on amicable terms with the larvae. Probably the fish approach the head of larvae to examine them and see if they are good to eat, thus rendering themselves liable to attack.

The larvae only feed at night during which period they are as active as they are sluggish in the day-time. A bowl of larvae approached at night and seen under the rays of a lamp was seen to be in the wildest commotion, the larvae plunging in every direction seeking for cover.

Zygoptera.

Family COENAGRIONIDAE.

Subfamily *COENAGRIONINAE*.

Ceriagrion coromandelianum Fabr.

Agrion coromandelianum, *Ent. Syst.*, p. 287 (1798); Selys, *Bull. Acad. Belg.* (2) XLII, p. 528 (1876); Ramb. (*Agrion cerinum*), *Ins. Neur.*, p. 529 (1842); Laidlaw (*C. coromandelianum*), *Rec. Ind. Mus.* XII, p. 132 (1916); *id.*, *Rec. Ind. Mus.* XVI, p. 190 (1919).

Barkuda, many specimens, viii·19 (*Annandale*, "from pond," "in jungle"); viii·20 (*Dover* and *Ribeiro*, "larvae caught in pond on 16·viii·20, hatched, 18·viii·20").

A common species, endemic on Barkuda.

Enallagma insula Fraser.

Rec. Ind. Mus. XIX, p. 32, ♀ (1920).

Barkuda, one specimen, 5·x·19 (*Annandale*).

A unique specimen.

Agriocnemis pygmaea Ramb.

Agrion. pygmaeum, *Ins. Neur.*, p. 278 (1842); Selys, *Bull. Acad. Belg.* (2), XLIII, p. 142 (1877); Kirby, *Cat. Odon.*, p. 158 (1890).

Barkuda, many specimens, 4·viii·19 (*Annandale*, "among sedge at edge of pond, 6·viii·19; larva from pond on 6·viii·19, hatched in the afternoon on 16·viii·19"); 10–20·viii·19 (*Annandale*. "caught in jungle"); 27·viii·19 (*Annandale*, "larvae from pond"); 4–19·x·19 (*Gravely*); 4·x·19 (*Annandale*, "resting on walls in house").

A common species usually found among grass and shrubs. It breeds on Barkuda in the pond.

Ischnura senegalensis Ramb.

Agrion. senegalense, Ins. Neur., p. 276 (1842); Selys, *Rev. Odon.*, p, 186 (1850); *id.* (*Ischnura senegalensis*), *Bull. Acad. Belg.* (2) XLI. p. 273 (1876); Kirby (*Micronympha senegalensis*), *Cat. Odon.*, p, 141 (1890) Laidlaw (*Ischnura senegalensis*), *Rec. Ind. Mus.* XII, p. 129 (1916).

Barkuda, many examples, 16·viii·19 (*Annandale*, "in jungle")· 4–19·x·19 (*Gravely*); 5·xii·19 (*Annanda'e*); 14·xii·19 (*Gravely*, "at light"); 15·xii·19 (*Annandale*, "from side of lake").

A common species.

Ischnura aurora Brauer.

Agrion aurora et Ischnura aurora, Verh. zool.-bot. Ges. Wien, XV. p. 510 (1865); *Reise d. Novara, Neur.*, p. 56 (1866); Selys (*Ischnura delicata*), *Bull. Acad. Belg.* (2) XLI, p. 281 (1876); Kirby (*Micronympha aurora*), *Cat. Odon.*, p. 143 (1890).

Barkuda, one example,.x·19 (*Annandale*).

Rare.

Rhodischnura nursei Morton.

Ischnura nursei, Trans. Ent. Soc. Lond., 1907, pp. 306–307, pl. xxiv, figs. 4, 5 and 6; Laid. (*Rhodischnura nursei*), *Rec. Ind. Mus.* XVI, p. 177 (1919); (*Ischnura? nursei*) *loc. cit.*, XII, p. 131 (1916); Fras., *loc. cit.*, XIX, p. 31 (1920).

Barkuda, one example, 20·viii·19 (*Annandale*, "among herbage"). This specimen is the interesting andromorph female described by Fraser, which has also given us the most easterly locality yet recorded for the genus. Other localities are Karachi, Dehra Dun, Pusa, Deesa, Agra and Nagpur.

Pseudagrion Microcephalum Ramb.

Agrion microcephalum, Ins. Neur., p. 259 (1842); Selys (*Pseudagrion microcephalum*), *Bull. Acad. Belg.* XLII, p. 504 (1876); Kirby, *Cat. Odon.*, p. 153 (1890); Laid., *Rec. Ind. Mus.* V, p. 178 (1915); *id.*, *loc. cit.* XII, p. 23 (1916), *id.*, *loc. cit.*, XVI, p. 467 (1919).

Barkuda, many examples, 25·vii-4·viii·17 (*Annandale*); 25·viii·19 (*Annandale*, "common on shore of lake"); 4–19·x·19 (*Gravely*, "one pair *in copula*"); 14·viii·20 (*Dover* and *Ribeiro* "rather common on shores of island").

A common species which breeds in abundance in the lake.

Subfamily *LESTINAE*.

Lestes elata Selys.

Bull. Acad. Belg. (2), XIII, p. 319 (1862); Kirby (*Lestes elatus*), *Cat. Odon.*, p. 162 (1890); Laid., *Rec. Ind. Mus.* XIX, p. 153 (1920).

Barkuda, four examples identified by Dr. F. F. Laidlaw, 2·x·19 (*Annandale*).

Probably not uncommon on the mainland, and also breeds on the island. The Indian Museum has an example from Barkul, 1000 feet, Orissa.

Lestes gracilis Selys.

Bull. Acad. Belg. (2), XIII, p. 327 (1862); Laid., *Rec. Ind. Mus.* XIX, p. (1920); Ris (*Lestes gracilis gracilis*), *Sup. Ent.* (1919).

Barkuda, males only, 4·viii·19 (*Annandale*, " among sedges at edge of tank."

We have noticed that specimens from Barkuda show a large amount of black pigmentation on the sides of the thorax. The species is widely distributed, and though we have captured many specimens this form of melanism has never been noticed before.

[In addition to the species recorded above Dr. F. F. Laidlaw has identified the Gomphine *Ictinus rapax* (Ramb.) from Barkuda (1–5 viii·14). A single specimen only was obtained. *N.A.*]

NOTES ON FISHES IN THE INDIAN MUSEUM.

IV. On Fishes belonging to the genus Botia (Cobitidae).

By Sunder Lal Hora, *M.Sc., Assistant Superintendent, Zoological Survey of India.*

The Kashmir Survey Party of the Zoological Survey of India has recently brought back a large series of specimens of the genus *Botia*. The taxonomy of the Indian species assigned to this genus is unsatisfactory and in this note an attempt is made to clear it up. I have also included a key to all the known species of the genus based, in the case of extra-Indian species, on the published descriptions and figures.

Genus **Botia** Gray.

The genus may be described as follows: A genus of Cobitidae consisting of elongate and laterally compressed species often of large size with minute scales on the body, with a bifid spine before and partly below the eye. There are six or eight barbels, in the former case four are situated on the rostrum and are united at their base and two at the corners of the mouth. In the case of those species that possess eight barbels there is an extra pair at the mandibular symphysis. The head is long and pointed. The eyes are provided with a free circular orbital margin. The mouth is small and is surrounded by thick lips. The nostrils are situated close together, the anterior ones are tubular. The origin of the dorsal is distinctly in advance of the ventrals; the anal fin is short and the caudal is deeply forked. The pharyngeal bones are delicate and bear a single series of sharp slender teeth. The air-bladder is of the Cyprinoid type, but the anterior chamber is partially or wholly enclosed in a bony capsule and the posterior chamber, which lies free in the abdominal cavity, is generally reduced.

The genus is closely allied to *Parabotia*[1] and *Leptobotia*[2]; the three genera may be distinguished by the following key:—

A. Suborbital spine bifid ... ... *Botia*.
B. Suborbital spine simple.
- I. Six barbels, two on the upper jaw and four on the mandible; preopercular region not ornamented with a series of small scales ... ... *Parabotia*.
- II. Six barbels, four on the upper jaw and two on the mandible; preopercular region ornamented with a series of small scales ... ... *Leptobotia*.

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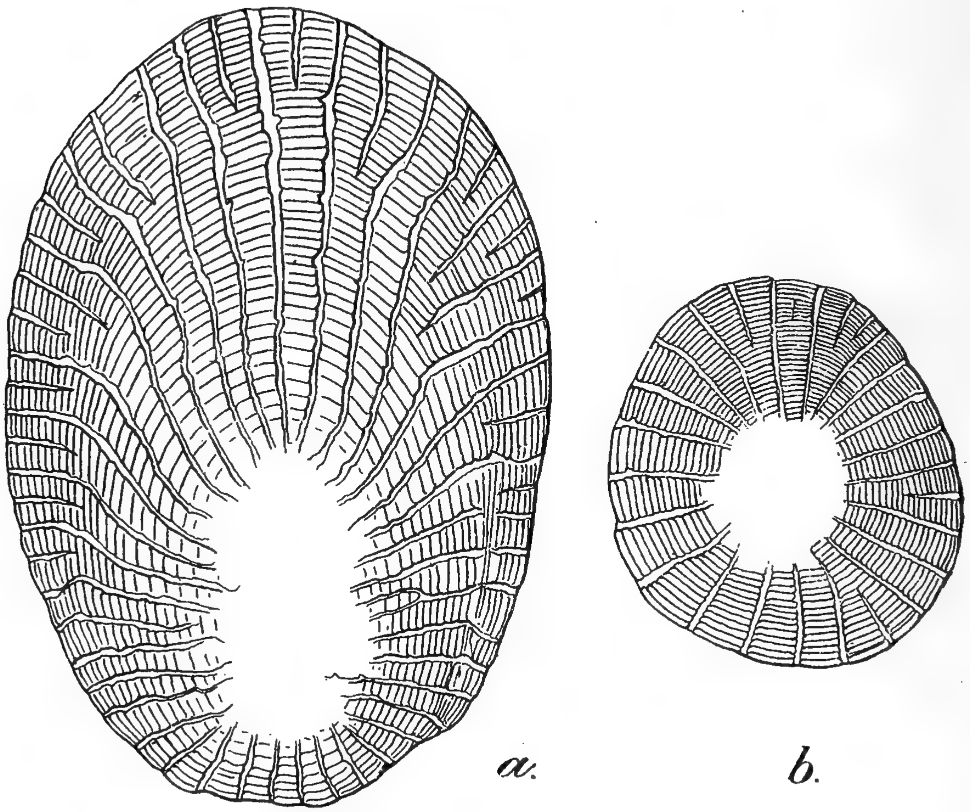
[1] Sauvage and Thiersant, *Ann. Sci. Nat.* (6) I, p. 17 (1874.)
[2] Bleeker, *Versl. Meded. Ak. Wetensch. Amsterdam* (4) IV, p. 254 (1870).

Both the genera *Parabotia* and *Leptobotia* are known from China (Yang-tse-kiang and Mu-tan-kiang) while the genus *Botia* is known from India, Burma, the Indo-Australian Archipelago (Sumatra, Java, Borneo and Singapore), China and Japan.

The fishes of the genus *Botia* may be conveniently divided into two groups according to the number of the barbels, viz. those with six barbels and those with eight barbels. With the



Two types of scale in *Botia*.

a. Scale from dorsal surface of *Botia almorhae*: ×65.
b. Scale from dorsal surface of *Botia hymenophysa*: ×65.

exception of *Botia hymenophysa* known from Burma, Siam and the Indo-Australian Archipelago, all the species from the Indian Empire possess eight barbels. On the other hand all the known species from China and Japan are characterized by six barbels only. In the intermediate regions, Burma, Siam and the Indo-Australian Archipelago, representatives of both the groups are met with. Jordan and Fowler [1] have regarded the two groups as distinct genera and have adopted the name *Hymenophysa* McClelland,[2]

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[1] Jordan and Fowler, *Proc. U.S. Nat. Mus.* XXVI, p. 772 (1903).
[2] McClelland, *Asiatic Researches* p. 443 (1838).

for the species possessing six barbels. I have, however, retained the name *Botia* for both the groups mainly for two reasons, firstly, because in several Cyprinoid genera species are grouped irrespective of the number of barbels and secondly because Günther's two species, *Botia pratti* and *B. superciliaris*, possess "a pair of soft rounded buttons" on the chin; these may or may not be considered as barbels and appear to afford a link between the two primary groups.

I have examined the scales in the various species represented in our collection and find that those of *B. hymenophysa* differ greatly in structure from those of the remaining species. In *B. hymenophysa* they are almost circular with a big central nucleus and a number of radii to all parts of the periphery, whereas in the other species the scale is ellipsoidal with an excentric nucleus and with a large number of long radii to the apex and a few short ones to the base.

Both Günther [1] and Day [2] considered that the anterior division of the bladder in the genus *Botia* is partially enclosed in bony capsule, whilst the posterior division floats free in the abdominal cavity. This is true in all the species that I have examined with the exception of *B. almorhae* in which the anterior chamber is completely enclosed in bone and the posterior, though lying free in the abdominal cavity, is greatly reduced. In other species also the posterior chamber is somewhat reduced.

Botia nebulosa, Blyth,[3] is known from a single specimen from Darjiling, which is now preserved in the collection of the Zoological Survey of India On examination I am unable to refer it to the genus *Botia*. I believe that it belongs to *Nemachilus* and in all probability is the male of *N. botius*. My reasons are as follows:—

(i) I have not been able to find any trace of the suborbital spine in the unique specimen. Day [4] thought that the suborbital spine was damaged, but the groove that is present is not sufficiently deep to justify the view that it ever contained a spine. The groove is of the nature of a shallow slit partly covered superiorly by a fold of skin. I [5] have already remarked in a previous paper that such grooves and folds of skin form the secondary sexual characters of the males of certain species of *Nemachilus*.

(ii) The caudal fin of the specimen is now damaged, but Day, who examined it in a better condition, remarks "caudal slightly rounded." Some years ago Dr. B. L. Chaudhuri had this specimen figured and the manuscript drawing is now with me. It shows the caudal fin as slightly emarginate with both the lobes rounded. In the genus *Botia* the caudal fin is forked and the lobes sharply pointed.

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[1] Günther, *Brit. Mus. Cat. Fish.* VII, p. 366 (1868).
[2] Day, *Journ. As. Soc. Bengal* XLI, part II, p. 176 (1872).
[3] Blyth, *Journ. As. Soc. Bengal* XXIX, p. 165 (1860).
[4] Day, *Proc. Zool. Soc. London*, p. 549 (1869).
[5] Hora, *Rec. Ind. Mus.* (in press).

(iii) The air-bladder consists of two lateral chambers enclosed in a bony capsule. This type of bladder is characteristic of the genus *Nemachilus* and is not to be met with in any species of *Botia*.

(iv) There are six barbels, four rostral and two maxillary, but the rostral barbels are not united at their base as is the case in *Botia*.

(v) The shape of the mouth, the structure of the lips, jaws and of the scales is quite different from any species of the genus *Botia* that I have examined.

The following is an artificial key to all the known species of the genus *Botia* [1]:—

GROUP I. BARBELS SIX (*Hymenophysa*).

I. Eye in middle of head [Commencement of dorsal equidistant from tip of snout and base of caudal] ... ... *B. multifasciata.*
II. Eye not in middle of head.
  A. Eye nearer end of operculum than that of snout or almost wholly in posterior half of head.
    1. Length of head equals depth of body [Suborbital spine extending to below posterior margin of eye; a broad black bar at base of caudal] ... ... *B. modesta.**
    2. Length of head greater than depth of body.
      a. Suborbital spine extending beyond eye in both directions ... ... *B. superciliaris.*
      b. Suborbital spine extending to below middle of eye ... ... *B. hymenophysa.**
  B. Eye nearer end of snout than that of operculum.
    1. Suborbital spine not extending to below hind margin of eye ... ... *B. curta.**
    2. Suborbital spine distinctly extending to below hind margin of eye.
      a. Interorbital space twice as wide as orbit; "ground-colour yellowish, the body ornamented with five black bands" ... ... *B. variegata.*
      b. Interorbital space three to four times as wide as orbit; "ground-colour brownish olive, without distinct markings on the body" ... ... *B. pratti.*

GROUP II. BARBELS EIGHT (*Botia* s.s.).

I. Eye in middle of head ... ... *B. helodes.*
II. Eye not in middle of head.
  A. Length of snout considerably more than that of remaining part of head.
    1. Body marked with two broad bands ... ... *B. macracanthus.**
    2. Body marked "with irregular and partly confluent brown cross bands, which enclose larger and smaller round whitish spots" ... . *B. rostrata.*
  B. Length of snout either equal to or less than that of remaining part of head.
    1. Eye almost in posterior half of head.
      a. Head and body marked with a number of narrow oblique vertical bands ... ... *B. striata.**
      b. Head and body marked with a few broad vertical bands or reticulations.

[1] The species marked with an asterisk are present in the collection of the Zoological Survey of India.

i. Anterior origin of dorsal almost equidistant from tip of snout and base of caudal.
  α. Eye small, its diameter contained 4 to 4·5 times in length of snout ... ... *B. birdi.**
  β. Eye moderately large, its diameter contained 3 times in length of snout ... . *B. dario.**
ii. Anterior origin of dorsal not equidistant from tip of snout and base of caudal ... ... *B. histrionica.**

2. Eye not situated wholly in posterior half of head.
  a. Head and body marked with reticulation. Air-bladder much reduced, anterior chamber wholly enclosed in bone ... ... *B. almorhae.**
  b. Head and body marked with vertical bands. Air-bladder almost normal, anterior chamber partially enclosed in bone.
    i. Caudal marked with 2-3 bands, body marked with loops dorsally and with short vertical bands laterally ... ... *B. lohachata.**
    ii. Caudal marked with two black spots, body marked with 6-7 oblique vertical bands ... ... *B. geto.**

Botia multifasciata Regan.

1905. *Botia multifasciata*, Regan, *Rev. Suisse Zool.* XIII, p. 389, pl. v, fig. 3.

Habitat:—China.

Botia modesta Bleeker.

1864. *Botia modesta*, Bleeker, *Nederl. Tydsch. Diek*, p. 11.
1868. *Botia modesta*, Günther, *Brit. Mus. Cat. Fish.* VII, p. 368.
1870. *Botia modesta*, Bleeker, *Versl. Meded. Ak. Amsterd.* IV, p. 254 (figured).
1876. *Botia modesta*, Sauvage, *Bull. Soc. Philom.* XIII, p. 99.
1876. *Botia rubripinnis*, Sauvage, *Bull. Soc. Philom.* XIII, p. 99.
1881. *Botia modesta*, Sauvage, *Nouv. Arch. Mus. Paris.* (2) IV, p. 192.

Habitat.—Siam. I have examined specimens from Lopburi sent to me by Dr. Malcolm Smith.

Botia superciliaris Günther.

1892. *Botia superciliaris*, Günther, in Pratts' "*Snows of Tibet*", p. 250, pl. iv, fig. B.

I have placed this species in the section comprising forms having six barbels. It possesses, however, according to Günther, "a pair of soft rounded buttons" which are probably remnants of the additional pair.

Habitat.—Kia-tiang-fu (foot of Amieshan), Province Sze Chuen, China.

Botia hymenophysa (Bleeker).

1852. *Cobitis hymenophysa*, Bleeker, *Nat. Tijdschr. Ned. Indië* III, p. 602.
1858. *Hymenophysa MacClellandi*, Bleeker, *Nat. Tijdschr. Ned. Indië* XVI, p. 358.
1860. *Hymenophysa MacClellandi*, Bleeker, *Ichth. Arch. Ind. Prodr.* II., *Cyprini*, p. 63.
1860. *Syncrossus Berdmorei*, Blyth, *Journ. As. Soc. Bengal* XXIX, p. 166.

1863. *Botia hymenophysa*, Bleeker, *Atl. Ichth.* III, p. 6, pl. cii, fig. 3.
1868. *Botia hymenophysa*, Günther, *Brit. Mus. Cat. Fish.* VII, p. 368.
1869. *Botia berdmorei*, Day, *Proc. Zool. Soc. London*, p. 549.
1872. *Botia hymenophysa*, Day, *Journ. As. Soc. Bengal* XLI, part II, p. 178.
1878. *Botia berdmorei*, Day, *Fish. India* II, p. 607, pl. cliv, fig. 3.
1889. *Botia berdmorei*, Day, *Faun. Brit. Ind. Fish.* I, p. 217.
1889. *Botia berdmorei*, Vinciguerra, *Ann. Mus. Nat. Genova* XXIX, p. 345.
1903. *Botia hymenophysa*, Volz, *Zool. Jahrb. Syst.* XIX, p. 406.
1906. *Botia hymenophysa*, Popta, *Notes Leyden Mus.* XXVII, p. 207.
1916. *Botia hymenophysa*, Weber and Beaufort, *Fish. Indo-Austral. Archipelago*, III, p. 24, fig. 6.
1921. *Botia berdmorei*, Hora, *Rec. Ind. Mus* XXII, p. 195.

This species is distributed over a very wide area. It occurs in the Indo-Australian Archipelago, Siam and Burma. Its range extends as far as the Manipur Valley (Assam), whence the waters flow into the Irrawaddi system.

There has been considerable confusion as to the occurrence of this species in Burmese waters. Day in 1872 (*op. cit.*) recorded it from "the northern portions of British and also Upper Burma," but in his later works he referred fishes with the same Burmese names, "*Nga-tha-lay-doh*," and "*Shoay-Zagay*" to *Botia berdmorei* which he considered to be "closely allied to *B. hymenophysa*, Bleeker," but differing "in its dorsal fin, and also in its colours, etc." In his "Monograph of Indian Cyprinidae" he gave the habitat of *B. berdmorei* as "Darjiling and Bengal generally." This is incorrect and it appears to me from the description of the species that the specimens referred to are not *Botia* at all. In the Manipur examples (*op. cit.*, p. 195) I found great variation in the number of oblique bands and also in the general colouration of the body. On the character of the colouration, therefore, I am unable to recognise *B. berdmorei* as distinct from *B. hymenophysa*. In my conclusions I am supported by Vinciguerra (*op. cit.*).

In the Siamese examples that I have examined, sent me from Lopburi by Dr. Malcolm Smith, the position of the anus is somewhat different. It is situated half-way between the base of the anal fin and the posterior origin of the ventral fin. In another example the anus is much nearer to the base of the anal fin than to that of the ventral fin. There are, however, so many points of agreement between the Siamese and the Burmese forms that I do not think myself justified in separating them.

Botia curta (Schlegel).

1850. *Cobitis curta*, Schlegel, *Faun. Japon. Pisces*, p. 223, pl. ciii, fig. 4.
1868. *Botia curta*, Günther, *Brit. Mus. Cat. Fish.* VII, p. 368.
1903. *Hymenophysa curta*, Jordan and Fowler, *Proc. U.S. Nat. Mus.* XXVI, p. 772.

Habitat.—Japan. I have examined a specimen from Yodo river, sent to the Indian Museum by the Otsu Lake Laboratory.

Botia variegata Günther.

1889. *Botia variegata*, Günther, *Ann. Mag. Nat. Hist.* (6) IV, p. 228.
1892. *Botia variegata*, Günther, in Pratt's "*Snows of Tibet,*" p. 249.

Habitat.—Ichang (China).

Botia pratti Günther.

1892. *Botia pratti*, Günther, in Pratt's "*Snows of Tibet,*" p. 250, pl. iv, fig. A.

Habitat.—Kia-tiang-fu (foot of Omie-shan), province of Sze Chuan, China.

Botia helodes Sauvage.

1876. *Botia helodes*, Sauvage, *Bull. Soc. Philom.* XIII, p. 99.
1881. *Botia helodes*, Sauvage, *Nouv. Archiv. Mus. Paris* (2) IV, p. 192.

Habitat.—Siam.

Botia rostrata Günther.

1868. *Botia rostrata*, Günther, *Brit. Mus. Cat. Fish.* VII, p. 367 (head figured).
1872. *Botia rostrata*, Day, *Journ. As. Soc. Bengal* XLI, ii p. 178,

Habitat.—Bengal and Assam.

Botia striata Rao.

1920. *Botia striata*, Rao, *Ann. Mag. Nat. Hist.* (9) VI, p. 60, pl. ii, figs. 4, 4*a*, 4*b*.

Habitat.—River Thunga in Mysore State, South India. The range of the species extends as far as the Satara District in the Bombay Presidency, whence a single specimen, now in our collection, was obtained by Dr. S. P. Agharkar.

Botia birdi Chaudhuri.

1878. *Botia geto*, Day (*nec* Buchanan), *Fish. India* II, p. 606, pl. cliv, fig. 2.
1889. *Botia geto*, Day (*nec* Buchanan), *Faun. Brit. Ind. Fish.* p. 217, fig. 77.
1909. *Botia birdi*, Chaudhuri, *Rec. Ind. Mus.* III, p. 339.

This species exhibits considerable variation in colour with the age of the fish. The dark bands on the body often break up to form an irregular reticulation on the dorsal surface and the sides. Recently a large series of specimens has been obtained from the Kashmir Valley. All forms of colour pattern from regular bands to reticulation are present in this series.

The females contain a large number of minute eggs; in a ripe female the depth of body is considerably greater than the length of the head and the ventral profile is greatly arched.

Habitat.—Sind in the Kashmir Valley and the Punjab.

Botia dario (Ham. Buch.).

1822. *Cobitis dario*, Hamilton Buchanan, *Fish. Ganges*, pp. 354, 394 pl. xxix, fig. 95.
1868. *Botia dario*, Günther (in part), *Brit. Mus. Cat. Fish.* VII, p. 366.
1872. *Botia dario*, Day, *Journ. As. Soc. Bengal*, XLI, part II, p. 177.
1878. *Botia dario*, Day, *Fish. India* II, p. 606, pl. cliv, fig. 1.
1889. *Botia dario*, Day, *Faun Brit. Ind, Fish.* I, p. 216

Habitat.—Upper Bengal and Assan. Hamilton Buchanan found this species in all the districts of Northern Bengal and Bihar that he visited. We have a number of specimens from Cachar.

Botia histrionica Blyth.

1860. *Botia histrionica*, Blyth, *Journ. As. Soc. Bengal* XXIX, p. 166.
1869. *Botia histrionica*, Day, *Proc. Zool. Soc. London*, p. 550.
1872. *Botia histrionica*, Day, *Journ. As. Soc. Bengal* XLI, part II, p. 179.
1878. *Botia histrionica*, Day, *Fish. India* II, p. 607, pl. cliv, fig. 4.
1889. *Botia histrionica*, Day, *Faun. Brit. Ind. Fish.* I, p. 218.
1889. *Botia histrionica*, Vinciguerra, *Ann. Mus. Civ. Nat. Genova*, p. 346.
1921. *Botia histrionica*, Hora, *Rec. Ind. Mus.* XXII, p. 195.

Habitat.—The species was originally described from Pegu, but since then it has been recorded from several other places in Burma such as Bhamo and Mandalay and from the Manipur Valley in Assam.

Botia macracanthus (Bleeker.)

1852. *Cobitis macracanthus*, Bleeker, *Nat. Tijdschr. Ned. Indië* III, p. 603.
1860. *Hymenophysa macracanthus*, Bleeker, *Ichth. Arch. Ind. Prodr.* II, Cyprini, p. 62.
1863. *Botia macracanthus*, Bleeker, *Atl. Ichth.* III, p. 5, pl. cii, fig. 2.
1868. *Botia macracanthus*, Günther, *Brit. Mus. Cat. Fish.* VII, p. 368.
1903. *Botia macracanthus*, Volz, *Zool. Jahrb., Syst.* XIX, p. 405.
1905. *Botia macracanthus*, Fowler, *Proc. Nat. Sci. Philadelphia.* (2) LVII, p. 474.
1916. *Botia macracanthus*, Weber and Beaufort, *Fish. Indo-Austral. Archipelago* III, p. 23, fig. 7.

I have examined a specimen of this species from Sumatra kindly sent me by Prof. Max Weber.

Habitat.—Sumatra and Borneo.

Botia almorhae Gray.

1831. *Botia almorhae*, Gray, *Zool. Misc.* p. 8.
1838. *Botia grandis*, Gray, *Ill. Ind. Zool.*, pl. xciv, fig. 3.
1868. *Botia almorhae*, Günther, *Brit. Mus. Cat. Fish.* VII, p. 367.
1872. *Botia almorhae*, Day, *Journ. As. Soc. Bengal* XLI, part. II, p. 178.
1878. *Botia almorhae*, Day, *Fish. India* II, p. 607, pl. cliv, fig. 5.
1889. *Botia almorhae*, Day, *Faun. Brit. Ind. Fish.* I, p. 217.

This species is known from Almora (United Provinces). McClelland[1] recorded a fish under the name of *Botia* (*Schistura*)

[1] McClelland, *Calcutta Journ. Nat. Hist.* II, p. 586 (1842).

grandis from the Khasi Hills and later on Vinciguerra[1] found *Botia almorhae* in "Meetan" and "Meekalan" (Burma). I think the later records require confirmation.

Botia lohachata Chaudhuri.

1912. *Botia lohachata*, Chaudhuri, *Rec. Ind. Mus.* VII, p. 441, pl. xl, figs. 2, 2*a*, 2*b*.

Habitat.—Gandak River in Saran, Bihar.

Botia geto (Ham. Buch.).

1822. *Cobitis geto*, Hamilton Buchanan, *Fish. Ganges*, pp. 355, 394, pl. xi, figs, 96.

This species is Buchanan's[2] *Gengto* of Goalpara. I collected some specimens at Gorakhpur which correspond in every respect with the figure published by its author. Günther[3] considered it to be the young of *Botia dario* and Day[4] in his earlier works was of the same view. The specimens from Gorakhpur are not in good condition for detailed morphological investigation and I am therefore unable to confirm Günther's statement. The colouration is, however, very distinct and seems to be characteristic of the species.

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[1] Vinciguerra, *Ann. Mus. Nat. Genova* XXIX, p. 344 (1889).
[2] Hunter's *Statistical Account of Bengal* XX, p. 41 (1877).
[3] Günther, *Brit. Mus. Cat. Fish.* VII, p. 366 (1868).
[4] Day, *Journ. As. Soc. Bengal* XLI, part II, p. 177 (1872).

NEW RECORDS AND SPECIES OF MEMBRACIDAE FROM INDIA.

By W. D. FUNKHOUSER, *University of Kentucky.*

(Plate X.)

Through the courtesy of Professor C. F. Baker of Los Banos, P.I., I have had the privilege of examining a most interesting series of Membracidae belonging to the Zoological Survey of India.

This collection contains five new species and furnishes a number of very valuable records. The report on these insects follows:—

Tricentrus pronus Distant.

One female from Tura, Garo Hills, Assam, 1400 ft., October 1917 (*Mrs. Kemp*).

Tricentrus projectus Distant.

One female from Calcutta, Tollyganj, Nov. 11, 1916 (*F. H. Gravely*).

Tricentrus resectus Distant.

A pair, each specimen labelled "Hills near Taiping, Perak, Dec. 26–30, 1915." The male is very slightly smaller than the female.

Tricentrus brevis Funkhouser.

One male from Barkuda I., Chilka Lake, Ganjam Dist., Madras Pres., Aug. 3–19, 1919 (*F. H. Gravely*).

Tricentrus albomaculatus Distant.

One male from Tura, Garo Hills, Assam, 1200–1500 ft., July 1917 (*S. Kemp*).

Tricentrus allabens Distant.

Two specimens, both females, one from Darjiling, 7000 ft., E. Himalayas, June 4, 1917 (*E. Brunetti*); the other from hills near Taiping, Perak, Dec. 26–30, 1915 (*N. Annandale*).

Acanthucus minutispinus, sp. nov.

(Pl. X, fig. 1).

Black with golden pubescence; tegmina smoky; legs ferruginous; suprahumeral horns long, sharp, triquerate; median spine very small, triangular, arising on dorsal line just back of suprahumerals; posterior process nearly straight, slightly upturned at tip, reaching just beyond internal angles of tegmina.

Technical description :—

Head about as long as wide, black, densely pubescent with long golden hairs, roughly sculptured; base arched and sinuate; eyes large, prominent, gray mottled with brown; ocelli small, amber-coloured, not conspicuous, about equidistant from each other and from the eyes and situated above an imaginary line drawn through centres of eyes; clypeus longer than broad, black, densely pilose, extending for about half its length below inferior margins of genae; margins of genae nearly straight, slightly turned outward at edges.

Pronotum black, finely punctate densely pubescent; metopidium vertical, as broad as high; humeral angles prominent, triangular, extending outward farther than the eyes; median carina strongly percurrent; suprahumeral horns as long as the distance between their bases, flattened dorso-ventrally, extending outward and upward and curving slightly backward, undersurface bearing central carina, tips sharp; central spine very small, triangular, entirely black, pubescent, situated on median dorsal line just behind bases of suprahumerals; scutellum only slightly exposed; posterior process slender, thicker through the middle than at the base, tricarinate, tip sharp and slightly upraised, extending just beyond internal angles of tegmina.

Tegmina long, narrow, smoky-hyaline, tinged with ferruginous; base narrowly opaque and punctate; veins prominent, marked with brown; basal costal margin pilose; five apical and two discoidal areas. Hind wings with four apical areas.

Undersurface of body black and strongly pubescent. Legs uniformly ferruginous.

Length from front of head to tips of tegmina 7·5 mm.; width between extremities of suprahumeral horns 3·5 mm.

Type.—Female. In collection of Zoological Survey of India.

Locality.—Sureil, Darjiling Dist., E. Himalayas, Oct. 11–31, 1917 (*N. Annandale* and *F. H. Gravely*).

Gargara pulchripennis Stal.

One female from Mujang, Sarawak, July 12, 1910 (*C. Beebe*).

Gargara nigrofasciata Stal.

One female from Talewadi, near Castle Rock, N. Kanara Dist., Bombay Pres., Oct. 3–10, 1916 (*S. Kemp*).

Gargara nitidipennis Funkhouser.

One male from Mujang, Sarawak, July 12, 1910 (*C. Beebe*).

Gargara majuscula Distant.

One female from Pashok, alt. 3500 ft., Darjiling Dist., E. Himalayas, June, 1916 (*L. C. Hartless*).

Gargara tumida Melichar.

One female from Pashok, alt. 2500 ft., Darjiling Dist., E. Himalayas, May 26, 1914 (*F. H. Gravely*).

Centrotypus asmodeus Distant.

One female from Kapit, Sarawak, Aug. 9, 1910 (*C. Beebe*).

Centrotypus parvus, sp. nov.

(Pl. X, fig. 2).

Small, slender, black, pubescent; suprahumerals slender-sharp, projecting upward and outward, as long as the distance between their bases; scutellum entirely concealed; posterior process long, slender, decurved, extending beyond internal angles of tegmina and just about reaching end of abdomen; tegmina ferruginous-hyaline; undersurface of body black; legs uniformly ferruginous.

Technical description :—

Head subquadrate, wider than long, black, impunctate, finely pubescent with short silvery hairs; base arcuate and sinuate; eyes large, prominent, dark brown; ocelli small, conspicuous, white, shining, equidistant from each other and from the eyes and situated about on a line drawn through centres of eyes; inferior margins of genae feebly sinuate; clypeus longer than wide, black, pilose, projecting for more than half its length below margins of genae, tip pointed.

Pronotum black, finely punctate, closely pubescent with short silvery hairs; gibbous above head; median carina percurrent; dorsum nearly straight; humeral angles small, triangular, sharp, inconspicuous; suprahumeral horns slender, sharp, extending outward and upward with tips bent slightly backward, as long as the distance between their bases; metopidium convex, broader than high, nearly vertical above the head, a smooth semicircular depression over each eye; scutellum entirely concealed; posterior process long , slender, tricarinate, nearly straight, tip slightly depressed, extending beyond internal angles of tegmina and just about reaching tip of abdomen.

Tegmina long, narrow, smoky-hyaline, tinged with ferruginous; base black, punctate, coriaceous and opaque; veins prominent, costal veins black, others brown; five apical and two discoidal cells.

Undersurface of body black and densely pubescent. Legs entirely and uniformly ferruginous.

Length from front of head to tips of tegmina 5 mm.; width between tips of suprahumeral horns 2·3 mm.

Type.—Male. The type-specimen bears Professor Baker's duplicate number 16912.

Locality.—Hills near Taiping, Perak, Dec. 26–30, 1915 (*N. Annandale*).

Leptocentrus decipiens Kirby.

One female from Calcutta, the label bearing the data "Tollyganj, April 9, 1917 (*F. H. Gravely*)."

Leptocentrus leucaspis Walker.

One male from hills near Taiping, Perak, Dec. 26–30, 1915 (*N. Annandale*), and one female from Rawalpindi, Punjab, June–July, 1917 (*R. Hodgart*).

Leptocentrus mephistopheles Buckton.

One female from Garo Hills above Tura, Assam, alt. 3500–3900 ft., Sept., 1917 (*Mrs. Kemp*).

I am very suspicious that Buckton's species is merely a colour variety of *L. leucaspis* Walker.

Leptocentrus longispinus Distant.

One female from Mormugao, Portuguese India, Sept., 1916 (*S. Kemp*).

Leptocentrus obortus Distant.

Four specimens, a male from Phagu, alt. 9000 ft., Simla Hills, May 18–21, 1916 (*N. Annandale* and *S. Kemp*); two females from Tura, Garo Hills, Assam, Oct. 1917 (*Mrs. Kemp*); and a female from Barkuda I., Chilka Lake, Ganjam Dist., Madras Pres., Sept. 20, 1919 (*E. Brunetti*).

Ebhul maculipennis, sp. nov.

(Pl. X, fig. 3).

Near *E. carinatus* Funkh., but larger, with differently shaped metopidium and differently marked tegmina.

Large, dark brown, not punctured, sparingly pubescent; base of metopidium flaring forwards over the head; pronotum high and subarcuate; posterior process long, sinuate, sharp, reaching just to internal angles of tegmina; tegmina opaque, richly marked with yellow and dark brown; trochanters, femora and bases of tibiae dark brown, rest of legs yellow. A beautiful, distinct and well-marked species.

Technical description:—

Head subtriangular, longer than wide, roughly sculptured, dark brown, not punctate, densely pubescent with short silvery hairs; base arcuate and nodose, partly hidden under overhanging margin of pronotum; eyes small, gray mottled with brown; ocelli very small, opalescent, inconspicuous, twice as far from each other as from the eyes and situated well above a line drawn through centres of eyes; inferior margins of genae sinuate; clypeus twice as long as wide, brown, densely pubescent, extending for two-thirds its length below margins of genae, tip broadly rounded.

Pronotum dark brown, roughly sculptured, not punctate, sparingly pubescent with short silvery hairs, elevated and gibbous over humeral angles, no indications of lateral carinae; metopidium wider than high, roughly sculptured, depressed at base, lower anterior margin projecting forward over the head, upper margin keel-shaped; median carina strongly percurrent; humeral angles large, triangular, blunt, projecting outward beyond the eyes as far as twice the width of the eyes; scutellum well exposed, longer than wide, apex bifurcate; posterior process long, slender, sinuate, dark brown at both ends and yellow in the middle, tip sharp and reaching just to internal angles of tegmina.

Tegmina short, broad, opaque, basal half bright yellow, apical half dark brown, the two colours meeting along an irregular diagonal line extending from the scutellum backwards and downwards; five apical and two discoidal cells; veins not prominent.

Undersurface of body dark brown, densely pubescent; trochanters, femora and bases of tibiae dark brown, apical two-thirds of tibiae and all of tarsi and claws bright yellow.

Length from front of head to tips of tegmina 6 mm.: width between extremities of humeral angles 2·7 mm.

Type.—Female. In collection of Zoological Survey of India.

Locality.—Pashok, alt. 2000 ft., Darjiling Dist., E. Himalayas, May 16–June 14, 1916 (*F. H. Gravely*).

Otinotus oneratus Walker.

One male from Coorg, S. India (*F. Hannyngton*).

Antialcidas attenuatus, sp. nov.

(Pl. X, fig. 4).

Small, slender, brown, shining, punctate, pubescent; suprahumerals large, triangular, sharp; posterior process extended upward in a plate before apex; tegmina shining smoky-hyaline marked with brown; undersurface of body dark brown; legs ferruginous.

Technical description:—

Head subquadrate, longer than wide, dark brown, densely pubescent with golden hairs, a white sericeous streak of longer white hairs down median line and another at right angles to it across genae; base arcuate and sinuate; eyes large, prominent, brown; ocelli large, prominent, glassy, elevated, twice as far from each other as from the eyes and situated well above an imaginary line drawn through centres of eyes; inferior margins of genae rounded; clypeus longer than wide, extending for two-thirds its length below inferior margins of genae, a broad white sericeous streak down median line tip rounded and pilose.

Pronotum bright golden brown, finely punctate, densely pubescent with short golden hairs, a white sericeous streak extending upwards from the head on each side the median line between the horns as far as the posterior process, another fainter streak on each side passing under the horns; metopidium broader than high, almost vertical above the head, convex, a smooth depressed spot over each eye; median carina percurrent; humeral angles large, triangular, sharp, extending outward as far beyond the eyes as the width of the eye; suprahumeral horns large, heavy, triquerate, sharp, extending outward and upward, about as long as their width at base but not as long as the distance between their bases, upper surface flat and white sericeous; posterior process elevated at base in subtriangular crest extending upward about as high as suprahumeral horns, tip suddenly short, sharp, upturned, just reaching internal angles of tegmina.

Tegmina smoky-hyaline, shining, marked with brown at tips and just before internal angles; base broadly opaque, coriaceous, punctate and pubescent; five apical and two discoidal cells; interior apical veins strongly bent upwards.

Undersurface of body very dark brown, almost black, pubescent with silvery hairs; legs uniformly ferruginous.

Length from front of head to tips of tegmina 4·6 mm.; width between extremities of suprahumeral horns 2·2 mm.

Type.—Female. In collection of Zoological Survey of India.

Locality.—Sureil, 5000 ft., Darjiling Dist., E. Himalayas, Oct. 11–31, 1917 (*N. Annandale* and *F. H. Gravely*).

Dograna suffulta Distant.

One female from Castle Rock, N. Kanara Dist., Bombay Pres., Oct. 11–26, 1916 (*S. Kemp*).

Emphusis malleus Walker.

One male from Castle Rock, N. Kanara Dist., Bombay Pres., Oct. 11–26, 1916 (*S. Kemp*).

Machaerotypus brunneus, sp. nov.

(Pl. X, fig. 5).

Large, entirely brown, coarsely punctate, densely pubescent; pronotum much swollen and elevated above the head; scutellum entirely exposed; humeral angles prominent; no suprahumerals; posterior process short, sinuate, sharp, arising high above the scutellum; tegmina smoky-hyaline; legs and undersurface of body brown.

Technical description :—

Head twice as wide as high, reddish-brown, nearly flat, coarsely punctate with black punctures, sparingly pubescent with long silvery hairs; base gradually arcuate; eyes large, prominent, brown; ocelli large, conspicuous, opaque white, equidistant from each other and from the eyes and situated about on a line drawn through centres of eyes; inferior margins of genae rounded; clypeus longer than wide, depressed, projecting for more than half its length below inferior margins of genae, very densely pilose, tip rounded.

Pronotum brown, coarsely punctate, densely pubescent, highly elevated above head, swollen subglobose; median carina nearly obsolete; metopidium higher than wide, a smooth irregular depression above each eye, convex in front, tectiform above as seen from the front; humeral angles large, prominent triangular, extending outward farther than the eyes; no suprahumerals; scutellum entirely exposed, wider than long, coarsely punctate, densely pubescent, apical margin weakly notched; posterior process short, sinuate, sharp, arising from highest point of pronotum well above the scutellum, not reaching internal angles of tegmina.

Tegmina long, narrow, ferruginous-hyaline, sparingly pilose both on veins and between veins; apex clouded; base narrowly opaque, coriaceous, dark brown, punctate; veins heavy, prominent, brown; five apical and two discoidal cells.

Undersurface of body dark brown and pubescent; legs light brown, the trochanters and femora marked with dark brown and ferruginous, the tibiae lighter brown and the tarsi and claws darker.

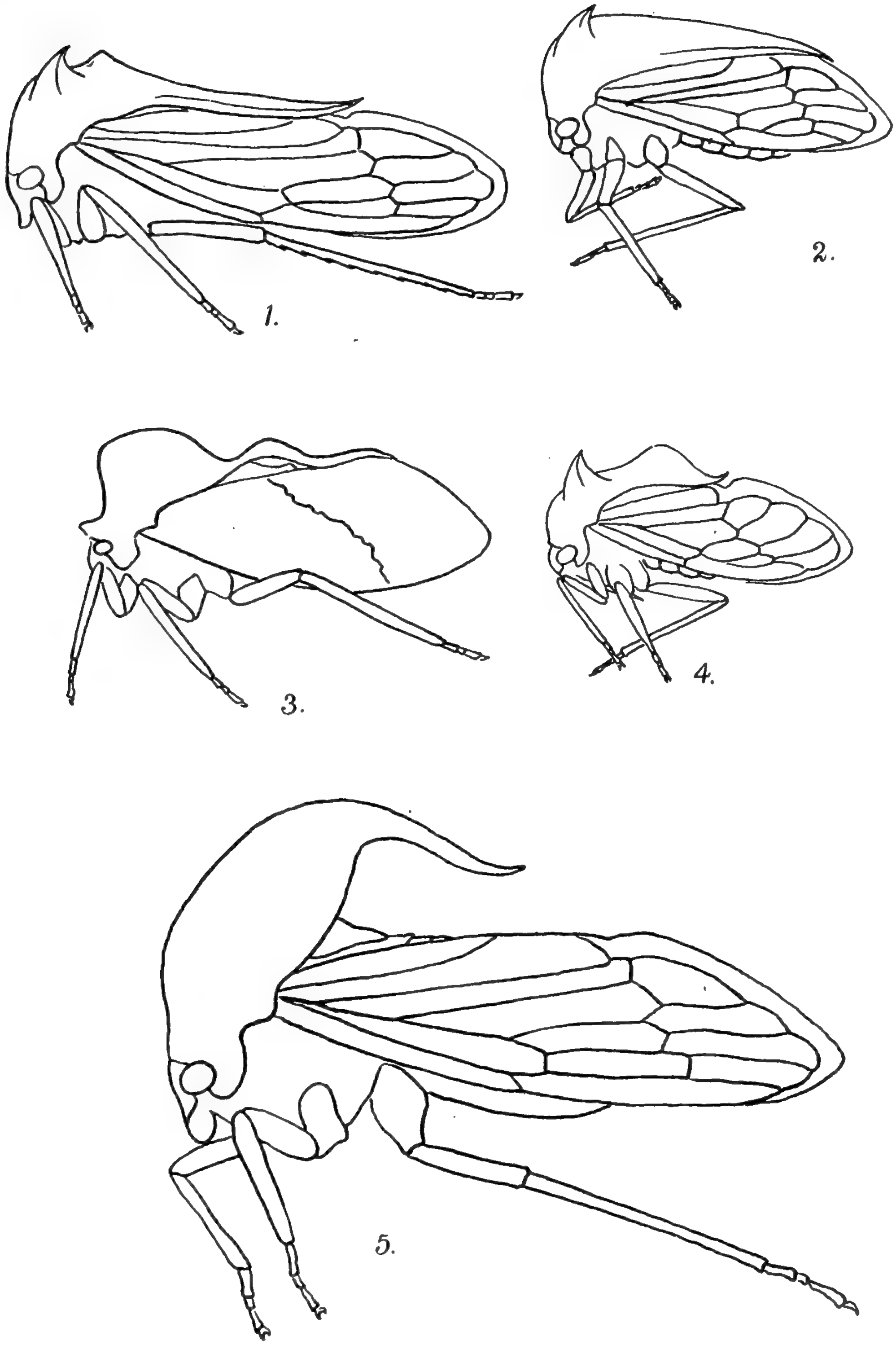
Length from front of head to tips of tegmina 10 mm.; width between extremities of humeral angles 4 mm.; height of pronotum above head 4 mm.

Type.—Female. In collection of Zoological Survey of India.

Locality.—Mungpoo, alt. *ca.* 3000 ft., Darjiling Dist., E. Himalayas, Oct. 11–31, 1917 (*N. Annandale* and *F. H. Gravely*).

EXPLANATION OF PLATE X.

FIG. 1.—Lateral outline *Acanthucus minutispinus*, sp. nov.
,, 2.—Lateral outline *Centrotypus parvus*, sp. nov.
,, 3.—Lateral outline *Ebhul maculipennis*, sp. nov.
,, 4.—Lateral outline *Antialcidas attenuatus*, sp. nov.
,, 5.—Lateral outline *Machaerotypus brunneus*, sp. nov.



INDIAN MEMBRACIDAE.

FIVE NEW SPECIES OF THE RHYNCHOTAN GENUS *CORIXA*.

By the late C. A. PAIVA *and* CEDRIC DOVER.

When Mr. W. L. Distant's third volume on the Rhynchota in the "Fauna of British India" series was published in 1906, the widely distributed *Corixa hieroglyphica* was the only species of the genus then known from India. In 1910 Distant[1] described seven more species and Paiva[2] recently added another two to the fauna of British India, thus making a total of ten species in all. The present note adds five more species to the list, and many more species will no doubt eventually be described.

This paper has been compiled from notes left by the late Mr. Paiva.[3] My own share in its production has been mainly to check Mr. Paiva's rough descriptions, give his species names, and compare them with the other known species of the genus. As at the close of this work I had obtained a good deal of knowledge of the genus I have ventured to incorporate the description of another species which I believe to be new.

[*C. Dover.*]

Corixa rambhaensis, sp. nov.

Two specimens from an ornamental fountain in the palace of the Raja of Kallikota, Rambha, Ganjam District, Madras (*N. Annandale*, 3·xii·13).

Head stramineous, longer than width at base between eyes, about half the greatest breadth of the pronotum; on each side of the centre of the vertex with a short line of shallow punctures, and a small tubercle on the middle of the hind margin; eyes large, posteriorly overlapping the anterior angles of the pronotum.

Pronotum ochraceous, with six dark castaneous transverse fasciae; about twice as broad as medial length; obtusely angularly rounded, behind lateral angles posteriorly somewhat acutely pointed.

Elytra very pale ochraceous, rather faintly mottled with castaneous; costal margin pale white.

The body beneath and the legs pale ochraceous.

Length 6·15 mm.

This species is closely allied to *C. promontoria* and *C. affinis*,

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[1] *Faun. Brit. Ind. Rhyn.* V, p 340, 1910.

[2] *Rec. Ind. Mus.* XIV, p. 19, 1918.

[3] Dr. Annandale has published a short obituary notice of Mr. Paiva in his *Report on the Zoological Survey India, for the years* 1917-1920 (Calcutta: 1920), which has also been adopted by Mr. T. Bainbrigge-Fletcher, Imperial Entomologist, in his Presidential address to the Fourth Entomological Meeting held at Pusa in February, 1921. (See *Rep. Proc. Fourth Ent. Meeting Pusa,* 1921, p. 4.)

but differs from the former in the less produced head and the absence of any dark markings on the hind tibiae, and from the latter in the more regularly fasciate pronotum and less mottled elytra. Type in the collection of the Zoological Survey of India.

Corixa annandalei, sp. nov.

Two specimens from Satpara, Orissa (*N. Annandale*, 16·ix·13).

Head ochraceous, about as long as width at base between eyes, obscurely centrally carinate, the carina ending posteriorly in an obtuse tubercle at the middle of the hind margin of the head; on each side of the carina a row of four or five shallow punctures; face with a few scattered rather long silky white hairs; a blackish spot at apex of clypeus.

Pronotum ochraceous, with five distinct dark castaneous transverse fasciae, the second one short and not reaching the lateral margins; breadth between humeral angles twice the medial length, posterior margin broadly rounded; anterior and posterior margins narrowly dark castaneous, the ochraceous interspaces somewhat broader than the fasciae.

Elytra ochraceous, rather densely mottled with castaneous, the markings on the clavus linear, and transverse towards the base; costal margins dull white, very sparingly mottled with castaneous a little before apex, a linear castaneous marginal fascia at apex.

Length 7·25 mm. Body beneath and legs ochraceous.

Easily distinguished from all other Indian species of *Corixa* by its large size and the small number of fasciae on the pronotum.

I have much pleasure in associating this species with the name of its collector, Dr. N. Annandale, to whom I am personally indebted for many favours. Type in the collection of the Zoological Survey of India.

Corixa dubia, sp. nov.

A single example from Mazbat, Darrang District, Assam (*S. W. Kemp*, 4·i·11).

Head ochraceous, about as long as width at base between eyes, distinctly acutely tuberculate at middle of posterior margin, a short rather obscure carina on posterior area of vertex, on each side of which is a moderately long line consisting of shallow single punctures; posterior margin narrowly spotted with castaneous; eyes blackish-grey.

Pronotum ochraceous with six transverse blackish fasciae, the second and third broken in the centre, anterior area with a short carina, posterior margin obliquely subacute.

Elytra ochraceous, mottled with castaneous; costal margin much paler, with three fasciate fuscous spots on outer margin, the apical one darkest and most conspicuous.

Body beneath and legs ochraceous, posterior tarsi with two fuscous streaks on upper side.

Length 6 mm.

Closely allied to *C. affinis*, but differing in the nature of the markings on the pronotum. Type in the collection of the Zoological Survey of India.

Corixa ribeiroi, sp. nov.

A single example from Malwa Tal, 3000 ft., Kumaon, W. Himalayas.

Head yellowish-white, shining, the basal margin reddish-brown, distinctly longer than width at base between eyes, wider than pronotum, a few scattered punctures on disk of vertex; eyes black, large, overlapping the anterior angles of the pronotum.

Pronotum twice as broad as medially long, disk with about six castaneous, transverse lines, posterior margin broadly rounded.

Elytra ochraceous, rather thickly mottled with castaneous, on the basal claval area the markings are more or less linear and transverse.

Body beneath and legs ochraceous, posterior tarsi fuscous.

Length 6 mm.

I have named this species after Mr. Sydney Ribeiro, the Entomological Assistant of the Zoological Survey of India, in recognition of the assistance he has rendered me in various ways. Type in the collection of the Zoological Survey of India.

Corixa paivana, Dover, sp. nov.

Several specimens from Kalka, Umballa District, base of W. Himalayas (*N. Annandale*, 16·v·11); Dhurampur Kooa, Patiala State, base of Simla Hills (*R. Hodgart*, 21·vii·17); Satpara, Orissa (*N. Annandale*, 16·ix·13); from an ornamental fountain in the palace of the Raja of Kallikota, Rambha, Ganjam District, Madras. Anwargangi, Cawnpore District, U.P. (*J. Caunter*, 1–13·x·11).

Head pale yellowish, rather paler at base, short, about as long as width at base between eyes, a distinctly raised tubercle at middle of hind margin in front of which is a short blackish fasciate spot; a few shallow punctures on each side of the middle of the vertex, and another line of small punctures within the margin of each eye.

Pronotum olivaceous-brown, unicolorous, minutely punctured; anterior margin slightly sinuate in the middle, lateral margins truncate, its posterior angle acute; posterior margin rounded; a pale, somewhat obscure medial carina on middle of disk.

Elytra olivaceous-brown, thickly but very finely punctured, having a large piceous spot on anterior area of clavus; the subcostal area dull ochraceous, the outer margins fuscous or black.

The body beneath and legs rather pale ochraceous.

Length 7–7·5 mm.

A distinct species. I have named it after the late Mr. C. A. Paiva as a slight recognition of his services to entomology. Type in the collection of the Zoological Survey of India.

ON SOME INDIAN DERBIDAE (HOMOPTERA).

By F. MUIR, *Hawaiian Sugar Planters' Experiment Station, Honolulu, T.H.*

I have recently received for study a small collection of Indian fulgorids belonging to the Zoological Survey of India. The present paper deals with the Derbidae.

This is an interesting family of mostly small and delicate insects found in forest lands. The eggs are at present unknown. The young live under bark and in rotten wood; what their food is is not at present known. There are over ninety genera and nearly five hundred species described. The species generally have a limited geographical distribution, especially the island forms, but this cannot always be recognized unless the genitalia be examined, as the species are often difficult to recognize by any other character.

The types have been returned to the Indian Museum, cotypes have been retained by the describer. Measurements are from apex of head to anus and from base to apex of one tegmen.

DERBINAE.

CENCHREINI.

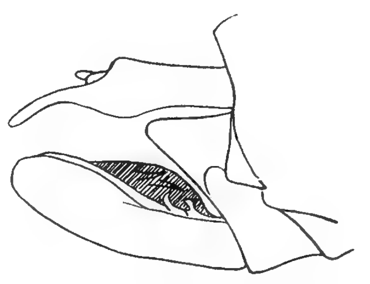
Herpis turae, sp. nov.

(Fig. 1.)

Male. Length 3 mm.; tegmen 5 mm.

Length of vertex equal to width at base, apex narrower than base, lateral margins thick and granulate, base angularly emarginate. Face fairly narrow. Subantennal process distinct but not very large.

Pygofer produced angularly below anal segment. Anal segment large; anus slightly distad of middle, in dorsal view slightly narrowed beyond anus to the truncate apex. Genital styles large, long, comparatively narrow, margins subparallel, apex rounded, inner margin slightly sinuate, outer margin with a narrow border turned inward, two small processes near base, one pointed and curved, the other smaller with truncate apex.



TEXT-FIG. 1.—Lateral view of male genitalia of *Herpis turae*, sp. nov.

Head, thorax, legs and genitalia light brown, abdomen reddish.

Tegmina stramineous, veins yellowish, all the apical cells slightly fuscous. Wings slightly fuscous with brown veins.

Female. Length 4·4 mm.; tegmen 5·4 mm. The subantennal process is larger than in the male. In colouration similar to male. Pregenital plate longer than broad, hind margin evenly produced from the side to middle, the apex of the production rounded, the produced portion forming more than half the length of the plate.

Described from one male and one female from above Tura, Garo Hills, Assam, 3500 to 3900 ft., July, 1917 (*S. Kemp*); and one female from Shillong, Khasi Hills, Assam, elevation 5500 to 6400 ft., August, 1915 (*S. Kemp*).

I have not seen the type-species of *Vekunta* Dist., but the figures of it show the subcostal cells short and there is no subantennal process. The present species of *Herpis* differs from such species as *Herpis vulgaris* in having the vertex much longer and the lateral margins broad and granulate, as in *Vekunta*. Its division into two subgenera may be convenient.

Vekunta flavipes, sp. nov.

Female. Length 3·6 mm.: tegmen 5·4 mm.

Subantennal process forming a very small flange below the antennae. Pregenital plate very short at sides, the middle half produced into a large process, the sides at first gradually curved then nearly straight with the apex rounded. Anal segment slightly longer than broad, anus near base, apex subtruncate. Genital styles fairly large, projecting beyond process of pregenital plate.

Very dark brown or black; as antennae, face and clypeus light brown, legs yellow, hind margin of abdominal sternites yellow. Tegmina dark brown or nearly black, yellowish along costal margin, a small yellow spot at stigma.

Described from one female from Tura, Garo Hills, Assam, 3500 to 3900 feet elevation (*S. Kemp*, August, 1917).

OTIOCERINI.

Lyricen vagans, sp. nov.

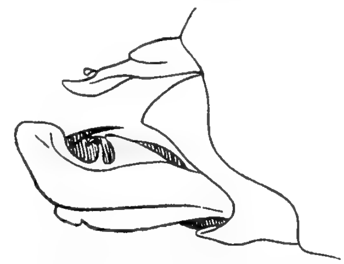
(Fig. 2.)

Male. Length 3 mm.; tegmen 5 mm.

The vertex and face slightly wider than in the type-species and the cubitus forks slightly lower down, otherwise quite typical.

Light brown, darker over lateral portions of pronotum and mesonotum, face, genae, clypeus and front coxae. Tegmina fuscous with darker markings in middle of clavus, fork of Cu, middle of M and fork of Sc and R; veins darker at base of median sectors and apical cross-veins.

Lateral margins of pygofer widely angularly produced below anal segment; medio-ventral margin angularly produced with a pair of curved spines just within the pygofer (these may pertain to aedeagus). Anal segment short, broad, slightly narrowed at apex which is slightly rounded, anus near apex. Genital styles large, long, curved dorsad on apical third, apex rounded ; outer margin about middle produced into a wide angle, distad of that the margin is roundly excavate with a curved spine arising from the bottom of the emargination, inner margin produced into a small, quadrate process about middle.



Text-fig. 2.—Lateral view of male pygofer of *Lyricen vagans*, sp. nov.

Female. Length 4 mm.; tegmen 7·3 mm.

The hind margins of abdomen red. The tegmina lighter than the males, with the mottling more distinct.

Pregenital plate broader than long, hind margin angularly produced to middle, the sides of the production slightly excavate, apex rounded and slightly lipped, in lateral view flat.

Described from two males and two females from above Tura, Garo Hills, Assam, elevation 3500 to 3900 ft., August, 1917 (*S. Kemp*).

The genus has hitherto been known only from Fiji.

Kamendaka (Eosaccharissa) albipennis, sp. nov.

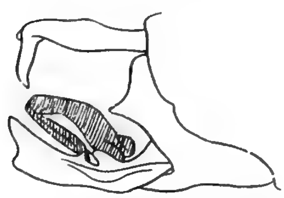
(Fig. 3.)

Male. Length 2 mm.; tegmen 2·7 mm.

In profile the vertex and face meeting at an angle of about 95, face curved, especially the apical half.

Stramineous thickly encrusted with white waxy secretion; a dark fuscous mark on genae in front of eyes continued over pronotum; clypeus and front legs slightly fuscous. Wings thickly encrusted with white waxy secretion, slightly fuscous at apex of media, in the middle of tegmina and at apex of clavus. Wings white with waxy secretion, hyaline with yellow veins.

Ventral margin of pygofer produced into a long, narrow angular process nearly half the length of genital styles. Anal segment long, narrow, apical third turned ventrad at right angle to base, anus at base of the apical third, apex narrow with a small emargination making it minutely furcate. Genital styles long, narrow, apex obliquely truncate and slightly emarginate, outer margin slightly produced just basad of middle with a small curved spine distad of the produced part; inner margin slightly sinuous.



Text-fig. 3.—Lateral view of male genitalia of *Kamendaka* (*Eosaccharissa*) *albipennis*, sp. nov.

Described from one male specimen from Barkuda Island, Chilka Lake, Madras Pres., July, 1916 (*F. H. Gravely*).

The species of the three subgenera that constitute this genus are mostly obscurely coloured and difficult to recognize unless the genitalia be examined. The genitalia of none of the Indian species have been described.

Niceta kanarae, sp. nov.

Female. Length 5 mm.; tegmen 8 mm.

In lateral view head produced in front of eye slightly more than the width of the eye, the width of the head greater than the depth. Antennae cylindrical not reaching to apex of head, a small curved knob at base.

Pregenital plate wider than long, very short at sides, hind margin gradually and angularly produced to middle; the sides of the production slightly sinuous and the apex slightly rounded.

Stramineous; fuscous over genae in front of eyes and over pronotum behind eyes, and over mesonotum. Tegmina hyaline, slightly opaque with waxy secretions fuscous over apical half of clavus, over cubitus from the fork and over median apical cells, a little mark in radial cell at cross-vein and in apical cells, veins yellow. Wings hyaline, veins yellow, slightly opaque with waxy secretion.

Described from one female specimen from Castle Rock, North Kanara District, Bombay Pres., October, 1916 (*S. Kemp*).

Phra amplificata Distant.

Phra, Distant, Muir, *Ent. Mo. Mag.* 1918, p. 242.

One female specimen from Castle Rock, North Kanara District, Bombay Pres., October, 1916 (*S. Kemp*).

I have already remarked upon the type of this insect and the difference in the figures of the head. The present specimen agrees with the type-specimen and is apparently the same species.

Mysidiides fuscinervis, sp. nov.

(Fig. 4.)

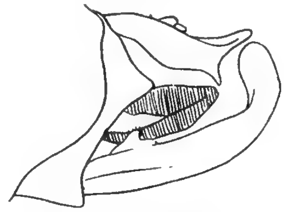
Male. Length 2 mm.; tegmen 5 mm.

Light brown; mesonotum darker. Tegmina hyaline, slightly opaque with waxy secretion, with slight fuscous marking over base and clavus, two or three marks in costal cell, over Cu 1, base of median sectors spreading out into the median cells, over apical cells; the veins darker where the membrane is fuscous. Wings slightly fuscous with brown veins.

Lateral margins of pygofer produced into a broad angle below anal segment. Anal segment comparatively short, broad, lateral margins slightly flattened, produced into a small thin process before apex; anus about middle, broadest distad of anus, apex broad, slightly emarginate in middle making it broadly and slightly bilobed. Genital styles long, narrow, curved on apical third, a small projection on outer margin near base.

Female. Lengh 2·9 mm.; tegmen ·6 mm.

In colour similar to male. Anal segment small, subtriangular, anus at base; pregenital plate wider than long, posterior margin widely angularly produced from sides to middle, the sides of the production slightly excavate; in lateral view straight, hind margin not turned ventrad.



Text-fig. 4.—Lateral view of male genitalia of *Mysidiides fuscinervis*, sp. nov.

Described from a male and female (types), from Talewadi, near Castle Rock, North Kanara District, Bombay Pres., October, 1916 (*S. Kemp*); and two males and two females from Castle Rock, October, 1916 (*S. Kemp*).

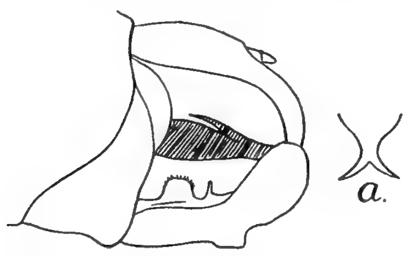
Mysidiides furcata, sp. nov.

(Fig. 5.)

Male. Length 1·8 mm.; tegmen 5 mm.

Dark brown; lighter over middle of mesonotum, legs, lateral portions of pronotum and genital styles. Tegmina hyaline, slightly opaque with waxy secretion, veins yellow except Cu 1, fork of Cu and first (basal) median section, radial cross veins and base of second median sector and apical cross-veins which are fuscous, the fuscous spreading out into the membrane, fuscous at apex of subcostal cell and over apical cells.

Lateral margins of pygofer rounded, not angularly produced. Anal segment large, in lateral view curved ventrad, anus about middle, in dorsal view gradually narrowing to near apex where it is produced into a furcate apex. Genital styles large, apical half curved dorsad, apex rounded, outer margin with two processes near base, the basal one subquadrate and broader than long, the distal one small and thin, inner margin with a subquadrate projection about middle.



Text-fig. 5.—Lateral view of male genitalia of *Mysidiides furcata*, sp. nov. *a*. Apex of anal segment.

Female. Length 2·7 mm.; tegmen 6 mm.

In colouration similar to male. In lateral view the pregenital plate concave, the posterior margin slightly and angularly produced in middle and turned ventrad, a minute emargination in the middle.

Described from one male and two females from Castle Rock, North Kanara District, October, 1916 (*S. Kemp*).

Mysidioides, sp.

One female specimen from above Tura, Garo Hills, Assam, August, 1917 (*S. Kemp*), in colouration similar to *M. furcata*, but having the pregenital plate flat and not turned ventrally at apex. In the absence of the male I refrain from naming it.

DERBINI.

Zeugma fuscinervis, sp. nov.

Female. Length 5 mm.; tegmen 11 mm.

Characteristic of the genus; face fairly narrow.

Head and pronotum light brown, darker over vertex and down the middle of face and clypeus and in the middle of pronotum; mesonotum and tegulae dark brown or black, lateral carinae lighter; abdomen dark brown; legs lighter brown. Tegmina hyaline slightly yellowish, slightly fuscous over apical and hind areas, veins dark spreading into membrane, a small dark spot at base of cubitus, another in radial cell and one at fork of cubitus. Wings hyaline, slightly fuscous, veins brown.

Pregenital plate large, in lateral view well rounded, middle third of posterior margin produced into a plate broadly conical in outline, a keel runs from apex to a little beyond the base of produced portion. Anal segment short, ventral edge produced beyond apex with a small patch of short stout hairs at each angle of apex.

Described from one female from above Tura, Garo Hills, Assam, 3500 to 3900 ft., July, 1917 (*S. Kemp*).

RHOTANINI.

Sumangala delicatula Distant.

One male specimen from Castle Rock, North Kanara District, October, 1916 (*S. Kemp*).

The figure of this species has no cross-vein between the media and cubitus (really the base of first or basal median sector) otherwise this specimen agrees with the figure and description.

Levu iridipennis ? Melichar.

Rhotana iridipennis, Melichar, *Hom. Faun. Ceylon*, p. 62.

One male specimen from above Tura, Garo Hills, Assam, 3500 to 3900 ft., August, 1917 (*S. Kemp*). The specimen is not in very good condition, but it appears to agree with the original description.

ZORAIDINAE.

ZORAIDINI.

Pamendanga pallata (Distant).

(Fig. 6.)

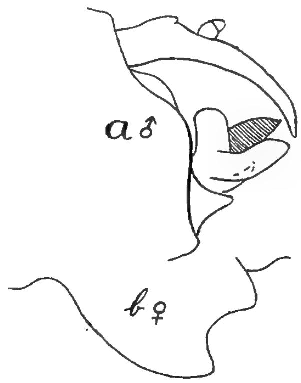
Phenice pallata, Distant, *Ann. Mag. Nat. Hist.* (8) VIII, p. 639 (1911); *Faun. Brit. Ind. Rhynchota* VI, appendix, p. 64 (1916).

Two males and four females from above Tura, Garo Hills, Assam, 3500 to 3900 ft., August, 1917 (*S. Kemp*).

This was originally described from a female from Kumaon, W. Himalyas.

The male is coloured similarly to the female. The male pygofer is sunk within the preceding segment, ventral margin slightly and roundly produced. Anal segment large, anus before middle, evenly curved ventrad, in dorsal view widest at base, gradually and slightly narrowed to the rounded apex. Genital styles small, short, slightly curved, apex rounded, at base on outer margin produced into a large, quadrate process, on inner margin into a stout pointed process.

In outline the pregenital segment in female roundly produced somewhat like a Phrygian cap.



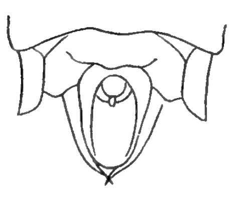
TEXT-FIG. 6.—*Pamendanga pallata* (Distant).
a. Lateral view of male genitalia.
b. Lateral view of female pregenital plate.

Zoraida brunnipennis, sp. nov.

(Fig. 7.)

Female. Length 5·3 mm.; tegmen 14 mm.; wing 6 mm.

Antennae longer than face, cylindrical. Four cubital veins reaching hind margin; radial cell not very narrow, slightly widened distad of second median sector. Pregenital plate large, in lateral view concave, hind margin roundly produced and with a small cleft in the middle. Anal segment large, reaching to apex of styles, broadest at base, slightly narrowing to the rounded apex, anus at base.



TEXT-FIG. 7.—Dorsal view of female genitalia of *Zoraida brunnipennis*, sp. nov.

Brown; tegmina and wings hyaline, uniformly brown with brown veins.

Described from one female from Tura, Garo Hills, Assam, 1200 to 1500 ft., July, 1917 (*S. Kemp*).

Zoraida (Peggiopsis) kempi, sp. nov.

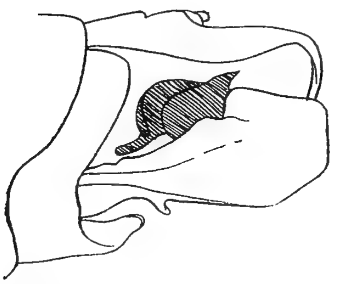
(Fig. 8.)

Male. Length 3 mm.; tegmen 8 mm.; wing 3·8 mm.

Antennae slightly longer than face, flat, broad. Radial cell not very narrow, slightly widened beyond cross-vein.

Stramineous inclined to salmon, more so over antennae and abdomen Tegmina hyaline, slightly fuscous; costal, subcostal and radial cells fuscous; veins brown, apices of apical veins light.

Medio-ventral process of pygofer longer than broad, apex truncate, slightly narrower than base. Anal segment large, anus before middle, in dorsal view narrrow at base, slightly widened beyond anus then narrowed to the acute apex, the apical third turned ventrad. Genital styles large, narrow at base, considerably widened on apical half, apex truncate; outer margin considerably produced beyond middle. Aedeagus complex, not dissected out.



TEXT-FIG. 8.—Lateral view of male pygofer of *Zoraida* (*Peggiopsis*) *kempi*, sp. nov.

Described from two males from Mormugao, Portuguese India, September, 1916 (*S. Kemp*).

NEW INDIAN HOMOPTERA.

By F. Muir, *Hawaiian Sugar Planters' Experiment Station, Honolulu, T. H.*

The material dealt with in this paper belongs to the Zoological Survey of India. In a former paper the Derbidae were dealt with. This paper deals with the Cixiidae, Delphacidae, and Achilidae.

Sixteen of the twenty-six species recorded are considered as new, which indicates the large amount of work still to be done in these families.

The types have been returned to the Zoological Survey of India, and paratypes placed in the H.S.P.A. Experiment Station collection, Honolulu. Measurements are from apex of vertex to anus and from base to apex of one tegmen.

Family CIXIIDAE.

Cixius gravelyi, sp. nov.

Congeneric with *C. nervosa* but the base of vertex more deeply and angularly emarginate.

Male. Length 3·5 mm.; tegmen 4·7 mm.

Black; lateral carinae of face and vertex and hind margin of pronotum and the legs light brown, basal portion of abdomen yellow, apical portion brown. Tegmina hyaline, base brown, a broad light brown or yellowish band across from middle of clavus to middle of costa; stigma brown; fuscous over apical cells, darker in apical radial cells; cross-veins infuscate; tubercles small, dark, bearing black macrotrichia. Wings hyaline with brown veins.

Lateral margins of pygofer roundly produced beside anal segment, medio-ventral process angular. Anal segment large, longer than wide, anus about one-fourth from apex, apex rounded and turned ventrad. Genital styles long, narrow, apex acute, the middle of the inner margin produced into an angle. Aedeagus large, complex.

Described from one male from the Darjiling District, East Himalayas, India, elevation 4000 feet (*F. H. Gravely*, June, 1916).

Genus **Oliarus** Stål.

In describing the genus *Mnemosyne* Stål states that the mesonotal carinae are obsolete, but he placed *M. philippina* in the genus although it has five carinae. Fowler in describing the genus says, "the three keels on the scutellum more or less obsolete." Distant places *Oliarus punctipennis* and *M. cingalensis* in *Mnemosyne* although they have five mesonotal carinae.

Apart from the carinae of the mesonotum *Mnemosyne* and *Oliarus* appear to differ only in the width of the vertex, and as the width of the vertex varies in the different species of *Oliarus* it is difficult to draw the line between them. Until the type species of *Mnemosyne* is redescribed I shall consider that it has three mesonotal carinae and describe all those having five, and only differing in the width of vertex, as *Oliarus*.

Oliarus kempi, sp. nov.

Female. Length 4·3 mm.; tegmen 5·3 mm.

Length of vertex 3·3 times the width at base, base slightly wider than apex, inner carinae leaving lateral carinae one-third from base, gradually converging to apex where they meet and touch the apical transverse carina. Face very narrow at base; median carina forked at base. Fronto-clypeal suture straight at sides, the middle half rounded. Median ocellus present a little distance before apex of face. Forking of *Sc* and *R* slightly distad of fork of *Cu*.

Pygofer oblong, broader than long (1·8 to 1). Anal segment small, half the width of pygofer, ovate, anus at apex. Genital styles not quite so long as anal segment. Hind margin of pregenital plate slightly emarginate in middle, the corners forming a small angular projection.

Dark brown; carinae of head and pronotum, abdominal pleura and hind margin of segments yellow. Tegmina hyaline very slightly infuscous, darker over apical portion; veins brown with small tubercles bearing small, black macrotrichia.

Described from one female specimen from Talewadi, near Castle Rock, North Kanara District, Bombay Pres. (*S. Kemp*, October, 1916).

Oliarus kierpurensis, sp. nov.

Male. Length 3·7 mm.; tegmen 5 mm.

Vertex a little longer than width at base (1·3 to 1), base 1·4 times the width at apex. Latero-median carinae leaving lateral carinae about one-third from apex, converging and meeting together a little before apical transverse carina to which they are joined by a short carina; base angularly emarginate. Fronto-clypeal suture forming a half circle. Median ocellus present at apex of face. *Cu* forking slightly basad of *Sc* and *R*.

Lateral margins of pygofer rounded, medio-ventral margin produced into a small, sublanceolate process. Anal segment large, dorsal surface tectiform, ventral surface concave, anus at apex which is slightly narrowed and emarginate. Genital styles large, flattened, elongate, **S**-shape with the apex widened.

Dark brown; carinae of head and pronotum and the middle of pronotum, legs and basal half of abdominal segments yellow or light brown; carinae of mesonotum slightly lighter than disc. Tegmina clear hyaline, veins light yellow, tubercles small, yellow, bearing white or yellowish macrotrichia; over the apical area the veins and tubercles are darker.

Female. Length 3·7 mm.; tegmen 5·2 mm. In colour similar to male.

Pygofer wider than long. Anal segment small, reaching about half-way across pygofer, in dorsal aspect quadrate, a little longer than wide, anus at apex. Hind margin of pregenital plate very slightly rounded and minutely emarginate in middle, the margin curved slightly dorsad. Genital styles long, reaching nearly across pygofer.

Described from one male and two females from Kierpur, Bihar, India (*C. Paiva*, October, 1915).

Oliarus goae, sp. nov

Female. Length 4 mm.; tegmen 5·4 mm.

Length of vertex twice the width at base, base very slightly wider than apex, angularly emarginate; medio-lateral carinae leaving sides one-fourth from apex, straight, converging and meeting in middle slightly before apex. Face narrowed for some slight distance at base, fronto-clypeal suture obscure, median ocellus distinct. *Cu* forking some distance basad of fork of *Sc* and *R*.

Pygofer large, wider than long. Anal segment subdiamond shape, slightly broader than long, apex small, truncate, on dorsal aspect a raised, longitudinal ridge down middle. Hind margin of pregenital plate very slightly curved. Genital styles reaching across pygofer.

Dark brown or black; carinae of head and thorax lighter, more especially so on pronotum; legs lighter brown; hind margin of abdominal segments yellowish. Tegmina hyaline, very slightly opaque and whitish, veins light brown with darker tubercles bearing light brown macrotrichia; a dark mark on margin of clavus at apex of claval vein; fuscous over cross-veins and apical cross-veins and apical veins; stigma dark brown. Wings hyaline with brown veins.

Described from one female from Mormugao, Goa, Portuguese India (*S. Kemp*, November, 1916).

Oliarus turae, sp. nov.

Female. Length 3·8 mm.; tegmen 5·7 mm.

Length of vertex from apex to basal angles slightly greater than width at basal angles; base deeply and angularly emarginate, 1·4 times the width at apex; medio-lateral carinae arising from the sides about one-third from apex, converging and meeting in middle at apex.

Pygofer large, oval, width 1·5 times the length. Anal segment not reaching quite across pygofer, flat, length nearly twice the width, sides slightly curved, width about one-third the width of pygofer, ovipositor incomplete, the styles reaching about two-thirds across pygofer; pregenital segment small, hind margin straight or very slightly curved.

Dark brown or black; carinae of frons, vertex and pronotum and the margin of pronotum and margin of metanotum light brown, legs light brown. Tegmina with venation as in *O. kurseongensis*, Dist.; clear hyaline with brown veins, stigma brown, tubercles brown bearing black macrotrichia. Wings hyaline with brown veins.

Described from one female from Tura, Garo Hills, Assam, 3500 to 3900 feet elevation (*S. Kemp*, July, 1917).

Kuvera brunettii, sp. nov.

Male. Length 3·4 mm.; tegmen 4·6 mm.

Lateral margins of pygofer slightly curved, medio-ventral process conical in outline. Anal segment considerably longer than broad, anus about one-third from apex, sides straight to near apex then converging to pointed apex. Genital styles narrow at base, broadly round at apex, outer margin strongly concave, inner margin nearly straight. This forms a sickle-shape organ with handle very thin and blade broad. Aedeagus large and complex.

Dark brown or black; carinae of frons and vertex, the hind margin of pronotum, tegulae, legs, margins of pygofer and genital styles lighter brown. Tegmina hyaline with brown veins which are blacker over apical half; tubercles small with black macrotrichia; stigma dark brown, light at base. Wings hyaline with brown veins.

Female. Length 3·6 mm.; tegmen 5 mm.

In colour similar to male. Pygofer small, slightly wider than long, concave, wax-bearing; ovipositor complete, large, projecting more than half its length beyond apex of pygofer. Anal segment small, about as wide as long, apex truncate, reaching about two-thirds along pygofer.

Described from two males and three females from Darjiling, Eastern Himalayas, India, elevation 7000 feet (*E. Brunetti*, May, 1917). This species is closely allied to the type species *K. semihyalina*, Dist.

Mundopa vagans Dist.

One female from Tura, Garo Hills, Assam, 3500 to 3700 feet elevation (*S. Kemp*, August, 1917). This agrees with the description but the vertex is not so wide at apex as is indicated in the figure.

Mundopa pashokensis, sp. nov.

Female. Length 2·7 mm.; tegmen 3·7 mm. Apex of vertex slightly narrower than base; width at apex three times the length in middle; base roundly emarginate.

Pygofer small, much longer than wide; ovipositor complete, large, extending nearly half its length beyond apex of pygofer.

Anal segment cylindrical, long, about four times as long as broad.

Dark chocolate brown; lateral carinae of face except the apical third, clypeus except the basal sides, lateral portions of pronotum and the legs, lighter brown. Tegmen hyaline, the apical two-thirds, from slightly before stigma and apex of clavus, dark brown with four light areas, one on costa at stigma, one at apex of clavus, a larger central one stretching from radius to clavus, and one at apex of median veins; a dark band across base; veins same colour as membrane, tubercles minute bearing fine macrotrichia the same colour as veins. Wings hyaline, fuscous, darker over apical half of costal area.

Described from one female from Pashok, Darjiling District, India, 2000 feet elevation (*F. H. Gravely*, May, 1916).

There is a third species in the collection which appears to be undescribed, but as it has no abdomen and the sex is not known, I refrain from naming it.

Brixia albomaculata Dist.

Eight males and six females from Castle Rock, Kanara District, India (*S. Kemp*, October, 1916).

Brixia plagosa Dist.

One male and one female from Tura, Garo Hills, Assam, 3500 to 3900 feet elevation.

These specimens agree with the description except that they have no median carina on face. If the description be correct then this identification may not be correct and Distant's species may be a *Leirioessa* Kirk.

Leirioessa pulchra, sp. nov.

This genus differs from *Brixia* Stål, in the shortness of the antennae; the frons has a median carina and *Sc*, *R* and *M* separate to the basal cell and do not form a stalk.

Male. Length 3 mm.; tegmen 4·6 mm.

Dark chocolate brown; antennae, carinae of face, lateral portion of pronotum and the carinae of mesonotum light brown or yellow, legs and genital styles light brown. Tegmina hyaline with light infuscations and darker markings. A dark mark at base over basal cell and half-way along suture and extending to first claval vein; a large subquadrate mark from costa to cubitus commencing at apex of basal mark and ending at apex of clavus, on the costa it includes two light marks, the basal one triangular and the distal one smaller and round; the apical cells of *R* and *M* dark enclosing two lighter marks; three small marks in a row, one from hind margin to *Cu 2a*, the second from *M* 2+3 to *K* and the third at apex of stigma; veins light with minute brown tubercles bearing fine brown macrotrichia.

Described from two males from Talewadi near Castle Rock

North Kanara District, India (*S. Kemp*, October, 1916). This species comes near to the type, *L. tortricomorpha* Kirk., from Australia.

It is possible that *Cotyleceps* Uhler, and *Leirioessa* Kirk., are the same, as a specimen I identify as *C. marmorata* Uhler, from Japan is generically the same as the above species. It is also probable that both are the same as *Andes* Stål.

Leirioessa mander (Walk.).

Brixia meander (Walk.), Distant, *Faun. Brit. Ind. Rhyn.* III, p. 270 (1906).

Two males from Castle Rock, North Kanara District, Bombay Pres. (*S. Kemp*, October, 1916).

Leirioessa nubila (Walk).

Brixia nubila (Walk.), Distant, *Faun. Brit. Ind. Rhyn.* III, p. 270 (1906).

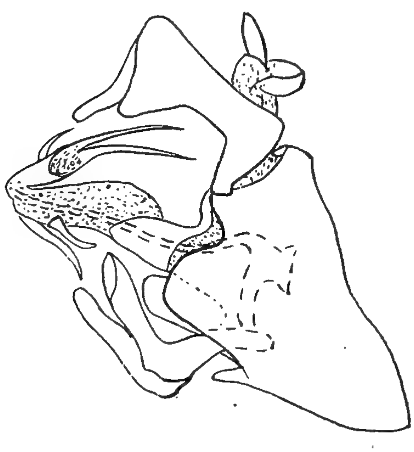
One male and two females from Castle Rock, North Kanara District, (*S. Kemp*, October, 1916).

If my identifications of these two species be correct then they should not be placed in *Brixia*.

Borysthenes fascialatus, sp. nov.

(Fig. 1.)

The genus *Borysthenes* is distinguished from most of the Cixiidae by the presence of a swollen subantennal process which is fringed with hairs. When at rest the hind margins of the tegmina overlap considerably, but not in the same manner as in the Achilidae and the claval veins do not reach the apex of the clavus.



TEXT-FIG. 1.—*Borysthenes fascialatus*, sp. nov.
Lateral view of male genitalia.

Male. Length 3 mm.; tegmen 4 mm.

The lateral margins of pygofer produced broadly beside the anal styles, the production on right side being broader than that on the left, medio-ventral edge angularly produced. Anal segment large, anus near base, broad before anus then narrowed to bluntly pointed apex, the edges of the apical portion turned ventrad and produced into an angular process on each side, the one on the left the larger. Genital styles narrow, long, subequal in width throughout, bent at an angle before middle, apex bluntly pointed. Aedeagus complex, consisting of two parts, a large basal portion and an apical portion at an angle to the basal portion. A strong chitinous tube runs through the middle of the basal portion, its apex in connection with the apical portion of aedeagus and its base joined to the structure connecting with the base of genital styles. The outer portion of the basal part of aedeagus is membranous with two large sclerites and having two large spines arising from near the apex. The apical portion consists of a cup-shaped organ from the edge of which two long, slender spines arise, there is a third curved spine from the outer portion of the cup.

Head, pronotum and legs light brown, mesonotum and abdomen dark brown. Tegmina hyaline, fuscous with two light bands and a light mark, the first band from costa at apex of subcostal vein to hind margin, the second from before stigma to hind margin above clavus and the light mark over base of cubitus; veins same colour as membrane without tubercles or macrotrichia.

Female. Length 3·6 mm.; tegmen 4·3 mm.

In colour similar to male.

Pygofer small, longer than broad, depressed down the middle, forming a wax-secreting area; ovipositor complete, moderate in size, reaching to apex of pygofer. Anal segment short, apical angles slightly produced.

Described from five males and three females from Castle Rock, North Kanara District (*S. Kemp*, October, 1916).

Kinnara spectra Distant.

One female specimen which agrees with the original description. Above Tura, Garo Hills, Assam, 3500 to 3900 feet elevation (*S. Kemp*, August, 1917). This genus, like *Borysthenes*, has a subantennal process.

Kinnara maculata Distant.

One male from Talewadi near Castle Rock and two females from Castle Rock, North Kanara District (*S. Kemp*, October, 1916). These agree with Distant's description but the dark mark at base of tegmina is slightly more extensive.

Genus **Commolenda**, Distant.

The genus is described as having two ocelli at the apex of the frons. This, I think, must be an error as no homopteron has a pair of ocelli in that position and if the normal lateral ocelli be present then it possesses four ocelli. Apart from this character I cannot separate it from *Ptoleria* Stål. In *Australoma* Kirk. the vertex is distinctly wider than long and there is no longitudinal median carina.

Australoma brunnia, sp. nov.

Female. Length 3·6 mm.; tegmen 5 mm.

Width of vertex 2·7 times the length. Pygofer much longer than wide, depressed down the middle for the reception of ovipositor which is complete, curved and reaches a little beyond the apex of pygofer; lateral plates short, broad at base, inner margin slightly concave apically convex basally; posterior margin of seventh sternite straight. Anal segment short, convex dorsally flat or slightly concave ventrally; anus at apex.

Head light brown, darker over apical half of lateral carinae of frons and in the basal half of middle of frons; pronotum light brown, darker on hind margin; mesonotum dark brown; legs and abdomen light brown. Tegmina light brown darker over posterior half including clavus, veins same colour as membrane with a double or treble series of minute dark tubercles bearing black macrotrichia.

Described from one female from above Tura, Garo Hills, Assam, 3500 to 3900 feet elevation (*S. Kemp*, August, 1917).

Kermesia parva, sp. nov.

Female. Length 2 mm.; tegmina 3·6 mm.

Stramineous; tegmina and wings hyaline, milky white with waxy secretion, veins light yellow. Tubercles along first claval vein and *Sc* + *R*. The *M* 3+4 and *Cu* 1 are in contact for a short distance.

Described from one female from Pashok, Darjiling District, 1000 feet elevation (*F. H. Gravely*, June, 1916). The small size of this species distinguishes it from *K. albida* Mel.

Family DELPHACIDAE.

Nilaparvata sordescens (Motsch.).

Delphax sordescens, Motsch. *Bull. Soc. Nat. Mosc.* XXXVI, p. 109 (1863).

Liburnia sordescens (Motsch.), in Melichar's *Hom. Faun. Ceylon*, p. 102 (1903); Distant, *Faun. Brit. Ind. Rhyn.* III, p. 486 (1906).

Nilaparvata greeni, Distant, *Faun. Brit. Ind. Rhyn.* III, p. 473 (1906); Muir, *Can. Ent. Jan.* p. 7 (1919).

Kalpa aculeata, Distant, *Faun. Brit. Ind. Rhyn.* III, p. 474 (1906); Muir, *Can. Ent. Jan.*, p. 8 (1919).

Dicranotropis anderida, Kirkaldy, *H. S. P. A. Ent. Bull.* III, p. 133 (1907).

Delphacodes anderida (Kirk.), Muir, *Proc. Haw. Ent. Soc.* III, 4, p. 335 (1917).

One male specimen from Castle Rock, North Kanara District (*S. Kemp*, October, 1916).

I have accepted Melichar's identification of Motschoulsky's species to be correct. If it be not correct then *N. greeni* will be the name of the insect. It is only separated from *Delphacodes* by the presence of two or three small spines on the hind basitarsus.

The genus includes *D. bakeri* Muir, and another species from Porto Rico not yet described.

Kelisia fieberi Muir.

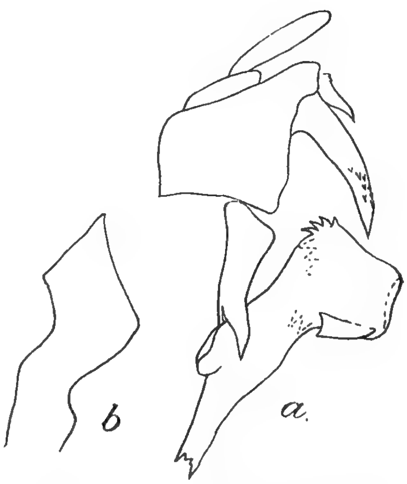
One female specimen from Tura, Garo Hills, Assam (*S. Kemp*, July, 1917). This species is not typical of the genus, but had better remain until the genus is revised. This may be the same as *Sogata pusana* Distant.

Euidella kashmirensis, sp. nov.

(Fig. 2.)

Male. Macropterous; length 2·8 mm; tegmen 3·7 mm.

Head brown, lighter on vertex; pronotum and mesonotum light brown between carinae, dark brown on sides; abdomen dark brown, yellowish at base; legs light brown. Tegmina hyaline, a dark brown mark over base of radial and median cells and a broad, semicircular mark from apex of costal cell, over subcostal cell the cross-veins and to apical margin between cubital apical veins and first median apical vein. In some specimens, including the type, the dark mark at base is more extensive and extends along costal cell to the apical curved band; veins dark brown with minute tubercles bearing very fine black macrotrichia. Wings hyaline, slightly fuscous with dark brown veins.



TEXT-FIG. 2.—*Euidella kashmirensis*, sp. nov.
a. Lateral view of anal segment and aedeagus.
b. Full view of right genital style.

Opening of pygofer round, a little wider than long, margins entire; from the medio-ventral edge arises a small process subconical in outline and cleft down the middle. Phragma fairly long, dorsal margin straight, from the middle arises two small spines. Anal segment large with two spines on ventral margin, the one on the right large, strong, with several fine teeth on the apical half, the one on the left about one-fourth the size of the other. Aedeagus slightly flattened laterally, basal two-thirds straight, apical third bent at right angle and slightly wider, a small comb of teeth on dorsal aspect at bend and another on ventral aspect, both inclining to right side, a large flat flange-like spine at apical third on ventral aspect. Genital styles large, apex widely angular, inner margin roundly emarginate, outer margin angular.

Female. Macropterous. Length 3·8 mm.; tegmen 4·6 mm. In colour similar to male.

Described from four males and four females from Kashmir, North-West Himalayas (*H. T. Pease*, 1915) and one male from Pashok, Darjiling District, East Himalayas (*F. H. Gravely*, June, 1916). This species is very near to *E. speciosa* (Bohem) of Europe but the genitalia are different. I have only a brachypterous female of the European species for comparison.

Sadia rostrata Melichar.

One female specimen from Eden Gardens, Calcutta (*F. H. Gravely*, November, 1911).

Family ACHILIDAE.

Faventia pustulata (Walker).

One female from above Tura, Garo Hills, Assam, 3500 to 3900 feet elevation (*S. Kemp*, August, 1917).

Anal segment beyond anus pointed and curved ventrad.

Faventia flava, sp. nov.

Female. Length 5·4 mm.; tegmen 7·7 mm.

Vertex broader than long, the base widely and angularly emarginate, apex widely angular, the carinae of face projecting in dorsal view. Apart from the shape of vertex typical of genus.

Yellow or light brown. Pronotum darker brown with a narrow lighter hind margin, head darker between carinae. Tegmina yellowish, veins same colour; fuscous between the oblique cross veins at apex of costal cell, a few small, scattered spots of brown over clavus and corium, a series of six minute dots in apical cells. Wings hyaline, veins light, fuscous over apical portion.

Male. Length 5·4 mm.; tegmen 7 mm. In colour similar to female.

Lateral margins of pygofer roundly produced; medio-ventral angularly produced with the apex narrow and truncate. Genital styles large, apex rounded, produced into a narrow angular or spine-like projection on the outer margin near apex. Anal segment flattened horizontally, broadened slightly to apex which is rounded. When at rest the genital styles come together in the middle line, the medio-ventral process of pygofer filling the space between their bases, the projection on outer margin of genital styles laying between the anal segment and the rounded projection of the lateral margins of pygofer, thus forming a "closed" pygofer.

Described from one male and one female from above Tura, Garo Hills, Assam, 3500 to 3900 feet elevation (*S. Kemp*, August, 1917).

Majella albomaculata, sp. nov.

The genus *Majella* Kirkaldy differs from *Gordia* Melichar in having the vertex much longer than wide with its apex very much narrower than its base. *Phenelia* Kirkaldy differs from both the above by not having the "break" in the tegmina causing the apical portion beyond the apex of cortal cell and clavus to drop down over the end of the abdomen, there being a distortion of the veins along that line, especially of the cubitus.

Female. Length 2·8 mm.; tegmen 3·7 mm.

Vertex and face light brown, a dark mark on each side of the median carina of vertex, three dark marks across gena in front of eyes; clypeus dark brown. Pronotum light brown with a series of five or six dark spots behind eyes; mesonotum dark brown with lighter carinae. Coxae dark brown, femora and tibiae light brown with two darker marks on hind tibiae; abdomen dark brown. Tegmina brown, darker over base, a dark mark at apex of costal cell with a small scarlet spot in the middle, veins darker brown with a number of small, white dots along them, some small light dots in costal cell. Wings light brown, veins darker. Anal segment oval, wider than long, anal style narrow, long.

Male. Length 2·9 mm.; tegmen 3·4 mm. Colour similar to female.

Pygofer short, broad, flattened horizontally; ventral margin produced in the middle into two right angle triangles which meet together on the middle line and appear as one angular projection. Anal segment broader than long, nearly semicircular with a small emargination at apex. Genital styles triangular with the apex forming the base, a small projection on the outer margin near apex. The aedeagus complex, of the normal Achilid type.

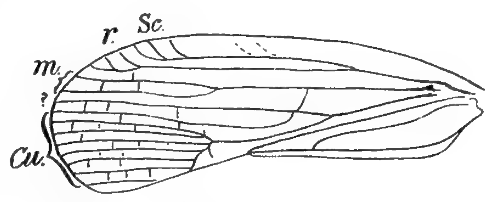
Described from one female and one male from above Tura, Garo Hills, Assam, elevation 3500 to 3900 feet (*S. Kemp*, August, 1917).

Rhotala gravelyi, sp. nov.

(Fig. 3.)

This species agrees with Walker's generic description as far as it goes, only a comparison with the type will settle the question.

In dorsal view vertex a little broader than long, apex broadly rounded, base roundly emarginate, a small depression in each side, without carinae; the vertex stands up above the pronotum; frons longer than broad, apex broader than base, broadest in front of



TEXT-FIG. 3.—*Rhotala gravelyi,* sp. nov. Left tegmen.

antennae, smooth and shiny with small pits, no median carina and no true lateral carinae; only the margins as seen in lateral view form carinae; clypeus with lateral and median carinae. Hind tibiae with six spines. Pronotum 5-carinate, the lateral outer ones in front of tegulae very distinct; mesonotum tricarinate with a small, round spot on each side near lateral carinae.

Sc and *R* parting about one-fourth from base, *M* not joining *Sc*+*R* at base, the cubitus with seven or eight apical veins. One of these may be *M* 3+4 touching the cubitus.

Male. Length 7 mm.; tegmen 8·4 mm.

Dark brown, face dark and shiny, light at apex, the front and middle tibiae banded. Tegmina hyaline, brown along costa reaching back to fork of cubitus, slightly brownish over apical area, a series of seven dark spots along margin of clavus, veins darker. Wings fuscous with brown veins.

Pygofer with ventral margin entire, not produced; genital styles large meeting together on middle line, apex rounded. Anal segment slightly flattened horizontally, slightly broader at base than apex; anus at apex which is rounded. Aedeagus complex but not dissected out.

Described from one male from Pashok, Darjiling District, elevation 5500 feet (*F. H. Gravely*, June, 1916).

Magadha flavisigna (Walker).

One female specimen and one with abdomen missing from above Tura, Garo Hills, Assam, 3500 to 3900 feet elevation (*S Kemp*, August, 1917).

Kempiana, gen. nov.

Vertex slightly broader than long, apex slightly narrower than base, angularly produced, base angularly emarginate, no median carina, lateral carinae large. Frons considerably longer than broad, broadest at apex, tricarinate, the carinae continuing on to the clypeus. Pronotum short, 5-carinate, the carinae behind tegulae short and reaching a curved carina running from the medio-lateral carinae to the lateral margin. Mesonotum tricarinate; the anterior portion between the carinae marked off by a different texture to the rest.

The costa within the membrane forming a distinct costal membrane on basal half of tegmina. *Sc* and *R* joined together for basal third, *M* with three apical veins.

This genus is close to *Magadha* Distant, with the exception of the distinct costal area.

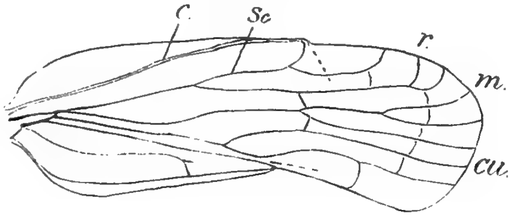
Type, *Kempiana maculata*.

Kempiana maculata, sp. nov.

(Fig. 4.)

Female. Length 7·7 mm.; tegmen 8·4 mm.

Dark brown; vertex lighter with a dark mark across the sides, frons with light marks down the sides which form a band across the middle; clypeus light at base and at apex; pronotum lighter over middle; mesonotum lighter over lateral carinae; abdominal segments with light hind margins.



TEXT-FIG. 4.—*Kempiana maculata*, sp. nov. Right tegmen.

Tegmina hyaline speckled all over with brown, darkest over middle of subcostal and radial cell and middle of costal membrane and costal cell.

Described from one female from above Tura, Garo Hills, Assam, elevation 3500 to 3900 feet (*S. Kemp*, August, 1917).

MATERIALS FOR A GENERIC REVISION OF THE FRESHWATER GASTROPOD MOLLUSCS OF THE INDIAN EMPIRE.

No 5.—The Indian Planorbidae.

By N. Annandale, *D.Sc., F.A.S.B., Director, Zoological Survey of India.*

The Planorbidae are distinguished from their allies the Limnaeidae and Physidae by well-defined conchological, anatomical and physiological characters. In their dextral bodies they come nearest the Physidae (which are not represented in the Indian fauna) and in the sinistral more or less ovate shells of one of their two subfamilies (the Bullininae) there is also a close resemblance to the same family, but important differences are to be found in the radulae, the lateral teeth of which in the Planorbidae are simply cusped, while in the Physidae they bear a curious lateral process. A still more important difference is to be found in the colour of the blood, which is red in both subfamilies of the Planorbidae and colourless in the Physidae and also in the Limnaeidae and Ancylidae. The Bullininae, moreover, comprise comparatively few species and the much more numerous Planorbinae have disc-shaped shells quite unlike those of any of the other two families.

The genitalia of the Planorbidae show great diversity in the structure of the male organ, but otherwise conform to the same type as those of the Limnaeidae. The digestive system is also similar, allowance being made for the more elongate type of body, correlated with the difference in shell-form, in the Planorbinae. The jaws in most genera consist, as in *Limnaea*, of a central more or less lunate or sublinear upper transverse piece and of two slender vertical sidepieces, but in some species they are broken up into many horny teeth as in the Ancylidae. The radulae bear smaller teeth with shorter and often more numerous cusps than in *Limnaea*.

There is present on the left side of the body in the Planorbidae a vascular outgrowth (pseudobranch) of more complex structure in some genera than in others.

Before discussing the subfamilies and genera I wish to say a few words about the colour of the blood. In all the Planorbid genera I have examined, including *Bullinus* and *Camptoceras* among the Bullininae, it is some shade of red or pink, but its colour is much more intense in some species than in others. In certain minute lacustrine forms, indeed, such as *Gyraulus velifer* [1] it

[1] Annandale, *Rec. Ind. Mus.* XIV, p. 112, pl. xi, figs. 7-11 (1918).

appears at first sight to be colourless, but even in *G. velifer* the tentacles of the living animal have a faint pink tinge under a high power of the microscope and if the mollusc be killed suddenly, as with hot corrosive solution, a distinct pink drop can be seen in the region of the heart through the transparent shell. Intensity of colour in the blood is, however, not correlated with size, for the tint is a deep scarlet both in *Indoplanorbis exustus*, the largest, and in *Intha capitis*, the smallest Indian species known to me. It is, perhaps, correlated in some species and to some extent both with external pigmentation of the body and with habitat. *G. velifer* has as a rule very little external pigment and even in pigmented individuals from the Inlé Lake the blood is only a faint pink, though it is deep red in *I. capitis* from the same habitat; but in individuals of the former species from canals and swamps, where pigmentation of individuals of *G. velifer* is more general and as a rule more intense, the blood is slightly pinker, but still much paler than it ever is in the closely allied *G. convexiusculus* and *G. euphraticus*, species that are always pigmented. In both *Bullinus* and *Camptoceras* it is bright red.

The Planorbidae may, as a matter of convenience, be separated, as already indicated, into two subfamilies: the Bullininae (or Isidorinae) and the Planorbinae. In the former the shell is hardly to be distinguished from that of the Physidae, while in the latter it is disc-shaped or at least discoidal. These differences in the shell do not seem to be correlated with any important differences in the soft parts, which show considerable generic variation in both subfamilies.

Subfamily *PLANORBINAE*.

In dealing with the Planorbinae most European authors include the species in a single genus with many subgenera. These subgenera were founded, almost without exception, on shell-characters only, but subsequent investigations have shown that shell-characters are supported by others in the radulae and soft-parts, and it seems to me preferable to regard the "subgenera" as true genera. In his invaluable *Catalogue of the Planorbidae in the Indian Museum*, of which only a part has yet appeared (*Rec. Ind. Mus.* XXI, 1921), Germain regards *Segmentina* as distinct from *Planorbis*, in which he includes as subgenera *Gyraulus*, *Diplodiscus* and *Hippeutis*, here treated as genera; but in so doing he relies solely on conchological evidence. I have found it necessary not only to recognize the one large Indian discoidal Planorbid (*Planorbis exustus* Deshayes) as representing a distinct genus on anatomical grounds, but also to describe a new genus based both on shell and on anatomy, with a minute Burmese species as genotype.

In the structure of the soft parts the Planorbinae show much greater diversity than the allied families. In the genitalia Simroth [1]

[1] Simroth, in Bronn's *Tier-Reichs*, Mollusca III, p. 502, figs. (1912).

has recognized four distinct types of male organ. All but one of these are found in the Indian species, as well as a fifth. Slightly modifying Simroth's definitions and adding one of the fifth type, they may be defined as follows:—

TYPE I. Penis short, bulbous, asymmetrical, without a penial stylet, with an elongate, thick-walled praeputium. Sheath with two retractor muscles. (Indian genera, *Intha*, gen. nov.; ? *Planorbis* Geoffroy.)

TYPE II. Penis slender, elongate, asymmetrical at the tip, with a comparatively short, thick-walled praeputium, without a penial stylet. Sheath with a pair of ear-like processes above, with a single retractor muscle. (Indian genus, *Segmentina* Flemming.)

TYPE III. Penis cylindrical, symmetrical, without a penial stylet, with a short, thin-walled but well differentiated praeputium and two retractor muscles. (No Indian genus.)

TYPE IV. Penis cylindrical, but asymmetrical at the tip, with a horny stylet and a praeputium of complex structure. Sheath with a single retractor muscle. (Indian genera, *Gyraulus* Agassiz; ? *Diplodiscus* Westerlund.)

TYPE V. As in type III, but without differentiated praeputium and with the penis very long and sometimes coiled in the sheath (Indian genera, *Indoplanorbis* Annandale and Prashad; *Hippeutis* Agassiz.)

Type V is closely allied to type III but may for convenience be considered distinct.

The radulae of the different genera are not so distinct as the genitalia, but afford good characters in some instances. In *Indoplanorbis* the teeth are relatively large and the whole organ is broad. In *Hippeutis* the lateral teeth are arranged in pairs.

The jaws differ more markedly. In *Indoplanorbis* and *Gyraulus* they consist of a comparatively stout but almost linear transverse upper piece and of a pair of slender vertical side-pieces, which in *Indoplanorbis*, as my assistant Mr. Sri Navasa Rao has observed, are fragmented; but in *Segmentina* (at any rate in some species) and in *Intha* the three pieces are completely broken up into numerous horny teeth as in the Ancylidae.

Key to the Indian Genera of Planorbinae.

I. Shell comparatively thick and large (as a rule well over 1 cm. in diameter); whorls convex above and below without peripheral keel. No penial stylet.

  A. Young shell discoidal. Pseudobranch simple. Male organ of type I ... ... *Planorbis.*

  B. Young shell *Physa*-like. Pseudobranch when expanded ribbon-like with alternate depressions and projections, lobed in contraction. Male organ of type V ... ... *Indoplanorbis.*

II. Shell small and thin, usually less than 1 cm. in diameter, at least one surface more or less flattened

  A. Shell with internal ridges of enamel-like substance, of a flattened and truncate conoidal shape. Male organ of type II ... ... *Segmentina.*

B. Shell without internal ridges. Male organ not of type II.
1. Shell flattened and disc-like, often carinate, but never excessively so, its aperture lunate. Male organ of type IV.
a. Whorls not more than four, increasing rapidly; the body-whorl much broader than the penultimate ... ... *Gyraulus*.
b. Whorls more than four, increasing gradually; the body-whorl not much broader than the penultimate ... ... *Diplodiscus*.
2. Shell more or less of the form of a flattened conoid, with the aperture cordate. Male organ not of type IV.
a. Spire partly exposed on upper surface of shell. Male organ of type V, but with the penis coiled inside the sheath ... ... *Hippeutis*.
b. Body-whorl completely occluding spire. Male organ of type I ... ... *Intha*, nov.

Genus **Planorbis** Geoffroy (1776).

1921. *Planorbis* s.s., Germain, "Catalogue of the Planorbidae in the Indian Museum," *Rec. Ind. Mus.* XXI, pp. 619.

There is great doubt as to the occurrence of the true *Planorbis* (taking *Helix corneus* L. as type-species) in the Indian Empire. I include it here on the evidence of Clessin's figure of *Planorbis hindu*,[1] but both the provenance and the generic position of this species are doubtful. It may be a *Gyraulus*, and may not be Indian.

Genus **Indoplanorbis** Annand. & Prashad (1920).

1920. *Indoplanorbis*, Annandale and Prashad, *Journ. Ind. Med. Res.* VIII, p. 112.

1921. *Indoplanorbis*, *iid.*, *Rec. Ind. Mus.* XXII, p. 537.

In our recent account of this genus we failed to observe the retractor muscles of the penis-sheath, and also to recognize the fundamental agreement in structure of the male organ with Simroth's type III. The muscles are two in number, one situated at the upper end of the sheath, the other a short distance down its side, but relatively higher than in Simroth's diagram. When not distorted by the presence of spermatophores the sheath is more sausage-shaped than our figure would indicate (*op. cit.*, 1921, p. 579, fig. 14) and the penis can be much contracted, but without losing its straight cylindrical form.

The only species of the genus with which I am acquainted is *Planorbis exustus* Deshayes. Germain has discussed the variations and growth of the shell in a masterly manner (*op. cit.*, 192, pp 34–41, figs. 2–16).

[1] Clessin on *Planorbis* in Martini and Chemnitz's *Conch. Cab.* (ed. Kuster and Duncker).

Genus **Gyraulus** Agassiz (1837).

1919. *Gyraulus*, Annandale & Prashad, *Rec. Ind. Mus.* XVIII, p. 52.
1921. *Gyraulus*, Germain, *op. cit.*, p. 8.

Most of the smaller Indian Planorbidae are comprised in this genus. The species I have examined are *G. euphraticus* Mousson, *G. convexiusculus* (Hutton), *G. labiatus*, *G. cantori* and *G. rotula* Benson, but Germain also assigns to the subgenus (as he conceives it) *G. himalayanus* (Hutton). I think he is wrong in assigning *cantori* to *Segmentina*, though he follows Benson and other early Indian conchologists in so doing.[1]

The type-species of *Gyraulus* is *Planorbis albus* Müller, which is widely distributed in the Palaearctic Region.

Genus **Diplodiscus** Westerlund (1897).

1921. *Diplodiscus*, Germain, *op. cit.*, p. 7.

I have not seen any Indian species of this genus, but Germain assigns to it Benson's *Planorbis hyptiocyclos* from Ceylon. According to Simroth[2] the type-species (*Helix vortex* L.) has the male organ of the same type as that of *Gyraulus*, viz. *P. albus* Müller.

Genus **Hippeutis** Agassiz (1837).

1921. *Hippeutis*, Germain, *op. cit.*, p.
1921. *Hippeutis*, Annandale and Prashad, *op. cit.*, p. 584.

Dr. Prashad has been able to confirm our recent identification of Benson's *P. umbilicalis* as belonging to this genus by an examination of the anatomy of a European species.[3] The male organ of the latter resembles that of *Indoplanorbis* except that the penis is coiled inside the upper part of the penis-sheath. This character is still more strongly marked in *H. umbilicalis*, in which, however, the praeputium is apparently longer. The radulae of the two species also agree in general characters and in particular in having the lateral teeth arranged in pairs as if twinned.

The only Indian species I have seen is *Planorbis umbilicalis* Benson. *P. sindicus* Benson also probably belongs to the genus, but his *P. cacnosus* is a *Segmentina*.

Intha, gen. nov.

In this genus the body-whorl, though relatively smaller than it is in *Hippeutis*, completely embraces and occludes the rest of

[1] See Annandale and Prashad, *Rec. Ind. Mus.* XXII, p. 583 (1921).

[2] Simroth, *op. cit.*, p 503.

[3] The specimens examined belong to a very large and well-developed phase from the mouth of the Var in the south of France. They seem to me, however, to be at least generically identical with typical shells of *H. fontanus*, the type-species, from England which Mr. Tomlin has been kind enough to give me. My French shells apparently belong to the form called *euphaeus* Bourg. by Germain in his *Mollusques de la France*, tom. II (1913).

the shell in such a way that the spire is entirely concealed, except in so far as it can be detected by transparency. The shell is very minute and has few whorls, which increases in size rapidly. Those of the spire are cylindrical, but the body-whorl is flattened below and has the form of a flattened conoid slightly truncate above. The outer lip arises in the middle of the upper surface and forms a small lobe at its point of origin. The aperture is large and very oblique but with a cordate outline. There is a well-developed simple callus on the inner lip, but internal ridges are completely absent. The lower surface is narrowly umbilicate. The external surface is practically smooth.

The animal is remarkable externally for the large upper and lower lobes into which the mantle is divided. The pseudobranch is poorly developed. The jaw is broken up into many horny teeth as in *Segmentina* and *Ancylus*. The radula is very minute but appears to be quite normal. The male organ resembles that of *Planorbis*, except that the penial bulb is relatively very large.

Type species. *Intha capitis*, sp: nov.

Intha capitis, sp. nov.

The type-species may be described here very briefly. I hope to discuss it at greater length shortly in a second paper on the Inlé fauna.

Shell minute (2·5×2×1 mm.), colourless, hyaline but rather thick, highly polished, with the upper surface somewhat convex, with about 3 whorls; a minute pinhole on the upper surface at the base of the outer lip, which bears a minute lobe at its point of origin. Aperture very large; the callus of the inner lip broad and rather opaque, extending outwards on the shell beyond the lip, but not greatly thickened. Lower surface quite flat, very narrowly umbilicate. External surface with fine curved vertical striae; no spiral sculpture.

Habitat. He-Ho and Inlé valleys (3000–3800 ft.), Southern Shan States, Burma (recent and subfossil).

Type-specimen. No. M 11998/2, *Zoological Survey of India.*

Segmentina Flemming (1828).

1919. *Segmentina*, Annandale and Prashad, *op. cit.*, p. 56.
1921. *Segmentina*, Germain, *op. cit.*, p.

The Indian species examined are *P. calathus* and *P. caenosus* Benson and an undescribed species from the Southern Shan States. Benson's *P. trochoideus* also undoubtedly belongs to it. In *P. caenosus* the internal ridges are often poorly developed and concealed by the opacity of the shell, but at least traces of them can always be detected on close examination.

The type-species is the Palaearctic *Planorbis nitidus* Müller, to which *P. calathus* is closely related.

Subfamily *BULLININAE* (*ISIDORINAE*).

The only living Indian genus is *Camptoceras* Benson, but in late cretaceous times the gigantic *Bullinus* (*Platyphysa*) *prinsepii* (Hislop) and the same author's "*Physa*" *elongata*, for which a new genus will ultimately have to be created in the same subfamily, were dominant forms in the Indian freshwater fauna.

Genus **Camptoceras** Benson (1843).

1910. *Camptoceras* Annandale & Prashad, *Journ. As. Soc. Bengal* (n.s.) XVI, p. 457.
1919. *Camptoceras, iid., ibid.*, XVII, p. 27.

Four Indian and one Japanese species are now known, and I have another, as yet undescribed, from the Southern Shan States, where it was found subfossil.

The external structure of the animal is very like that of *Gyraulus* except that there is a large anal siphon constructed of a leaf-shaped epipodium which is coiled up spirally to form a funnel each time the animal expands. This has been observed both in the Japanese and in one of the Indian forms. The blood is deep red. Very little is known of the genitalia, but there is no penial stylet or flagellum. The jaws resemble those of *Planorbis* and the radula is of normal Planorbid type. The pseudobranch is simple.

The type-species is *C. terebra* Benson from the United Provinces. Other Indian species are *C. austeni* and *C. lineatum* Blanford from Eastern Bengal, *C. subspinosum* Annand. & Prashad from Kashmir. *C. lineatum* has also been found in Manipur, Assam.

The genus may be divided into two groups as follows :—

CAMPTOCERATA LINEATA. Shell ovate but dissolute, with spiral lines of minute chaetae.

Species—*C. lineatum* and *C. subspinosum*.

CAMPTOCERATA TEREBRAE. Shell definitely cornucopia-shaped, without chaetae.

Species—*C. terebra*, *C. austeni*, *C. hirasei* (Japan) and an undescribed subfossil Burmese species.

ON A NEW *ALYCAEUS* FROM THE KHASI HILLS.

By Lt.-Col. H. H. Godwin-Austen, *F.R.S.*

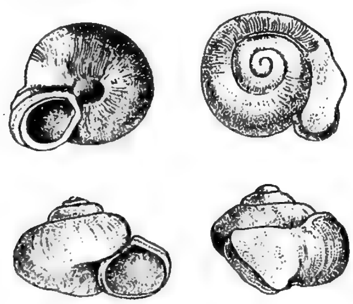
In a tour made last year in the Khasi Hills Mr. Sunder Lal Hora collected a number of shells. These he has sent me together with others which he collected at Amingaon, across the river from Gauhati. These shells have been determined. The most interesting specimens he sends me, belong to the genus *Alycaeus* and were "found under stones and damp leaves." They turn out to be a new species, which I now describe and figure.

Although I made the recess quarters of my Survey Party at Cherrapunji for two summers, I never collected near Maosmai cave and it has been left to Mr. Sunder Lal to discover the new species, which will no doubt be found on the same limestone both to the west and east of Cherrapunji in suitable places. I must regret the delay in publication, but I have been so much occupied with other matters that malacological work could not be touched. Remarks on the anatomy of the animal must find a place later on.

Alycaeus maosmaiensis, sp. nov.

Habitat. Khasi Hills, near Cherrapunji, at the mouth of the Maosmai cave.

Shell turbinate, openly umbilicate, small; sculpture: fine costulation on the upper whorls, suddenly stronger and regular at the sutural tube, as far as its base. Colour dull ochraceous brown or very pale. Spire conoid, apex blunt. Suture impressed. The sutural tube rather short and large in diameter throughout. Whorls 4, the last slightly swollen midway between the aperture and the tube, this portion smooth. Aperture oblique, circular, a slight angulation above, rounded below. Peristome solid, double, well defined. Columellar margin rounded. Major diameter 4·0, alt. axis 2·0 mm.



Alycaeus maosmaiensis, sp. nov.

The species must be plentiful from the number sent to me in spirit. It finds its nearest counterpart in its thickened simple peristome in *Alycaecus pachitaensis* of the Dafla Hills, and may be regarded as a representative of this form on the Khasi Hills, south of the Brahmaputra. It is more tumid and globose and flatter behind the peristome.

A LIST OF THE DRAGONFLIES RECORDED FROM THE INDIAN EMPIRE WITH SPECIAL REFERENCE TO THE COLLECTION OF THE INDIAN MUSEUM.

Part V. The Subfamily Gomphinae.

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With an Appendix

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

Contents.

Introduction.

In 1907 Williamson published an account of the Gomphines of Burma and Lower Siam (see literature) in which he gave the first systematic review of the Gomphine fauna of the Oriental Region that has been attempted. Up to the present day no other account of this fauna as a whole has been published.

There are very considerable difficulties to be faced in making such a review, difficulties that may be defined as the results of two sets of circumstances. Firstly, the subfamily as a whole shows a remarkably small range of important venational differences and, as it is on venation that systematic writers have so largely depended, this has not unnaturally resulted in a lack of clearness in the definition of major series and even of genera in the subfamily. It has also resulted in the necessity of using for specific characters those other than venational— characters in many cases confined to or drawn from a single sex; hence it has come about that the identification of specimens is at times a laborious matter, indeed sometimes impossible without the examination of type-specimens. Secondly, these insects are usually rare, in collections at any rate, the sexes are not often taken together and specimens are frequently teneral or damaged; these factors depend probably rather on the habits of the insects than on any real scarcity. At any rate it is for this reason difficult to obtain adequate material in many cases.

Williamson's paper, one of the most important contributions to systematic and faunistic Odonatology that has yet appeared, has made it possible for me to deal with the material before me with greater confidence than would have been possible otherwise. The number of species available for this survey is so considerable that I consider myself exceptionally fortunate in having to deal with so rich a supply of material. The sequel will show only too plainly how much I have left undone, and how very much more remains for the collector to do.

From want of leisure I have omitted any study of the genital structures of the second abdominal segment of the male, and for the present I have not attempted any account of the larvae in the collection.

The Gomphinae are a very clearly defined group, not likely to be confused with any other of the subfamilies of the suborder Anisoptera, either in the larval or in the adult state.

The larvae are essentially burrowers, living in mud, silt or sand at the bottom of streams, either sluggish or rapid-flowing. Fraser has given an account of several of the Indian species [1] and he makes the interesting statement that in the larvae of *Macrogomphus annulatus* "the syphon-like end of the abdomen projects from the mud and thus permits the easy inspiration of clear water for purposes of respiration." Correlated with this burrowing habit no doubt are other characteristics of Gomphine larvae—small eyes, short limbs with two-jointed tarsi, short thick antennae and relatively long abdomen.

The larvae of *Ictinus*, however, have an almost circular abdomen, with a flattened, disc-like ventral surface, which suggests that they live under boulders and rocks in rapidly running water.

The adults though probably individually numerous, are not at all gregarious and probably disperse themselves widely over the country, resting high up in trees. Hence they are so usually captured soon after emergence.

With regards to literature bearing on the subject; the following is a list of the more important works consulted. It is not exhaustive.

E. de Selys Longchamps.

1854. Synopsis des Gomphines. *Bull. Acad. Roy. Belg.* (i) XXI.

1857. Monographie des Gomphines. *Mém. couron. Soc. Roy. Sci. Liège* XI.

1859. Addition au Synopsis des Gomphines. *Bull. Acad. Roy. Belg.* (ii) VII.

1869. Secondes Additions au Synopsis des Gomphines. *Bull. Acad. Roy. Belg.* (ii) XXVIII.

[1] *Rec. Ind. Mus.* XVI, pp. 461–463, pls. xxxiii, xxxiv (1919).

1873. Troisièmes Additions au Synopsis des Gomphines. Appendices. *Bull. Acad. Roy. Belg.* (ii) XXXV.

1878. Quatrièmes Additions au Synopsis des Gomphines. *Bull. Acad. Roy. Belg.* (ii) XLVI.

1890. Odonates de Birmanie. *Ann. Mus. Civ. Genova* XXX.

1894. Causeries Odonatologiques, No. 7. *Ann. Soc. Ent. Belg.* 1894, pp. 163–181.

Calvert, P. P.

1898. Odonata (Dragonflies) from the Indian Ocean and from Kashmir, collected by Dr. W. L. Abbott. *Proc. Acad. Nat. Sci. Philadelphia* 1898, pp. 141–154.

Kirby, W. L.

1890. A Synonymic Catalogue of Neuroptera Odonata or Dragonflies.

1894. Catalogue of the described Neuroptera Odonata of Ceylon with descriptions of new species.

Krüger, L.

1898. Die Odonaten von Sumatra: II Thiel, Familie Aeschniden, iv, Unterfamilie Gomphinae. *Stettin entomol. Zeit.* 1898, pp. 290–330.

Martin, R.

1904. Liste des Neuroptères de l'Indo-Chine. *Mission Pavie* (sep.), pp. 1–18.

Ris, F.

1912. Neue Libellen von Formosa, Sudchina, Tonkin und den Philippinen. *Supplementa Entomologica*, No. 1.

1916. H. Sauter's Formosa-Ausbeute: Odonata. *Supplementa Entomologica*, No. 5.

Williamson, E. B.

1908. The Dragonflies (Odonata) of Burma and Lower Siam: II Subfamilies Cordulegastrinae, Chlorogomphinae, and Gomphinae. *Proc. U. S. Nat. Mus.* XXXIII, pp. 267–317.

1920. A new Gomphine genus from British Guiana with a note on the classification of the subfamily. *Occas. Papers Mus. Zool. Univ. Michigan*, no. 50.

LIST OF THE SPECIES.

The fifty or so species of the subfamily I have to list are arranged according to Williamson's suggested grouping, which I have adopted as by far the most satisfactory classification so far published. I have even ventured to elaborate this classification to a limited extent as regards his series *Gomphus*, which remains still in an unsatisfactory state for the systematist. The characters I have given in my generic definitions are such as I hope will render the reference of species to their appropriate genera not a very difficult task. I confess I have myself not found it easy in many cases.

As to terms employed, it is perhaps necessary to explain that as regards the colour pattern of the synthorax an *imaginary* typical species would have the dorsum (*mesepisternites*) black with a '*dorsal*' yellow stripe or band on either side of the median suture (or mid-dorsal carina) and external to this a *juxta-humeral* (or more shortly *humeral*) stripe just internal to the humeral suture. The sides of the synthorax of such a species would be yellow, with a fine black line marking the position of the two lateral sutures. The term meso-thoracic collar explains itself. De Selys uses also the term *antehumeral* in the same sense as I give here to the word *dorsal*, referring to the yellow bands placed near the mid-dorsal carina.

For terms used in discussing venation I would refer the reader to Tillyard's book "The Biology of Dragonflies" or to Needham's "Genealogic study of Dragonfly wing-venation"[1] or to Williamson's paper already quoted on 'The Dragonflies of Burma and Lower Siam.' For wing-photographs I am indebted, as on other occasions, to Mr. F. W. Campion.

I fear that this paper is in danger of being too lengthy already. I will therefore not attempt to deal with the interesting questions of geographical distribution that suggest themselves. They may be postponed for future consideration, when our knowledge of the group is more complete.

I have not been able to deal with certain questions of synonymy satisfactorily, especially as concerns some of the species of *Ictinus*. I hope they will be tackled and solved by field-workers in India.

In the following list species marked with an asterisk have not been seen by me. Species of doubtful distinctness are put in brackets. I have throughout adopted the synonymy of Kirby's 'Catalogue.'

Series HAGENIUS.

Sieboldius japponicus Selys.

Series DIASTATOMMA.

Ictinus rapax Ramb.
,, (*praecox*)* Selys.
,, (*mordax*)* Selys.
,, *angulosus* Selys.
,, (*atrox*)* Selys.
Gomphidia T-nigrum Selys.

[1] *Proc. U.S. Nat. Mus.* XXVI, pp. 703–764 (1903).

Series EPIGOMPHUS.

Macrogomphus annulatus Selys.
,, *robustus* Selys.
,, *montanus* Selys.
Perissogomphus stevensi, sp. nov.
*Leptogomphus gestroi** Selys.
,, *inclitus** Selys.
,, (?) *maculivertex** Selys.
Heliogomphus nietneri (Selys).
Microgomphus torquatus (Selys).

Series GOMPHUS.

Davidius (*zallorensis*)* Selys.
,, *aberrans* (Selys).
,, *davidi assamensis* Laidlaw.
Anormogomphus heteropterus Selys.
*Gomphus xanthenatus** Williamson.
,, *personatus* Selys.
,, (?) *promelas** Selys.
,, *nilgiricus* sp. nov.
,, (?) *ceylonicus** Selys.
Platygomphus dolabratus Selys.
,, *feae** Selys.
Burmagomphus pyramidalis sp. nov.
,, *vermiculatus** (Martin).
,, *sivalikensis* sp. nov.
Cyclogomphus hypsilon Selys.
,, *heterostylus* Selys.
,, *vesiculosus** Selys.
,, (?) *minusculus** Selys.
Temnogomphus bivittatus (Selys).
Anisogomphus occipitalis Selys.
,, *orites* sp. nov.
Onychogomphus grammicus (Ramb).
,, *lineatus* (Selys).
,, *cerastis** (Selys).
,, *bistrigatus** Selys.
,, *M-flavum* Selys.
,, *saundersi* Selys.
,, *aureus** sp. nov.
,, *biforceps* Selys.
,, *acinaces* sp. nov.
,, *modestus** Selys.
,, *frontalis** Selys.
,, *annularis** Selys.
,, *maclachlani** Selys.
,, (?) *circularis** Selys.
*Heterogomphus smithii** Selys.
,, *ceylonicus* sp. nov.
Ophiogomphus reductus Calvert.

Types of new species unless otherwise stated will be deposited with the Zoological Survey of India (Indian Museum, Calcutta).

SYSTEMATIC NOTES WITH DESCRIPTION OF NEW SPECIES.

Series HAGENIUS Williamson.

A small series characterized by the possession of a distinct trigonal supplement; that is to say, the boundary nerve between the two rows of cells which follow immediately the triangles of fore and hinder-wings is straightened out to form a single continuous nerve and does not consist, as in other Gomphines, of a number of separate nerves meeting one another in angular fashion. (Or in other words, the cells immediately following the triangles are rectangular.)

The distal margin of the triangle posterior to the attachment of this supplement, is distinctly concave. Triangles crossed by a single nerve. Some reduction of the cross-nerves between M_{1-3} and M_4 in hinder-wings. Legs very long, hinder femora as much as 17·5 mm. long in *Sieboldius*. Head relatively small, thorax robust, wings rather pointed.

Distribution: Holarctic and oriental.

Genus **Sieboldius** Selys.

Genotype: *Sieboldius japponicus* Selys.

Head very small relatively, abdomen black with yellow rings; second segment of abdomen shorter than third.

Sieboldius japponicus Selys.

This fine species is chiefly Malayan in its distribution. It occurs in Lower Siam, and I have entered it on my list as there seems a possibility that it may turn up in Burma. In all probability it does not occur in Japan. Its only near allies are another species of the genus, *S. albardae* Selys from Pekin and the two species of the closely related genus *Hagenius*, one, *H. brevistylus* Selys, from N. America, the other *H. gigas* Martin, from Tonkin. Krüger's species, *S. grandis* from Sumatra, does not appear to be separable from the Selysian species.

Series DIASTATOMMA Williamson.

(= Legion *Lindenia* Selys.)

Venation dense. The series "is unique by the presence of a strongly developed sector (branch) of Rs and a usually less well developed sector of M_4." Triangles of fore and hinder-wings dissimilar. Outer side of triangle of hinder-wing slightly concave. Legs short.

This series includes a small number of rather large insects; it is represented in S. America by a single species of a peculiar genus; otherwise it is peculiar to the old world, mainly to the Oriental and Ethiopean regions.

Genus **Ictinus** Selys.

Genotype: *Ictinus rapax* (Ramb.).
Species examined: *I. rapax* (Ramb.), *I. angulosus* Selys.

Characters of the series. Leaf-like expansion on either side of the tergite of the eighth segment of the abdomen. Upper anal appendages of male longer than the tenth segment, parallel to one another and straight or nearly so. Lower appendage much reduced, with a pair of small processes.

A genus of large and handsome insects ranging from Africa to the warmer parts of Australia, but most abundantly represented in tropical Asia.

Ictinus rapax (Ramb.).

Ictinus rapax, Selys, *Mon. Gomph.*
,, *praecox*, Selys, *Mon. Gomph.*
,, *mordax*, Selys, *Mon. Gomph.*

2 ♂ ♂, 1 ♀. Calcutta, Labelled in de Selys' handwriting "*Ictinus rapax*, Ramb. Calcutta." (154/6, 387/6, 5441/20).
4 ♂ ♂. Calcutta, April, Sept. and Oct. (6235/20, 6331/20, 6333/20).
5 ♀ ♀. Calcutta (7220/8, 6283/14, 9282/14, 6332/20, 6334/20).
1 ♀. Calcutta, 17-ix-19 (1488/H 2).
1 ♀. Calcutta, Maidan, 27-vii-14 (8289/20).
1 ♂. Museum, Calcutta, 18-viii-16 (4246/H 1).
1 ♀. Calcutta, "sticking to railing in Museum Buildings," 28-ix-17 (7940/H. 1).
1 ♂, 1 ♀. Murshidabad (1815/10, 1817/10).
1 ♂ and exuviae. "Larva from hill-stream, Chakradharpur, Chota Nagpur, v-18. Adult emerged in Museum, 8-vi-18." F. H. Gravely (1428/H 2).
2 ♂ ♂. Chota Nagpur, 1000 ft., 1-ix-15. E. d'Abreu.
1 ♀. Barkuda I., Chilka Lake, 1–3-viii-14.
1 ♂. Chalakudi, Cochin State, 14-30-ix-14, F. H. Gravely (8236/20).
1 ♀. Trichur, Cochin State, 0–800 ft., 4-x-14. F. H. Gravely (8226/20).
1 ♂ and exuviae. "Larva from hill-stream, Chakradharpur, Chota Nagpur, v-18. Adult emerged in Museum, Calcutta, 8-vi-18." F. H. Gravely (1428/H 2).

Specimens from Calcutta have the juxta-humeral stripe complete or interrupted. In the specimens from Cochin this stripe is obsolescent, as is the yellow mark on the metepisternite; they are also slightly smaller than the more northern specimens. Possibly the S. Indian form may form a recognizable race. There seems a certain amount of individual variation, and in view of this I am strongly inclined to regard *praecox* Selys, and *mordax* Selys, as synonymous with the present species.

	Length of abdomen.	Length of hinder-wing.
♂, Calcutta.	48+3·25 mm.	40·5 mm.
♀, Calcutta.	50 mm.	41 mm.
♂, Cochin.	45+3 mm.	36 mm.
♀, Cochin.	43 mm.	35 mm.

This species seems to be one of the most widely spread, and perhaps one of the commonest of the Indian Gomphines. I have not seen specimens from Assam or Burma. A closely allied species or race, *I. fallax* Selys, is known from Shanghai.

Ictinus angulosus Selys.

1 ♂. Dum-Dum, near Calcutta, 4-vi-11 (6371/20).

Face entirely yellow save for fine black lines below the ante-clypeus and above the post-clypeus. A fine yellow line on the exterolateral surface of the middle pair of tibiae. The yellow markings, especially on the thorax and on segment 10, have a distinct red tone. Inter-alar spaces largely yellow, with a transverse black line between the wing-bases. Otherwise the specimen agrees with the description given of the type.

Length of abdomen 54 + 2·25 mm., of hinder-wing, 42 mm.

The species seems to me to be very near *atrox* Selys, of which only the female is known. Both are rare in collections, and I have not seen an example of *atrox*, nor the female of *angulosus*. I suspect the two are conspecific.

Genus **Gomphidia** Selys.

Genotype : *G. T-nigrum* Selys.
Species examined : *G. T-nigrum* Selys.

A genus of large and handsome insects, very similar in general to *Ictinus*, but readily distinguished by the *absence of any leaf-like lateral expansions on the eighth abdominal segment.* The members of the genus appear to be rarer insects of rather more restricted distribution than are the species of *Ictinus*. All are peculiar to the Oriental Region, and most of them are found in Malaya. *G. T-nigrum* is the only species recorded from within the limits of the Indian Empire. The larvae breed in tanks and still waters, thus differing from those of *Ictinus* which breed in running water (*Fraser*).

Gomphidia T-nigrum Selys.

2 ♂ ♂, 2 ♀ ♀. Poona, May, 1917. F. C. Fraser.

Recorded by de Selys as coming from the 'North of India.' The species, hitherto regarded as rare, is evidently fairly abundant near Poona, at any rate seasonally.

Length of hinder-wing of ♂ 38 mm., of abdomen 50 mm. + 4 mm.

Series **Epigomphus** (Williamson).

Characterized by free triangles, subtriangles and supra-triangles, and by the existence of more than two cross-nerves between M_{1-3} and M_4 in the hinder-wing. These cross-nerves are not widely spaced from one another as in the next series. Forking of M_{1-2} and M_3 usually unsymmetrical.

Five oriental genera can be distinguished. They may be very briefly separated as follows:—

A. Large insects (h.w.>36 mm.); ninth abdominal segment much longer than eighth ... *Macrogomphus* Selys.

B. Size moderate or small (h.w. usually less than 36 mm); ninth abdominal segment smaller than eighth.

- *I.* Basal antenodal nervure of 2nd series present *Leptogomphus* Selys.
- *II.* Basal antenodal nervure of 2nd series absent
  - *a.* Sectors of arculus approximated shortly after their origin.
    - 1. Size moderate (h.w. 25 mm. or more); outer side of triangles straight; upper anal appendages of male lyrate ... *Heliogomphus*, gen. nov.
    - 2. Size small (h.w. about 20 mm.); outer side of triangle broken; upper anal appendages of male chelate ... ... *Microgomphus* Selys.
  - *b.* Sectors of arculus not approximated after their origin ... ... *Perissogomphus*, gen. nov.

The unsymmetrical character of the forking of M_{1-2} and M_3 (which Williamson, doubtlessly the result of a *lapsus calami*, writes as M_{1-3} and M_4) is much more obvious in *Leptogomphus*, *Heliogomphus* and *Microgomphus*, than in *Macrogomphus* and in *Perissogomphus*. As to the specialization of cross-nerves between M_{1-3} and M_4, in all genera of the series *Gomphus* that I have examined, or of which I have seen photographs, the forking of M_{1-2} and M_3 is preceded in the hinder-wing by a single cross-nerve only. In *Perrissogomphus*, least typical of oriental Epigomphines, this forking usually occurs at the level of the third cross-nerve, occasionally distal to it.

The genera of this series are confined so far as is known to the Oriental and Neotropical Regions.

Genus **Macrogomphus** Selys.

Genotype: *Macrogomphus robustus* Selys.

Species examined: *M. annulatus* Selys; *M. robustus* Selys; *M. montanus* Selys; *M. decemlineatus* Selys; *M. quadratus* Selys.

Large insects (h.w. about 40 mm., abdomen still longer) easily recognized by the curious lengthening of the ninth segment of the abdomen in both sexes. Pterostigma unbraced. Forking of M_{1-2} and M_3 not markedly asymmetrical, more so in fore than in hinder-wing. Cubital space usually with two cross-nerves. Upper anal appendages of males chelate (much as in *Microgomphus*).

The lengthening of the ninth segment of the abdomen is diagnostic and at once distinguishes a *Macrogomphus* from any known oriental genus. The segment is roughly twice as long as the eighth.

Macrogomphus robustus Selys.

2 ♂♂. Assam.
1 ♀. "Sibs."=Sibsagar (6331/1). Specimen identified by de Selys.

The males are undoubtedly conspecific with the female. The latter is very mature and in bad condition. The head is missing from one of the males, the occiput of the other differs from that of the type male described by de Selys in not possessing a conical tubercle, and to some extent in details of colouring. The different appearance of the occiput may be an individual peculiarity, the colouring probably owes its distinctions to age and state of preservation. At any rate I propose to list the males under the Selysian species for the present.

FIG. 1.—Colour-pattern of synthorax of *Macrogomphus robustus* Selys.

MALE. *Head*. Upper lip black save for a small yellow mark on either side at the base. Ante- and post-clypeus largely brownish-yellow margined with black, vertical parts of frons black, its horizontal part brownish-yellow on the *synthorax*, the juxta-humeral stripes are quite obsolete, and the whole of the metepisternite is black. The *abdomen* has segments 3-8 ringed with yellow, the yellow ring on the seventh segment covering the basal half of the segment, that on the other segments about the basal fifth of each. Segments 9 and 10 entirely black. Upper anal appendages yellowish-white darkening apically, the outer branch of each being the stouter, jointed at its apex; the inner branch is slender rather knobbed terminally and not quite so long.

Length of abdomen of ♂ 51 + 2 mm., of hinder-wing 40·5 mm.; length of abdomen of ♀ 47 mm., of hinder-wing 40 mm.

Macrogomphus annulatus Selys.

3 ♂ ♂, 3 ♀ ♀. Poona. F. C. Fraser.

Fairly similar to *M. robustus*. It differs slightly in size. In colour its markings seem to be of a paler yellow than those of *M. robustus* in which (in dried specimens) they are distinctly brown. *M. annulatus* has the upper lip largely lemon-yellow, its base and a median longitudinal line black. The vertex has a small yellow spot immediately behind the ocelli.

The synthorax has a minute yellow spot, the last vestige of the humeral band, just in front of the alar sinuses to the outer side of the dorsal marks. This is present in all the specimens I have seen. The ninth segment of the abdomen has a small basal lateral spot of yellow. The metepisternite is entirely black. For an account of the larva of this species, and for an interesting note on its habits see Fraser.

Length of abdomen of ♂ 49+1·8 mm., of hinder-wing 38 mm.; length of abdomen of ♀ 51 mm., of hinder-wing 39 mm.

Macrogomphus montanus Selys.

1 ♂. Calcutta (5255/20). 1 ♀. No locality (5921/13). Both in poor condition. The male identified and labelled by de Selys.

Readily distinguished from the preceding species by its generally lighter colouration, which appears to me in some respects also to be more primitive. On the synthorax the juxta-humeral stripes are conspicuous, though incomplete below. The metepisternite is yellow, outlined by black lines along the lateral sutures. The basal yellow rings on segments 2-8 of the abdomen occupy about the basal third of the segment. The abdomen of the male specimen is missing, that of the female lacks segments 7–10.

FIG. 2.—Colour-pattern of synthorax of *Macrogomphus montanus* Selys.

Length of hinder-wing in ♂ 38 mm., in 41 mm.

In addition to these Indian species of *Macrogomphus* three other species apparently closely related to one another occur in Malaya. These species are *M. parallelogramma* Burm., *M. albardae* Selys, and *M. decemlineatus* Selys.

Of these species *M. parallelogramma* has no trace of the juxta-humeral stripe on the synthorax. The metepisternite is black, but with a narrow vestige of yellow banding in its middle. It is recorded from Java and Sumatra. *M. albardae* is very closely related (possibly only a local race) and differs from *M. parallelogramma* in having the metepisternite entirely black. *M. decemlineatus* has the dorsal stripes of the synthorax very narrow, juxta-humeral stripes present, complete but very narrow, mesepisternite yellow, but with black bands on the lateral sutures as broad as the yellow. Metepimerite yellow with well-marked black posterior margin.

Lastly, three Malayan species form a distinct section of the genus. This is characterized by the large size of its members, the well-marked curving and complexity of the sectors of the wings, and the specialized colouring of the synthorax. The species forming this section are *M. quadratus* Selys, from Borneo and the Malay Peninsula, *M. thoracicus* McLach., from Sumatra and also from the Malay Peninsula, and *M. abnormis* Selys, probably from Borneo. In them the dorsum of the synthorax is black with a large squarish yellow spot occupying about its anterior half. The way in which the species of the first section of the genus 'ring the changes' in the colour-pattern of the synthorax is very remarkable. It is parallelled in other genera of Gomphinae, but it seems to me that in other groups of Anisoptera at any rate the specific differences are of some other character. Here they suggest almost some sort of "permutation and combination," and I believe similar conditions may be traced in regard to other features, hinting as it were at the working of some Mendelian sorting out of characters.

Genus **Leptogomphus** Selys (*restr.*).

Genotype: *L. semperi* Selys.

Basal antenodal nervure of 2nd series present. A maximum of two rows of cells between Cu_2 and the hinder-margin of the fore-wing, only one row of cells between M_1 and M_{1a} at level of distal end of pterostigma. Proximal angle of triangle of fore-wing as far distant from the arculus as length of proximal side of subtriangle. Sectors of arculus not approximated after their origin. Forking of M_{1-2} and M_3 unsymmetrical in both pairs of wings. One or two cross-nerves in submedian space (number apparently varying). Pterostigma unbraced. Upper anal appendages of male simple, rather *Gomphus*-like. Hamuli large, vesicle of penis small or moderate. Ninth segment of abdomen shorter than eighth. Size moderate.

Unfortunately the Museum collection contains no example of this genus. I believe that *L. gestroi* Selys, from Burma, is certainly to be referred to it and also *L. inclitus* of the same author. The latter, of which a description of the female only is available, is said by de Selys to be very similar to *L. semperi*. In addition, Ris has described two species of the genus, *L. sauteri* and *L. perforatus*, the former from Formosa, the latter from S. China.

The type-species, *L. semperi* Selys, has been recorded from the Philippine Islands, Borneo, and Tonkin.

Lastly, from Malaya several species are known, of these *L. lansbergi* Selys, is recorded from Sumatra and Java, the closely allied *L. assimilis* Krüger, is from Sumatra. *L. kelantanensis* (Laidlaw) is from the Malay State of that name and *L. williamsoni* Laidlaw, is from Borneo.

The position of one or two species referred to the genus is doubtful. *L.? maculivertex* Selys, from Burma, known from the female only, is possibly a *Heliogomphus*. *L. parvus* Krüger, from Sumatra would seem to belong rather to the *Gomphus* series; at any rate the number of cross-veins between M_{1-3} and M_4 is reduced as in that series.

Genus **Heliogomphus**, gen. nov.

Genotype: *L. nietneri* (Selys).
Species examined: *H. nietneri* (Selys).

No basal antenodal nerve of 2nd series. A maximum of two rows of cells between Cu_2 and the hinder margin of the fore-wing. Only one row of cells between M_1 and M_{1a} at level of distal end of the pterostigma. Proximal angle of triangle of fore-wing as far distant from the arculus as the length of the proximal side of the subtriangle. Sectors of arculus approximated about 1 mm. after their origin. Forking of M_{1-2} and M_3 unsymmetrical in both pairs of wings. One or two cross-nerves in the submedian space (number apparently varying according to species and sex). Triangle of hinder-wing occasionally crossed. Pterostigma unbraced. Upper pair of anal appendages of male carrying a remarkable apical process, so that the two processes are together somewhat lyre-shaped. Hamuli small, vesicle of penis large and prominent. Ninth segment of abdomen shorter than eighth. Size moderate, colouring rather sombre, with (usually) fine, longitudinal, dorsal line on segments 3–7 of the abdomen. Appearance of adult male, more particularly of the abdomen, very like that of *Anisogomphus.*

The following species appear to me to be clearly referable to this genus: *H. nietneri* Hagen, from Ceylon and Assam (from the latter locality possibly as a geographical race); *H. gracilis* Krüger, from Sumatra; *H. retroplexus* (Ris), from Tonkin; and *H. scorpio* (Ris), from Yunnan.

The generic separation of these species has been clearly foreshadowed by Ris, and hinted at by Williamson and Krüger. Though I cannot claim to have had the opportunity of making as detailed a study of the species of this genus and of *Leptogomphus*, *s. restr.*, as any of these writers, it seems to me that a faunistic paper of the character of this on which I am now engaged affords a suitable opportunity for defining this new genus.

Heliogomphus nietneri (Selys).

1 ♂, 1 ♀. Tura, Garo Hills, Assam, 1500 ft. S. Kemp. (7977/H1).

These specimens are clearly examples of the same form as that described in the 'Odonates de Birmanie' by de Selys, which was regarded by him as being conspecific with Hagen's species from Ceylon. Not having any examples from the latter locality with which to compare the Assamese material I follow de Selys in leaving the specimens under this name, though I believe it not unlikely that they may prove to belong to a distinct race or even to a distinct species.

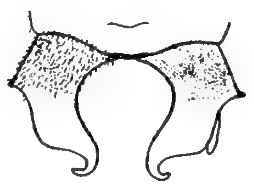

FIG. 3.—Anal appendages of *Heliogomphus nietneri* Selys, seen from above.

From Hagen's description they differ chiefly in having the two lateral black bands on the synthorax along the lines of the lateral sutures, the posterior band not being 'presque terminale.' The male has no lateral yellow markings on any of the segments beyond the fourth, whilst the pterostigma is brownish-black. In general appearance, and especially in the colouring and shape of the abdomen, the male of *H. nietneri* bears a curiously close resemblance to that of *Anisogomphus occipitalis* Selys.

The female of *H. nietneri* has not been described. In this sex the colouring of the *head* is, as in the male, largely black, with a pair of yellow spots at the base of the upper lip, the bases of the mandibles marked with yellow, and a yellow line across the frons from eye to eye. The frons, as in *Macrogomphus*, is flattened so that there is not the usual distinction between a vertical and a horizontal part. Behind the ocelli the vertex bears a pair of small conical tubercles. The occiput is depressed.

The *prothorax* has the yellow markings more extensive than in the male.

The *synthorax* has a small superior juxta-humeral spot not found in the mature male, in addition to the dorsal band, otherwise as in the male.

Abdomen. First segment entirely yellow, the remainder black, marked with yellow as follows :—Dorsum of 2-8 with longitudinal band, broader on the second segment than on the others, and from 2–7 occupying the whole length of the segment, on 8 only the basal third. A broad lateral band, including the well-developed auricles, along the second segment, a narrower and partly interrupted band on the third. Basal triangular spots on 4–7. Anal appendages whitish-yellow. Tenth segment extremely reduced (? shrivelled) not one-quarter the length of the ninth. Vulvar scale small, about one-third the length of the ninth segment, shaped like a truncated triangle, only slightly bifid.

Length of hinder-wing of ♂ 28 mm., of abdomen 29+1 mm. ; length of hinder-wing of ♀ 31 mm., of abdomen 32 mm.

Genus **Microgomphus** Selys.

Genotype : *M. chelifer* Selys.
Species examined : *M. torquatus* (Selys).

No basal antenodal nervure of 2nd series. Only one row of cells between Cu_2 and the hinder margin of the fore-wing. Only one row of cells between M_1 and M_{1a} at level of distal end of pterostigma. Proximal angle of triangle of fore-wing as far distant from the arculus as the length of the proximal side of the subtriangle. Sectors of arculus approximated after their origin. Forking of M_{1-2} and M_3 unsymmetrical in fore and hinder-wings. Pterostigma unbraced or feebly braced. Upper anal appendages of male chelate. Vesicle of penis large, ninth segment of abdomen shorter than eighth. Size small, colouring brilliant.

In this definition there is little to separate *Microgomphus* from *Heliogomphus*, and I think the two genera are related. *Microgomphus* differs mainly in its smaller size, more reduced venation, chelate upper anal appendages of the male, and in its richer colouring.

Microgomphus torquatus (Selys).

Cyclogomphus torquatus, Selys, *Mon. Gomph.*
7 ♂♂, 4 ♀♀. Poona. F. C. Fraser.

MALE. *Head.*—Lower lip yellow. Upper lip yellow with black line at base produced as a triangular mark in the middle line. Genae and bases of mandibles yellow. Ante- and post-clypeus yellow, the latter with a pair of small black marks where it joins the frons. This has a black band running from one eye to the other just above the clypeus, but is otherwise yellow, its crest not inflated. Vertex and occiput black, the latter with a slightly concave margin, without hairs.

Prothorax black, its anterior margin lined with yellow, and with a small lateral spot on the posterior margin, and a median spot of the same colour.

Synthorax largely yellow, the dorsum black marked with yellow as follows: a mesothoracic collar, not interrupted, and in the middle line sending a short projection upwards along the mid-dorsal carina; a pair of oblique dorsal markings, pointed above and below, on either side of the mid-dorsal carina, not reaching to the mesothoracic 'collar' nor to the ante-alar sinus; above and to the outside of these markings a pair of small triangular spots, with the apices directed anteriorly; and lastly a minute yellow spot between the ante-alar sinuses. Laterally a black band less

FIG. 4*a*.—Colour-pattern of *Microgomphus torquatus* (Selys) ♂, semi-diagrammatic.

than half a millimetre across, runs obliquely downwards from below the front pair of wings to the base of the posterior coxa.

Legs black, the postero-lateral surfaces of the first, and the proximal half of the posterior surface of the third pair marked with yellow. The anterior surfaces of the femora are thickly studded with fine, irregularly arranged spines.

Abdomen black. Dorsum and sides of first segment with yellow marks. Second segment yellow on the sides, and with a yellow mark on the dorsum, not reaching the apex of the segment, pointed distally and widened at its middle rectangularly. The third segment has a yellow mark on either side at its base, extending for rather more than a third of its length distally, and a dorsal triangle of the same colour, its base resting on the basal margin of the segment. In the middle of the distal half of the segment is a narrow oblong-oval yellow spot dorsally, and on either side of this a somewhat similar lateral mark. Segments 4–8 have each a basal ring of yellow narrowest on 4–5, lengthening on 7–8, more produced laterally than dorsally, especially on the two latter segments. In addition 4 has a small, longitudinal oval spot, lying mid-dorsally, and occupying about the middle third of the segment. The ninth has a rounded lateral spot, and the tenth is entirely black. The auricle is yellow and the genital structures of the second segment are black. The abdomen is slender, the segments 7–9 rather wider and deeper than the rest.

The upper anal appendages, which are pale yellow with darkened apices are a little longer than the 9th segment of the abdomen. Each is chelate; the outer branch is much the stouter and diminishes gradually to its apex. The inner branch is slender, cylindrical, and is widest at about its middle. The two branches separate at about the middle of the total length of the appendage and run at an angle of about 60° to one another. The outer branch is quite straight, the inner is turned a little upwards at its apex. The lower appendage is about two-thirds of the length of the upper pair. It is brownish black in colour, has nearly parallel sides, and at its apex divides into two short branches which run a little outwards and upwards.

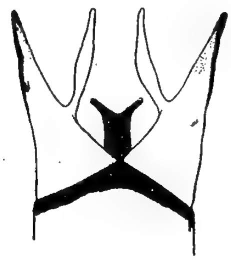

FIG. 4*b*.—Anal appendages of *Microgomphus torquatus* (Selys) ♂, seen from above.

The vesicle of the penis is large and conspicuous, almost as striking a feature of the male as in *Cyclogomphus*.

FEMALE. Colouring of the head, prothorax and synthorax as in the male. The abdominal colouring differs chiefly in that the two dorsal marks on the third segment are united, that on the fourth segment relatively longer, and in the fact that lateral spots lying at about the middle of the length of the segment occur on segments 4 and 5, that on 5 being very small. The anal appendages are minute, yellow in colour, and the abdomen is regularly cylindrical from the end of the third segment to the apex.

Length of abdomen of ♂ 23·5 mm., of hinder-wing 21 mm.; length of abdomen of ♀ 25·5 mm., of hinder-wing 22·75 mm.

It is curious that in this the smallest of the old-world Epigomphines the anal appendages of the males should bear a strong resemblance to those of *Macrogomphus*, a genus which includes the largest species of the series.

Microgomphus was founded by de Selys to include a species, *M. chelifer* from Malaya, which until Major Fraser's discovery of the male of the present species remained the only known example of the genus. The finding of a second species in Peninsular India under climatic conditions which must be very different from those obtaining in the countries inhabited by *M. chelifer* is interesting and a little surprising.

The larva of *M. torquatus* has been figured and described by Major Fraser under the name of *Cyclogomphus minusculus* Selys.

The Malay species differs from *M. torquatus* in having the dorsal band of the synthorax confluent at its upper extremity with the juxta-humeral band, which is apparently not reduced as in *M. torquatus* to a mere superior spot. The yellow rings on segments 4–7 of the abdomen are smaller, and the branches of each of the upper anal appendages of the male are nearly parallel to one another.

The venation differs but slightly from that of *M. chelifer*, the chief distinction being apparently that the present species has its venation a very little denser than in *M. chelifer*.

Nodal indicator $\dfrac{12-10}{10-8}\Big|\dfrac{10-12\text{–}13}{8-10}$.

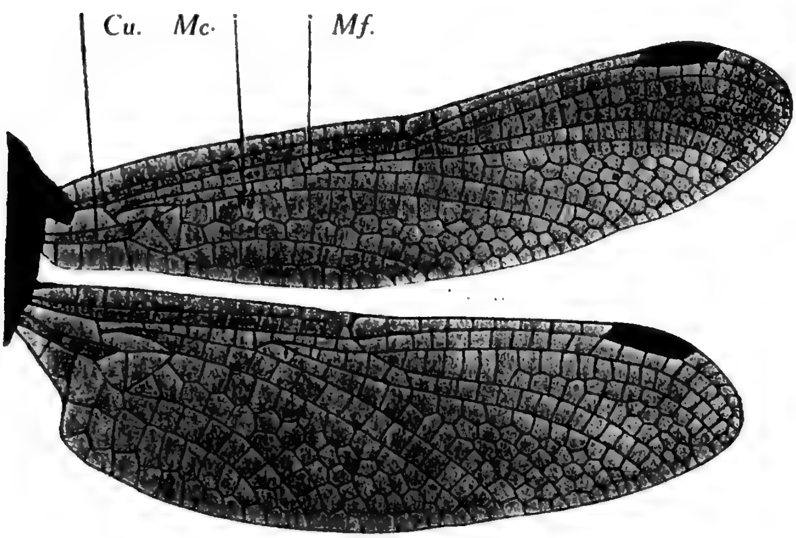

FIG. 5.—Venation of *Microgomphus torquatus* (Selys) ♂. (Photo by F. W. Campion.)
Cu., cubital space. *Mc.*, area between M_{1+3} and M_4. *Mf.*, Fork of M_{1-2} and M_3.

Perissogomphus,[1] gen. nov.

Genotype: *P. stevensi*, sp. nov.

An Epigomphine genus, without a basal antenodal nervure of 2nd series. A maximum of at least three rows of cells between Cu_2 and the hinder margin of the fore-wing. Only one row of cells between M_1 and M_{1a} at level of distal end of pterostigma. Proximal angle of triangle of fore-wing not so far distant from the arculus as length of proximal side of sub-triangle. Forking of M_{1-3} and M_4 unsymmetrical in both fore and hinder-wings. Two (sometimes three) cross-nerves in the submedian space of all four wings. Triangle of hinder-wing of female frequently crossed by a nerve running parallel to long axis of wing. Pterostigma braced. Anal

[1] περισσος=redundant, excessive.

appendages of male rather like those of *Gomphus, s. str.* Ninth segment of abdomen shorter than eighth. Legs short, hindermost femora when adpressed barely reaching the end of the first abdominal segment; armed with a number of very small tubercles on the ventral surface, not arranged in definite rows. Vulvar scale of female small, deeply cleft.

I have found it difficult to make up my mind as to the proper place of this genus. The character of the cross-nerves between M_{1-3} and M_4 shows a certain amount of variability even on the different wings of a single specimen. In some cases there is distinct evidence of a spacing out of the cross-nerves, suggesting an approach to the condition found in the *Gomphus* series; in other wings there is no evidence of anything of the sort. So that it would, it seems to me, be reasonable to regard this form as a primitive member of the *Gomphus* series, or as an Epigomphine showing a tendency to specialization in the same direction as the *Gomphus* series. The presence of two or even sometimes three cross-nerves in the submedian space, the frequent existence of a cross-nerve in the triangle of the hinder-wing of the female are characters that incline me to think the position of the genus should be rather with the Epigomphines. The colouring and so far as I know the other characters of *Perissogomphus,* do not lend any assistance in settling the question. On the whole I believe the genus is an annectant one and that it will ultimately prove to occupy a position not far from the base of both series.

Another oriental genus, *Merogomphus* Martin, known from a single species from Tonkin, seems to me to be, like *Perissogomphus,* intermediate between the series *Epigomphus* and the series *Gomphus.* It has fore-wings similar to those of the former series, hinder-wings with the differentiation of cross-veins characterizing the latter. The pterostigma is well braced. The anal appendages of the male closely resemble those of *Heliogomphus.* The position of the genus must be regarded as doubtful at present.

Perissogomphus stevensi, sp. nov.

1 ♂, 4 ♀ ♀. Gopaldhara, Darjiling District.
2 ♀ ♀ (fragmentary). Darjiling (cc/1060–cc/1061).

MALE. *Head.* Lower lip black, upper lip, ante- and post-clypeus brownish-black. Bases of mandibles yellow. Frons pale yellow. Occiput and vertex black, the former with a straight margin, edged with long hairs.

Prothorax black, with a fine yellow spot on its posterior margin, in the middle line.

Synthorax yellowish-brown, with a large M-shaped black mark anteriorly. The outer lines of the M run down along the humeral suture on either side from the ante-alar sinuses. The middle part is made up of a median black line running down from the sinuses on either side of the mid-dorsal carina, but not quite reaching the meso thoracic ridge. The carina itself is yellowish-brown.

In addition, the second lateral suture is marked with a narrow black band.

Legs black, the first pair of femora yellowish on their ventral surfaces.

Abdomen black, marked with yellow. The first segment is yellow laterally, and has a dorsal band of the same colour, much contracted at its middle. The second is likewise yellow on the sides, with yellow oreillet, and it has a trilobed dorsal band of yellow extending the whole length of the segment. Segments 3–7 have a narrow longitudinal band of yellow dorsally, commencing at the base of each segment, but not reaching to the apex except in the case of the third segment. In each case this band is broadest at the base of the segment and narrows rapidly apically to a very fine line. It is broadest on 7. In addition 3 has a small basal lateral mark. The dorsum of segments 8 and 9 is entirely black, but these segments and also 7 have each a complete lateral yellow band. Segment 10 is yellow with black margins. The abdomen is slender, the distal part of 7, and the whole of 8 and 9 rather inflated.

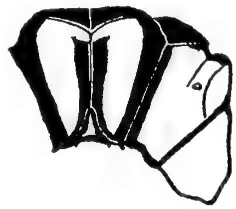

FIG. 6.—Colour-pattern of synthorax of *Perissogomphus stevensi*, sp. nov., ♀.

The anal appendages are pale yellow, and in general like those of *Gomphus*, *s. str.* The upper pair are simple, almost regularly conical, somewhat acuminate, a little flattened below, and very slightly upturned at the apices. They are a little longer than segment 10 of the abdomen.

The lower appendage is about two-thirds of the length of the upper pair. Its terminal half is deeply cleft so as to form two branches, which are a little divaricate and upturned at their apices.

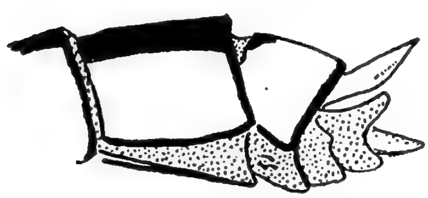

FIG. 7.—Anal appendages of *Perissogomphus stevensi*, sp. nov., ♂.

FEMALE. The female differs from the male in colouring chiefly as follows:—On the *head* the upper lip is dark brown margined with black. The ante- and post-clypeus are dark-brown, the vertex and occiput are also very dark brown. Further, the hinder margin of the latter carries at either extremity a small spine.

The *prothorax* has the posterior margin entirely yellow. On the *synthorax* the only noticeable difference lies in the fact that the black line situate on either side of the mid-dorsal carina is truncate below, and not rounded as in the male.

The abdominal markings are very much like those of the other sex. The lateral markings on the first three segments form a more definite band, reaching to the middle of the third segment. In general the colouring is not quite so bright as in the male, but the female specimens are all more mature and in worse preservation.

Length of abdomen of ♂ 35 + 1·5 mm. (approx.), of hinder-wing 33 mm.; length of abdomen of ♀ 41 mm., of hinder-wing 37 mm.

Antenodal cross-nerves on fore-wing 17, post-nodals 13; antenodal cross nerves on hinder-wing 14, post-nodals 14.

Two of the six females examined have the triangles of the hinder-wing free. One female has three cross-nerves in the sub-

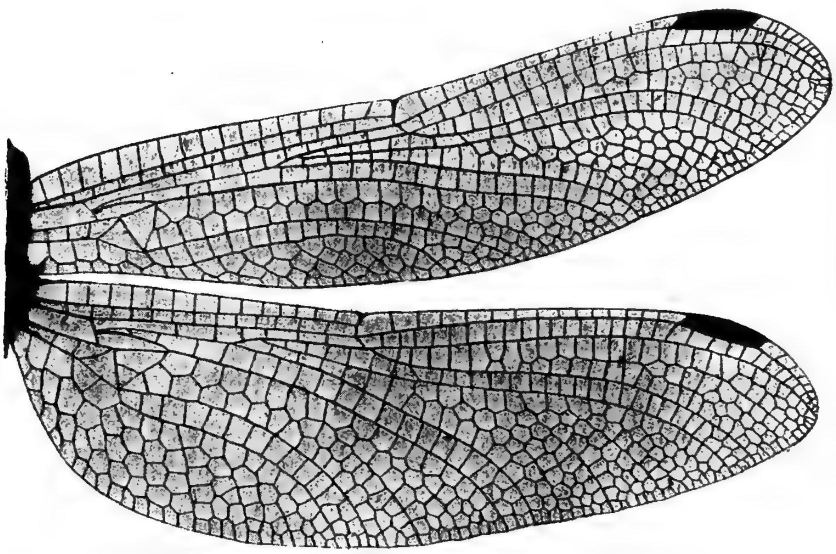

FIG. 8.—Venation of *Perissogomphus stevensi*, sp. nov. (Photo by F. W. Campion.)

median space of the fore-wing the other specimens have two apiece.

Series GOMPHUS (Williamson).

" Associated with uncrossed triangles, supra-triangles, and sub-triangles is a reduction and specialization in the cross-veins between M_{1-3} and M_4. This last character is unique in the Anisoptera." The forking of M_{1-2} and M_3 is approximately symmetrical.

The difficulty of defining genera in a satisfactory way, and of indicating their proper systematic position in grouping them with their allies, obvious enough in all the larger series of Gomphines, is especially so in the case of this large and dominant series which contains, as Williamson remarks, not less than thirty genera and two hundred and fifty species.

Clear-cut venational characters are not to be found, though this is possibly to some extent due to the fact that the very large genus *Gomphus* is something of a "dump" for a certain number of species whose exact position is at present doubtful. On the other hand, anyone who examines a considerable number of specimens belonging to several of the genera of the series can scarcely fail to notice that whereas the specialization of cross-veins between M_{1-3} and M_4, used by Williamson as the most important character for the definition of the series, is tolerably constant in the hinder-wing, in the case of the fore-wing a certain range of specific and even of individual variation may occur. Further, I believe that in certain genera, probably in those which are to be regarded as the most highly evolved of the series, this variability in the case of the fore-wing is by no means marked; it seems to me even to be absent in some cases, so that in such genera the specialization of the fore- and hinder-wings is about equal. Unfortunately, owing to the occurrence of tolerably numerous cases of individual variations of the fore-wing, the degree of specialization exhibited by it cannot as yet be used as a generic character.

Of characters available for grouping genera which appear to form natural assemblies in the series the most evident are those supplied by the anal appendages of the males. These characters, backed to some extent by colour peculiarities, and also here and there by features of the venation, give a grouping which I am persuaded is tolerably natural, and of some practical value. I would again insist that in presenting such an arrangement here I am drawing largely on suggestions and hints made by de Selys, by Williamson and by Ris, and that I am dealing entirely with Indian or Oriental forms. I believe the tribes or sections of the series defined below to have approximately equal value. *Davidius* would seem venationally to be the least specialized, and perhaps the most easily defined. *Onychogomphus* and *Heterogomphus* are the most advanced. In them it is rare or exceptional to find an individual in which the specialization of the cross-veins between M_{1-3} and M_4 of the fore-wing is not as fully developed as in the hinder-wing.

I propose then to group the bulk of the oriental members of the series in the following five "groups," leaving out of account one or two genera whose position is to my mind doubtful, or which are not sufficiently known to me. From what I have seen of the British Museum collection I should be inclined to say that there are still several genera awaiting recognition, especially amongst the material from Tonkin, a country apparently very rich in Gomphinae.

Groups:

DAVIDIUS,
CYCLOGOMPHUS,
GOMPHUS,
ONYCHOGOMPHUS,
HETEROGOMPHUS.

Group: DAVIDIUS.

Number of cross-nerves between M_{1-3} and M_4 not so constant, and not always showing the same amount of specialization in the fore-wings as in the hinder-wings. Sectors of arculus widely separated at their origin, constantly though slightly divergent, and scarcely curved Triangle of hinder-wing with costal margin about twice as long as the basal margin, its outer margin distinctly angled; often with a cross-nerve. Cu_1 and Cu_2 in hinder-wing distinctly divergent. Pterostigma braced. Basal antenodal nervure of 2nd series occasionally present. Hindermost femora when adpressed reaching almost to distal end of second abdominal segment (in *D. davidi*). Dorsum of segments 3–7 of abdomen entirely black, or marked with a fine longitudinal line of yellow.

Upper anal appendages of male each with large ventral process. Lower appendage cleft at the apex, its branches not divaricated.

Genus **Davidius** Selys.

Genotype: *D. zallorensis* Selys (?).[1]
Species studied: *D. aberrans* Selys; *D. davidi assamensis* Laidlaw.

Characters of the tribe.

Distribution: Himalaya, Assam, Tonkin, China, Japan, Manhuria.

Davidius aberrans Selys.

1 ♀. Binyar, Kumaon, 7700 ft., 24-v-1912. A. D. Imms, For. Zool. Coll.

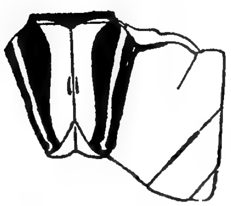

FIG. 9.—Colour-pattern of synthorax of *Davidius aberrans* Selys, ♀.

This specimen has the triangles of both hinder-wings crossed by a single nerve, and in addition the triangle of the right forewing is traversed by a nerve lying parallel to the long axis of the wing. The triangles of the fore-wings in this specimen are relatively more elongated than appears to be the case in the species figured by Ris.

Length of abdomen 34 mm., of hinder-wing 28 mm.

Davidius davidi assamensis Laidlaw.

1 ♂, 2 ♀ ♀. Gopaldhara Darjiling District 9-v-14. H. Stevens.

Dorsum of synthorax entirely black save for the small mesothoracic collar and a small extension from this running up the mid-dorsal carina for about the first half of its length.

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[1] Should *D. zallorensis* and *D. aberrans* prove to be conspecific the latter name must take precedence, and the genotype would then be *D. aberrans* (Selys).

In the male the last five segments of the abdomen are entirely black. The seventh segment shows a peculiarity that I have not seen remarked on. A little beyond the middle of the segment the ventral border of the tergite is produced on either side to form a small tubercle-like process armed with stout hook-like spines directed backward. The ventral margins of the tergite of the eighth segment carry a series of spines, about the middle of the segment, rather larger than is usual in that position, and the sternite of that segment carries, close after its base, a small blunt projection. The significance of these structures is unknown to me.

The anal appendages of the male resemble rather closely those of *D. cuniculus* Ris, a Japanese species.

Of the species referred to the genus, *D. nanus* Selys would appear to have a doubtful right to the position. As Ris has pointed out the anal appendages of the male are quite unlike those of other species where known. This species is Japanese.

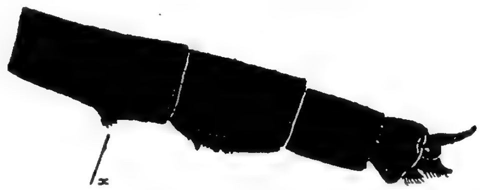


FIG. 10.—Apex of abdomen of *Davidius davidi assamensis* Laidlaw, ♂. *x*, process of edge of tergite of the seventh segment.

D. fruhstorferi Martin, is in its venation clearly a member of the tribe *Davidius*. But the reduced anal area of the hinder-wing, and the characters of the male anal appendages suggest to me that it may require transference to a distinct (and new) genus, as already hinted by Ris.

For the rest *D. lunatus* (Bartenef), *D. aberrans* Selys, and *D. zallorensis*, have a yellow mark on the occiput; the first of these is Manchurian, the two others (probably conspecific) are from the Himalayas.

D. davidi Selys, from S. China and Assam, *D. ater* Selys, and *D. cuniculus* Ris, both from Japan, have a black occiput.

Lastly *D. bicornutus*, also from Japan, is larger than the other species, is known only from a female specimen and is of doubtful generic position.

Length of abdomen of ♂ 31 mm., of hinder-wing 26·5 mm.; length of abdomen of ♀ 28 mm., of hinder-wing 28·5 mm.

Group CYCLOGOMPHUS.

It is impossible to give a really satisfactory definition of this tribe, apart from sexual characters. None the less I am persuaded that it is a true phylogenetic entity.

The tribe is characterized by the anal appendage of the male. The upper pair are small, nearly parallel to one another, and often brightly coloured. They are often provided with a strong ventral projection. The lower appendage has its branches widely divaricated, often these are longer than the upper appendages. In many cases the hinder femora are long, and have the spines of their apical half at least much longer than is usually the case with the other tribes of the series so far as I know. The occiput of the female is generally much reduced. A longitudinal dorsal stripe is often present on the last four segments of the abdomen. Lastly, the differentiation of the cross-nerves between M_{1-3} and M_4 does not seem so firmly fixed a character as in the three remaining tribes of series.

In *Anisogomphus* in fact, some individuals show scarcely more differentiation than does *Leptogomphus* in this respect, others in my short series show marked differentiation in the hinder-wing, less or none in the fore-wing. I have not enough material for a statistical study, but I believe that in *Cyclogomphus* about one individual in four shows lack of differentiation in the fore-wings.

An examination of the males of *Podogomphus praetorius* and of *Notogomphus* sp. in the British Museum has convinced me that these two genera at least, in addition to the Oriental forms here enumerated, belong to this tribe.

Genus **Cyclogomphus** Selys.

Genotype: *C. hypsilon* Selys.
Species examined: *C. hypsilon* Selys; *C. heterostylus* Selys.

A genus of rather small Gomphines, characterized by the presence of a basal antenodal nervure of 2nd series on all four wings (absent from one hinder-wing of a single female specimen of *C. hypsilon* only). The costal side of the triangle of the hinder-wing is much longer than the basal side (almost twice as long in *C. hypsilon*), only one cross-nerve in the submedian space of both wings. Costal nerve with a fine yellow line. The pterostigma is relatively long, more than one-quarter the length of the distance between the nodus and the distal end of the pterostigma.

The hinder pair of femora when adpressed reach to the end of the proximal third of the second segment of the abdomen. They are armed with two rows of spines on the ventral surface, and there are in addition a few scattered tubercles of minute size near the base. The vulvar scale is small.

Of the five species which have from time to time been referred to the genus, *C. torquatus* Selys is undoubtedly a *Microgomphus*. The small species, *C. minusculus* Selys, known from a single specimen, a female taken at an elevation of between 4000 and 6000 ft. near Tenasserim, will in all probability prove to belong to a different genus.

C. vesiculosus Selys, described from an imperfect male, has been recorded from Poona by Major Fraser, but is unknown to me; it appears to differ, according to de Selys' account, but little from *C. hypsilon*, chiefly in its smaller size.

Cyclogomphus hypsilon Selys.

12 ♂♂, 9 ♀♀. Poona, Kartraj Lake, Aug., Sept., 1918.

The pterostigma is uniformly brown, enclosed between dark brown nerves, whilst in the next species (*C. heterostylus*, Selys) it is dark in the centre, and distinctly paler for its outer third. Furthermore, the light markings on the dorsum of the terminal segments of the present species are more extensive. Colouring varies much with age and state of preservation.

FIG. 11.—Abdomen of *Cyclogomphus hypsilon* Selys, ♂, seen from above.

Length of abdomen of ♂ 28 mm., of hinder-wing 25 mm.; length of abdomen of ♀ 30 mm., of hinder-wings 26 mm.

Cyclogomphus heterostylus Selys.

2 ♂♂, 1 ♀. Poona, 19-ix-19. 1 ♀. Darjiling, 4-vii-18. 1 ♀, St. Thomas Mount, Madras, 9-iii-18 (all from Major F. C. Fraser).

I cannot find any characters by which to distinguish the Darjiling specimen from the female from Poona. The males agree precisely with the figure given for this species in the monograph.

Length of abdomen of ♂ 28·5 mm., of hinder-wing 26 mm.; length of abdomen of ♀ 30 mm., of hinder-wing 26·5 mm.

Genus Anisogomphus Selys.

Genotype: *A. occipitalis* (Selys).
Species examined: *A. occipitalis* (Selys); *A. orites*, sp. nov.

A genus of medium-sized Gomphines, distinguished from *Cyclogomphus* and *Temnogomphus* by the absence of a basal antenodal nervure of 2nd series. The costal nerve is black, and in general the colouring, especially in adult specimens, is rich but more sombre than in allied genera. Pterostigma relatively shorter than in *Cyclogomphus*. The inferior anal appendage of the male carries two stout rather widely divaricated branches, the superior appendages are coloured (in Indian species), each carries a stout black ventral process. The occiput of the female is much reduced. The vulvar scale has a length of about two-thirds of the ninth segment, its apical quarter is cleft.

Hindermost femora when adpressed reach to the middle of the second segment of the abdomen. Their armature consists of two rows of spines on the ventral surface, rather irregularly spaced, and varying a little in length, those placed more distally being on the whole the longer.

Of the species referred to the genus in Kirby's catalogue, the African *A. praetorius* Selys, has been since referred to an allied genus *Podogomphus* by its author.

I have ventured to remove *A. bivittatus* Selys, to a separate genus. The two species from N.-E. Asia, *A. maacki* Selys, and *A. M-flavum* Selys, are unknown to me save from the description. Both appear to belong to the genus.

Lastly *A. nietneri* Selys is referred by me to the new genus *Heliogomphus*.

Anisogomphus occipitalis (Selys).

2 ♂ ♂, 2 ♀ ♀ (in poor condition). Gopaldhara, Darjiling district. H. Stevens.

1 ♂. Darjiling, 1–3000 ft., May, 1912. Lord Carmichael's collection (cc/1167).

1 ♂, 1 ♀. Turzum Tea Estate, Darjiling, Mar. 1920. O. Lindgren.

1 ♂, Darjiling Dists. (1409/H2). 1 ♂, 1 ♀. Darjiling Dists. (3424/H1).

Closely allied to the following species, from which it is readily distinguished by the following characters:—

(i) All the specimens of *A. occipitalis* before me have two cross-nerves in the cubital space of the fore-wing.

(ii) The upper end of the dorsal stripe of the synthorax is not confluent with the upper end of the antehumeral stripe.

(iii) The black bands on the lateral sutures of the synthorax are much broader than in *A. orites*.

(iv) The anal appendages of male *A. occipitalis* also show marked differences. The ventral process of the upper pair is straight and dagger like, and this process, owing to the fact that the appendages are more closely approximated than is the case in *orites*, is invisible from above. Further the branches of the lower appendage are straighter and rather more slender, with a more pointed apex.

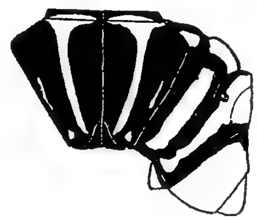


FIG. 12.—Colour pattern of synthorax of *Anisogomphus occipitalis* Selys, ♂, adult.

In young specimens of this species the antehumeral band of the synthorax is complete, in older specimens it is in part obliterated, and comes to consist of a dorsal spot, rather widely separated from a more anteriorly placed linear remnant.

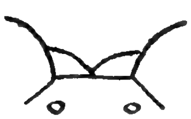


FIG. 12*a*.—Occiput, *Anisogomphus occipitalis* Selys, ♀, outline.

Length of abdomen of ♂ 32 mm., of hinder-wing 30 mm.; length of abdomen of ♀ 33 mm., of hinder-wing 32 mm.

Anisogomphus orites,[1] sp. nov.

1 ♂, 1 ♀. Shillong, Sept., 1919. T. B. Fletcher. (Type and allotype.) " ♀ Flying along hedge away from water."

MALE. *Head* black save for a small spot on either side of the upper lip, the bases of the mandibles, and a broad band across the top of the frons from eye to eye. The markings are lemon yellow.

Prothorax black, marked with yellow on its hinder lobe.

Synthorax with black dorsum, yellow mesothoracic collar interrupted in the middle line. Dorsal bands meeting the collar anteriorly, running close up to the ante-alar sinuses, narrow, regular, of a pale greenish-yellow-colour, confluent at their upper extremities with a small rounded spot on either side, the vestige of the upper end of the ante-humeral band, which is otherwise obsolete save for a fine line lying close against the humeral suture at about the middle of its length. The black of the dorsum passes on either side just beyond the humeral suture. The sides of the thorax are greenish-yellow in colour with a narrow black band on the first and second lateral sutures. The meso- and meta-notum are whitish-yellow.

FIG. 13.—Colour-pattern of synthorax, *Anisogomphus orites*, sp. nov., ♂.

Legs black; the first pair of femora have a greenish-yellow band on the extero-lateral surface.

Abdomen black, of a particularly rich, almost velvety quality. The first segment has a transverse mark of yellowish-white dorsally. Segments 2–7 have each of them a dorsal, longitudinal

FIG. 14.—Last six segments of abdomen of *Anisogomphus orites*, sp. nov., ♂.

band of the same colour, extending nearly the whole length of the segment but not quite reaching its apex. That on the second segment is trilobed; on segments 4–7 the bands are narrow and linear, that on the seventh being the most conspicuous. The sides of the first and second segments, including the oreillets, are greenish-yellow, also a small basal lateral spot on the third.

Upper *anal appendages* small, white in colour and aculeate. Each carries on its ventral side a large, black process. This process appears in side view almost triangular, attached above by its apex, widening ventrally. Each is somewhat incurved so as to be visible

[1] ὀρειτης = mountaineer.

between the upper part of the appendages when the abdomen is viewed directly from above. The lower distal angle of each of these processes ends in a small projecting point. Branches of lower appendage black, stout, curved a little upwards and outwards, with rounded apices.

FEMALE. Colouring in general very similar to that of the male. The third abdominal segment has a longitudinal lateral band of colour, and each of the segments 4–7 has a small lateral basal spot on either side. As in the male the upper anal appendages are white.

Length of abdomen of ♂ 31·5 mm., hinder-wing 30 mm.; length of abdomen of ♀ 34 mm., of hinder-wing 31·5 mm.

The *venation* of this species is in general very similar to that of its congener *A. occipitalis*. Neither of the two specimens before me, however, have the additional cross-nerve in the cubital space of the fore-wing. Though one cannot assert with any degree of certainty that the presence or absence of this additional vein can be used to distinguish the two species, what evidence exists points in this direction. I have accordingly omitted the presence of an additional nerve in this area from the generic characters.

Genus **Temnogomphus**,[1] nov.

Genotype: *T. bivittatus* (Selys).
Species examined: *T. bivittatus* (Selys) ♀.

A genus containing a single species of moderate size. It is characterized by the possession of a basal antenodal nervure of the 2nd series, and by the colour-line on the costal nerve which separate it from the closely allied *Anisogomphus*. From *Cyclogomphus* it differs in the relatively short pterostigma, and in having the triangle of the hinder-wing not elongated. It is also larger than in the species of *Cyclogomphus*.

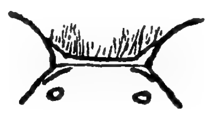


FIG. 15.—Occiput of *Temnogomphus bivittatus* (Selys) ♀, outline.

The occiput in the female is reduced to a marginal line. The hindermost femora when adpressed reach to the end of the first segment of the abdomen. The armature consists of relatively long spines, much as in *Anisogomphus*.

Temnogomphus bivittatus (Selys).

2 ♀. Kumaon, v-1911. A. D. Imms, For. Zool. Coll.

The species is readily identified by the yellow face with two black bands running across it. The lower of these is the "anteclypeus" the upper a black band across the lower part of the frons. The occiput in the female is reduced to a narrow yellow margin between the eyes, fringed with long yellow hairs. The prothorax has its anterior and posterior margins yellow. On the syntho-

[1] τέμνω=cut or separate.

rax the mesothoracic collar is narrowly interrupted in the middle line, the dorsal stripes join it on either side, and the juxta-humeral stripes are complete and rather broad. The sides are yellow with very narrow black lines along the sutures.

The abdomen has a longitudinal median band of whitish-yellow on all the segments except the tenth, complete save for the narrow black sutural rings, bounded on either side by a brownish-black band; this encloses on either side a lateral band of yellow, broad and complete on the first and second segments, divided into two parts on segments 3–7 by the black mark on the transverse carina of each of those segments. On 8–9 the yellow lateral band is complete, and on the tenth segment it passes entirely to the ventral side, whilst the dorsum of the segment is black. Anal appendages black. The femora are yellow, with brownish-black spines and a dorsal brown band on each, the tibiae are black.

On the back of the occiput is a curious rounded tubercle of a bright yellow colour.

Length of hinder-wing 33 mm., of abdomen 36 mm.

The two males in the British Museum labelled as belonging to this species, one of them so labelled by de Selys himself, are evidently rather examples of *A. occipitalis*, as was recognized by de Selys in his latest account of the species (*Causeries Odonatologiques* No. 7, 1894). In this account he remarks further that *A. bivittatus* has a basal antenodal nervure of the 2nd series. This combined with certain other features emboldens me to remove *bivittatus* from the genus *Anisogomphus*, and to erect for it the new genus described above.

Group GOMPHUS.

Fore-wing and hinder-wing showing about equal specialization in regard to the arrangement of cross-nerves between M_{1-3} and M_4. Sectors of arculus well separated as a rule, approximately parallel and well curved. Cu_1 and Cu_2 parallel or only slightly divergent on hinder-wing. M_4 and Cu_1 slightly divergent (or parallel in *Burmagomphus*) at the level of the nodus, in the fore-wing. Pterostigma braced, basal antenodal nervure of the 2nd series usually absent. Legs variable, in *Gomphus, s. str.*, rather long. The male often has a conspicuous yellow mark on the dorsum of the ninth abdominal segment. Upper anal appendages of male shaped much like the same structures in the Libellulinae. Lower appendage with its branches divergent, usually a little shorter than the upper pair, and roughly parallel with them.

A. Hinder-wing of male with its anal border rounded. Small insects with reduced venation. Body sandy colour ... ... *Anormogomphus* Selys.

B. Anal border of hinder-wing of male sharply angled.

1. Four rows of cells at least between Cu_2 and hinder margin of hinder-wing ... ... *Gomphus* Leach.
2. Usually three rows of cells between Cu_2 and hinder margin of hinder-wing.

a. Apical segments of male abdomen much dilated	*Platygomphus* Selys.
b. Apical segments of male abdomen only slightly dilated. M_4 and Cu_1 parallel to beyond level of nodus of fore-wing ...	*Burmagomphus* Williamson.

Genus **Anormogomphus** Selys.

Genotype: *Anormogomphus heteropterus* Selys.
Species examined: *A. heteropterus* Selys.

This genus may ultimately come to be placed in a distinct tribe, but there seems no reason to doubt that it is derived from ancestors belonging definitely to the Gomphine series. It is of course unique amongst the Gomphinae by reason of the rounded hinder wings of the males.

Its geographical distribution is of great interest. With *Vanderia* (an ally of *Ictinus*) and with the Libelluline *Selysiothemis*, it is characteristic of the desert areas of S.-W. Asia, but has apparently a more restricted distribution than either of the other genera.

Anormogomphus heteropterus Selys.

1 ♂. Lahore. H. T. Pease.

The small genus of which only two species are known, seems to be confined to the arid regions of W. Asia.

The specimen before me agrees precisely with the account given of this species in the monograph. The other described species occurs in Mesopotamia and Turkestan, and is rather larger than *A. heteropterus*. This species is *A. kiritshenkoi* Bart., of which I have seen a series in the British Museum.

Genus **Gomphus** Leach.

Genotype: *G. vulgatissimus* (Linn.).
Species examined: *G. personatus* Selys; *G. nilgiricus*, sp. nov.

My knowledge of this genus is very limited. A brief comparison of the genotype with the species inhabiting India (and some of their more immediate Eastern allies) gives one the impression that characters for a subdivision of the genus may be forthcoming in the future.

I confine myself to describing a species from the Nilgiri Hills that appears to be new, and to very short notes on the other Indian species.

Gomphus personatus Selys.

1 ♂ (fragmentary). Assam. Labelled by de Selys "*Gomphus promelas*? ♂." (5442/20).

Differs from the type in having only a superior spot, instead of a narrow vestige of the antehumeral stripe; in other respects what there is of the specimen agrees with the account given by de Selys; and I have no doubt but that the specimen is correctly referred to the present species. The structure of the second pair of genital hamules is very similar to that found in *G. nilgiricus*, but the hamule is more curved forward at its apex and not so prominent as in that species.

Gomphus nilgiricus, sp. nov.

1 ♂. Nilgiris, 3000–4000 ft. F. C. Fraser.

Head. Lower lip yellow, upper lip brown, bases of mandibles and anteclypeus of the same colour, post-clypeus black. Vertical part of frons black, horizontal part lemon yellow. Vertex and occiput black, the latter with its hinder margin a little raised medially.

Prothorax black, the middle lobe with a large lateral spot of yellow on either side, and a small mid-dorsal, paired, yellow spot; the hinder margin likewise yellow.

Synthorax black dorsally, with a pair of rather broad yellow dorsal stripes, meeting the yellow mesothoracic collar, which is widely interrupted in the middle line. Sides yellow, with black

FIG. 16.—Colour-pattern of *Gomphus nilgiricus*, sp. nov., ♂, semi-diagrammatic.

bands along the lateral sutures, the metepisternite between these bands is darkened so that at first sight the bands appear to coalesce.

Legs black, rather long; hindermost femora 7·5 mm.

Abdomen slender, cylindrical, the eighth segment a little wider and deeper than the rest. Black, marked with yellow as follows:—Sides of first and second segments, including the oreillet, which are, however, heavily margined with black; lateral ventral mark on third segment; dorsum of first segment, the yellow mark widening apically; a longitudinal band on the dorsum of the second segment, extending the whole length of the segment, widest basally; a dorsal line on the third segment, wide at its base, narrowing rapidly, extending as a fine line almost to the apex of the segment. Segments 4–7 with fine paired spots lying basally on the dorsum of each. Distal half of 9 yellow.

Anal appendages black; upper pair about as long as the tenth segment, curved slightly ventralwards, ending in a fine upturned point. Branches of lower appendage about equal to them in length and equally divaricated.

Genital structures of second abdominal segment, black in colour. Anterior pair of hamules, small, simple and partly concealed between the second pair. These are large and very conspicuous, rather trigger-shaped, their apices lying ventrally to the triangular vesicle.

Length of hind-wing 35 mm., of abdomen $39+1\cdot5$ mm.

Venation that of a typical *Gomphus*, pterostigma braced, nodal indicator $\frac{12-13}{12-\ \ 9}\Big|\frac{15-12}{10-13}$.

G. xanthenatus Williamson, Burma. Traces of the juxta-humeral band present, a broad black band on the two lateral sutures. Abdomen of ♂ 45 mm., hinder-wing 39 mm.

G. personatus Selys, Assam. Traces of juxta-humeral band present, narrow black bands on lateral sutures, the first incomplete above.

Abdomen of ♂ 42 mm., hinder-wing 37 mm.

G.? promelas Selys, Madras. Dorsal stripes of synthorax "presque confluentes" with mesothoracic collar, no juxta-humeral stripe. Pterostigma unbraced. Exact position doubtful. Female only known.

Abdomen of ♀ 42 mm., hinder-wing 38 mm.

G.? ceylonicus Selys, Ceylon. Narrow isolated dorsal stripes, juxta-humeral band represented by a superior spot. Pterostigma unbraced. Female only known. Abdomen of ♀ 41 mm., hinder-wing 39 mm.

Genus **Platygomphus** Selys.

Genotype: *P. dolabratus* Selys.
Species examined: *P. dolabratus* Selys.

Differs from oriental species of *Gomphus* in having the anal margin of the hinder-wing of the male only slightly excavated, so that the anal angle of the hinder-wing is not so bold as in that genus. In this respect it shows some approach to *Anormogomphus*. The number of rows of cells between Cu_2 and the margin of the hinder-wing is three only. The apex of the abdomen of the male is more dilated than in the oriental species of *Gomphus*, and the colouring is rather of the 'xerophilous' type; i.e. more brown and yellow than is usual in the allied forms where yellow and black prevails.

Platygomphus dolabratus Selys.

1 ♂.

Upper lip entirely yellow. Vertex with a diamond-shaped yellow spot between the posterior ocelli, occiput yellow glabrous. Dorsum of synthorax black, with dorsal stripe reduced to a large triangular spot on either side of the mid-dorsal carina. Juxta-humeral band remarkably broad, complete, mesothoracic collar not interrupted in middle line. Sides yellow, short dorsal black mark at upper end of first lateral suture, very narrow complete black line on second suture. Abdomen with segments 1–6 black with longitudinal brown bands dorsally; 7–10 mainly brown. Hindermost femora yellow.

Length of abdomen 38+1·25 mm., of hinder-wing 30 mm.

The species *P. feae* Selys, from Burma, is apparently closely allied. It differs in having no black on the clypeus, the yellow mark on the vertex is absent, and the short black band on the upper end of the first lateral suture of the synthorax is carried vertically downwards to join the black line of the second suture, forming with it a **Y**-shaped mark.

Genus **Burmagomphus** Williamson.

Genotype: *B. vermiculatus* Williamson? *nec* Martin.

Species examined: *B. pyramidalis*, sp. nov.; *B. sivalikensis*, sp. nov.; *B.* sp.

Rather small species (h.w. about 27 mm.). There is marked parallelism between M_4 and Cu_1 in the fore-wing to beyond the level of the nodus. As a rule only three rows of cells between Cu_2 and hinder margin of hind-wing. (Individually there are sometimes four rows). Generally only a single row of cells between M_1 and M_{1a} at distal end of pterostigma.

The genus probably contains a considerable number of small species which may shade off into *Gomphus* on the one hand and into *Platygomphus* on the other. Ris has pointed out that the parallelism of M_4 and Cu_1 is a feature common with *Onychogomphus* the Javanese species, *B. jacobseni* Ris, has the apex of the abdomen very like that of a *Platygomphus*, though the venation is definitely that of a *Burmagomphus*.

The genotype is the species described by Williamson under the name *Burmagomphus vermiculatus* (Martin). But his specimens are very probably not conspecific with Martin's, in which case the genotype would be without a name.

B. pyramidalis, sp. nov., is closely allied to both Martin's and Williamson's species; as in the latter the oblique yellow stripe of the dorsum of the synthorax is formed by the fusion of the upper part of the dorsal, with the lower part of the juxta-humeral stripe, a peculiarity which seems to occur in Martin's species as well. The three may well be geographical races of a single species. On the other hand the Bornean form which I described under the name *B. vermiculatus insularis* must rank as a distinct species, it appears to be related to a form from the Nilgiris represented in the collection before me by a single very immature example.

B. jacobseni Ris is quite distinct and as stated above in some respects approaches *Platygomphus*.

Lastly the new species, *B. sivalikensis*, from Dehra Dun is again quite distinct, and possesses a complete juxta-humeral stripe. In size and general proportions it resembles *B. pyramidalis*.

Burmagomphus pyramidalis, sp. nov.

8 ♂♂, 10 ♀♀. Poona, Aug., Sept., 1919. F. C. Fraser.
1 ♂. Nilgiri Hills, June, 1917. F. C. Fraser.
1 ♀. Gopaldhara, Darjiling district, 1913. H. Stevens.

MALE. *Head.* Lower lip yellow, black at its margins with lateral lobes greenish-yellow. Upper lip greenish-yellow, with narrow, black, anterior margin, and transverse black basal line prolonged forward in the middle line, but not meeting the black of the margin. Bases of mandibles yellow, genae black. Ante-clypeus black, post-clypeus black, with a median spot of greenish-yellow, and a pair of lateral spots of the same colour. Frons yellow, margined with black. Occiput and vertex black. The posterior margin of the occiput is slightly concave.

Prothorax black, with a greenish-yellow spot on either side.

Synthorax. There is a broad, complete mesothoracic collar of yellow. Above this is a pyramid of black, at the apex of which lies a small median yellow spot against the ante-alar sinuses. The pyramid is outlined on either side by an oblique yellow band which runs from just below the median yellow spot, without actually touching it, to the base of the second pair of legs. This

FIG. 17.—Colour pattern of *Burmagomphus pyramidalis*, sp. nov., ♂, semi-diagrammatic.

band is abruptly narrowed above from without inward, and ends dorsally in a fine point. To the outer side of its upper end and close below the lateral part of the ante-alar sinus is a small yellow triangle. The black colouring extends from the outer margin of the yellow band to just beyond the humeral suture. Laterally the synthorax is yellow, with a complete narrow band of black along the second lateral suture, and with a black mark along the lower part of the first lateral suture, extending upwards a very little beyond the level of the spiracle. A short black line descends vertically from the base of the first wing towards the black band of the second lateral suture, but does not meet it. Legs black, coxae of first and third pairs, and ventral surface of first pairs of femurs marked with yellowish-white.

Abdomen black. First segment with a basal dorsal mark of yellow, and a lateral mark of the same colour. Second segment with a basal ring of yellow, a mid-dorsal triangle of the same colour, and the sides of the segment, including the oreillet, likewise yellow: an apical ring of black. Segments 3–8 with a basal ring of yellow, extending for about one-sixth of the length of the segment on 3, about one-fifth on segment 7, very narrow on 8, where, however, it is produced at the sides for about one-half the length of the segment, and followed by a yellow apical mark. The ninth segment has a large apical dorsal brownish-yellow mark. Segment 10 and the anal appendages are entirely black. The upper pair are about as long as the tenth segment, slightly divaricate, acuminate at their apices, the outer margin elbowed at its middle, with a minute ventral tooth at the level of the elbow. The lower appendage has two branches, slightly longer than the upper pair of appendages, more widely divaricated, and sharply upturned apically. The genital structures of the second abdominal segment are black in colour. The first hamules are small and inconspicuous, the apices pointed and hooked backwards. The second pair are large, rather oval, and each carries a prominent forwardly directed hook near its apex.

FEMALE. Colouring very similar to that of the male. It differs chiefly in having the basal yellow ring of the third segment of the abdomen broader, and in the presence of a lateral distal yellow mark on the same segment, whilst the lateral distal mark on the eighth segment is reduced and the dorsal yellow mark on the ninth is much smaller than in the male.

Length of abdomen of ♂ 29+0·75 mm., of hinder-wing 23·5 mm.; length of abdomen of ♀ 33 mm., of hinder-wing 27 mm.

Burmagomphus sivalikensis, sp. nov.

1 ♂. Dehra Dun, 4-ii-19. F. C. Fraser.

Head. Lower lip pale yellow. Upper lip yellow with black margins, and a median black line dividing the yellow into two large lateral spots. Bases of mandibles yellow. Anteclypeus brownish-black, post-clypeus the same, with a median and pair of lateral yellow spots. Frons yellow, with a black line extending from eye to eye across its vertical part. Vertex black, occiput yellow, margined with black, its posterior margin gently convex, carrying a fringe of long brownish-black hairs.

Prothorax black, its anterior margin, a pair of lateral spots on the hinder margin and a minute median spot on the same margin yellow.

Synthorax. Dorsum black marked with yellow as follows:—a broad mesothoracic collar, finely divided by a median black line; a pair of dorsal lines separated below from the mesothoracic collar and above from the ante-alar sinuses, and outside these on either side, a longer irregular juxta-humeral band, constricted a little below its apex, running down and continuing on to the mesinfraepisternite. This band is margined externally by a black line which runs on either side of the humeral suture. The sides of the synthorax are yellow; a narrow black band, of about the same width as that lying along the humeral suture, runs along the position of each of the lateral sutures on either side.

Legs black, the inner surface of the first pair of femurs yellowish-white.

Abdomen black, marked with yellow as follows :—Sides of first and second segments, including the oreillet; dorsum of first segment, and a longitudinal band on dorsum of second segment, the latter mark narrowing apically; a basal ring, occupying nearly the first third of segment three, but contracted dorsally in the middle line, in addition a distal lateral yellow mark; a similar basal ring on segments 4–7, but relatively smaller, and occupying only about one-quarter of each segment. Eighth segment entirely black, ninth with a dorsal triangle of orange-yellow, its base resting on the apical margin of the segment, its apex not quite touching the base of the segment. Terminal segment black.

Anal appendages black, very similar to those of *B. pyramidalis*. The upper pair about as long as segment 10, acuminate, very slightly upturned at the apex, elbowed on the outer margin. Lower appendage a shade longer, its branches rather more divaricated than are the upper appendages, upturned at the apices.

Genital structures of second segment of abdomen similar to those of *B. pyramidalis*, but the first pair of hamules are relatively larger and more prominent, the second pair not so oval but sloping obliquely backwards and ending in a forwardly directed hook.

Length of abdomen of ♂ 33+1 mm., of hinder-wing 25·5 mm.

Group ONYCHOGOMPHUS.

Fore-wing and hinder-wing showing equal specialization in regard to the cross-nerves between M_{1-3} and M_4. Sectors of arculus as in preceding tribe. Cu_1 and Cu_2 nearly parallel as far as wing margin. Pterostigma braced. M_4 and Cu_1 parallel to level of nodus in fore-wing. A_2 separated from A_1 by two rows of cells from immediately below the subtriangle, whereas in the preceding tribe there is usually a single cell between them at their origin; further A_2 lies nearer the wing base in this tribe than in *Gomphus*. Legs very short, hindermost femora scarcely reaching beyond the end of the synthorax when adpressed. Colour pattern not affording any definite characters for separation of the tribe. Upper anal appendages of male longer than tenth segment of abdomen, often equal in length to the ninth and tenth segments together; parallel or converging apically, arcuate.

Genus **Onychogomphus**.

Genotype: *O. forcipatus* (Linn.).

Species examined: [*O. forcipatus* (Linn.)]; *O. lineatus* Selys; *O. grammicus*, Selys; *O. saundersi* Selys; *O. aureus*, sp. nov.; *O. M-flavum* Selys; *O. biforceps* Selys; *O. acinaces*, sp. nov.

Characters of the tribe.

Distribution: Warmer parts of Europe, Africa, tropical Asia as far as the Celebes.

I group the species of this large and rather difficult genus in several sections, which arrangement will, I hope, facilitate to some extent their identification. In this grouping I do not follow exactly de Selys' classification given in the monograph. Having to deal only with oriental forms I have adopted an order which bears more directly on them.

As usually is the case with collections of Gomphines the males are more abundant and more readily recognizable than the females. Hence in this list, as elsewhere in the paper, I am forced to rely largely on male characters, a practice not by any means theoretically ideal but, at the worst, useful in practice.

SECTION I, *grammicus*.

Frons and front of head entirely yellow. Dorsal stripes of synthorax not meeting mesothoracic collar, antehumeral stripes complete. Apex of abdomen of male not dilated. Upper anal appendages about twice as long as branches of lower appendage. A 'xerophilous' section.

Onychogomphus grammicus Selys.

1 ♂. Agra. S. Hankin.

Front of head including the whole of the frons, entirely yellow. Vertex and occiput largely yellow. Synthorax with dorsal yellow stripes not meeting the mesothoracic collar, antehumeral stripes complete. Femora and tibiae largely marked with yellow.

Abdomen almost cylindrical; the eighth segment shows a slight increase in depth compared with the others. The first segment is almost entirely yellow. The second has a trilobed longitudinal dorsal mark of yellow enclosed between lateral bands of brownish-black. Segments 3–6 are whitish-yellow as far as the transverse carina and beyond this black, but the black is marked with a prominent yellow spot dorsally, lying longitudinally.

Segments 7–10 entirely sandy yellow. Anal appendages of the same colour, upper pair nearly twice as long as branches of lower appendage; very like those of *O. lineatus*, but flattened and truncate apically.

Length of abdomen 32·5+3 mm., of hinder-wing 29 mm.

Closely allied to *O. flexuosus* Schneider, Asia Minor.

SECTION II, *lineatus*.

Front of head and frons entirely yellow save for a small transverse black line on the crest of the frons. Dorsal stripes of synthorax not meeting mesothoracic collar, antehumeral stripes complete. Apex of abdomen of male but little dilated from side to side, segments 8 and 9 carry leaf-like expansions. Upper anal appendages closely apposed, parallel and strongly decurved apically, lower appendage about one-quarter of the length of upper pair.

To this group belong the species *O. genei* Selys, and *O. pumilis* (Ramb.). Further the two species of *Mesogomphus* that I have seen in the British Museum, *M. coquatus* Selys, and *M. hageni* Selys, both appear to be derived from it. Like the last this section contains 'xerophilous' forms.

Onychogomphus lineatus Selys.

2 ♂♂, 2 ♀♀. Poona, May–Aug., 1918. F. C. Fraser.
2 ♂♂, 2 ♀♀. Chota Nagpur, July, August, 1915. E. d'Abreu.
1 ♂ (with larval exuviae). Peradeniya, Ceylon, 1700 ft., 7-x-17. N. Annandale.

Probably a very common species. The presence or absence of a row of small denticles on the posterior margin of the occiput seems to be an individual character; two of the females are without the denticles, and one of the males (from Poona) has three or four denticles unsymmetrically arranged in this position, the other males lacking them altogether. It would be interesting to study this character in series from different localities, and also to determine how it is inherited.

Young males have the last four segments of the abdomen entirely yellow, with increasing age a black band develops on the dorsum of these segments, and at the same time the colouring of other parts of the body deepens, making the fully adult insect differ considerably in appearance from younger specimens.

O. lineatus seems to range over the Indian Peninsular but the limits of its distribution to the north and east are not known.

Possibly allied to this species are *O. reinwardtii* Selys, from Java and *O. capitatus* Martin, from Celebes.

O. lineatus is the only Gomphus I know of that shows a development of the second abdominal segment resembling the "genital lobes" of the Libellulidae.

SECTION III, *geometricus.*

Black markings on upper lip and head; frons largely black. Dorsal stripes of synthorax meeting mesothoracic collar to form a pair of inverted 7-shaped marks. Antehumeral stripes interrupted or represented by superior spot only. Segments 7 (distal half), 8 and 9 of abdomen dilated from side to side, the dilatation increasing regularly to the distal end of 8. These segments black above.

Upper pair of anal appendages orange or yellow in colour, well separated at origin, regularly tapering, cylindrical, a little downcurved. Lower appendage with its branches approximately equal in length to the upper pair; closely applied to one another for their whole length, moderately upturned.

Specially characteristic of this group is the combination of inverted 7-shaped marks with a vestigial antehumeral band on the dorsum of the synthorax. Only one other Indian species of *Onychogomphus*, *O. annularis* Selys, shows this feature in addition to the species referred to the section. And as that species was described from imperfect specimens, and remains very imperfectly known, it is quite possible that it too may ultimately find its place here.

O. capitatus Martin, from the Celebes shows the same combination in the colour-pattern of the synthorax. But according to its describer the sides of segments 8 and 9 of the abdomen carry leaf-like expansions, which at once distinguish the male from any of the *geometricus* group.

Onychogomphus saundersi Selys.

1 ♂. Burma. E. B. Williamson. 1 ♀. Toungo, Burma. E. B. Williamson. 1 ♀ "Type." Brit. Mus.

The specimens from Burma have not been identified by Mr. Williamson as this species but I think there can be no doubt of their identity.

I have not seen the specimen recorded by Williamson from Burma as belonging here. His figure of the anal appendages leave little room for doubt but that the specimen belongs to the *geometricus* section, but the colouring of the sides of the synthorax is not that of *saundersi*, which has distinct bands along the lateral sutures, with the metepisternite yellow, not black. Hence I think his specimen must belong to a species distinct from *O. saundersi* Selys.

Length of hinder-wing of ♂ 30 mm., of ♀ 32·5 mm.

Onychogomphus aureus, sp. nov.

3 ♂♂. Tura, Garo Hills, Assam, 1200–1500 ft. S. Kemp. (7978/H1).

Close allied to *O. geometricus* Selys.

Head. Upper lip black with a pair of large yellow spots. Ante-clypeus and post-clypeus black, with a pair of lateral spots on the latter. Frons black with a broad yellow band across the horizontal part just behind its crest. Vertex and occiput black, the former with a pair of tubercle-like projections immediately behind the ocelli.

Prothorax black with small paired median spot anteriorly and larger lateral spots; its hinder lobe yellow.

Synthorax with dorsum black, yellow mesothoracic collar interrupted in the middle by the black of the mid-dorsal carina. Dorsal stripes meeting it on either side. Antehumeral stripe interrupted, represented by a superior spot and a vestigial line separated from the spot, along the humeral suture. Laterally the synthorax is golden-yellow, with a black line along the second lateral suture.

Legs black, but posterior femora largely brown deepening to black apically.

Abdomen with segments 1 and 2 yellow, with the yellow of the dorsum enclosed between longitudinal black bands. On the first segment this dorsal yellow widens apically. On the second it is trilobed diminishing from before backwards. Oreillets yellow margined finely with black. Segments 3–6 golden brown with apical black rings, which are progressively larger, on the third segment occupying about the distal quarter of the segment, on the sixth the distal third. In addition these segments have each an obscure darker longitudinal mark occupying about the middle of the segment. The basal two-thirds of the seventh segment are yellow, the apical third is black. Segments 8, 9 black, 10 golden brown margined apically with black, and with black marking on either side of the middle line dorsally.

Anal appendages yellow, very like those figured for *O. geometricus* in the monograph. Upper pair as long as segments 9 and 10 of abdomen, curved downwards, cylindrical and tapering to a point. Branches of lower pair closely approximated, rather abruptly curved upwards at the commencement of their apical third, truncate at their apices, rather shorter than the upper pair; and each carrying a dorsal tubercle at the end of the basal third of their length.

Length of abdomen of ♂ 35 + 3 mm., of hinder-wing 30·5 mm.

The species of this section of the genus may be distinguished as below.

A. Narrow complete black band on second lateral suture only, position of first lateral suture unmarked. Segments 3–6 with apical two-thirds yellow or brown, distal third black	*O. aureus*, sp. nov. Garo Hills, Assam.
B. Black bands marking the position of both lateral sutures of synthorax.	
1. Lower anal appendage of male black, upper pair tipped with black	*O. saundersi* Selys. Burma, Sumatra (Malay Peninsula ?).
2. Anal appendages of male entirely orange ...	*O. geometricus* Selys. Java.
C. Black bands marking the position of lateral sutures *confluent* over the metepisternite ...	*O. saundersi* Williamson (*nec* Selys ?). Burma.

There is a male specimen of a species of this group in the British Museum from Tonkin; I have not been able to identify it; but on casual inspection it would appear to be *O. geometricus*. I have also had the opportunity of examining a specimen from Sumatra identified by N. H. Campion, and of discussing it with him.

SECTION IV, *biforceps*.

Colouring largely black, dorsal bands of synthorax confluent or not with mesothoracic collar, antehumeral stripe present or absent. Dilatation of apical end of abdomen begins abruptly at base of eighth segment, the apical half of the seventh being scarcely enlarged. The dilatation attains its maximum at the middle of the eighth segment. Lower anal appendage of male longer than upper pair; its branches separated at their origin by a circular space. The branches project beyond the end of

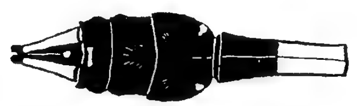


FIG. 18.—Apex of abdomen of *Onychogomphus biforceps*, Selys, ♂, seen from above.

the upper pair, or these latter may be sharply hooked downwards to lie along the dorsal surface of the lower appendage.

The insects contained in this section would appear from their colouring to be forest-haunting and shade-loving forms.

Onychogomphus biforceps Selys.

1 ♂. Pashok, Darjiling Distr., May, 1915. (3409/H1).

This splendid species remarkable for the specialization of the anal appendages of the male, is known only from examples of that sex. Owing no doubt to a misreading of de Selys' account, Williamson in his key to the species of *Onychogomphus* puts *biforceps* amongst the species in which the dorsal stripe joins the mesothoracic collar; this is not the case, the dorsal stripe being isolated.

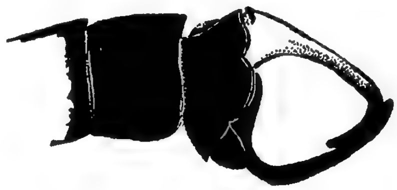


FIG. 19.—Anal appendages of *Onychogomphus biforceps*, Selys, ♂, side view.

The still larger Tonkinese species, *O. camelus* Martin, represented in the British Museum collection, has the anal appendages in the male almost identical in shape with those of *O. biforceps* but entirely black.

The dimensions of the Indian Museum specimen are as follows, length of abdomen 35+4 mm., of hinder-wing 35 mm.

Onychogomphus acinaces,[1] sp. nov.

1 ♂. Castle Rock, N. Kanara Dist. S. Kemp. (4392/H1).

Very distinct from other described species.

Head. Lower lip black, yellow at its base. Upper lip black with a pair of transverse, greenish-yellow spots. Ante-clypeus yellow, post-clypeus black. Frons, vertical part black, horizontal part yellow, the yellow divided into two distinct parts by a median triangle of black. Vertex and occiput entirely black.

Prothorax entirely black.

Synthorax, dorsum black, mesothoracic collar of greenish-yellow, interrupted by black in the middle line. A dorsal band of greenish-yellow on either side, *not joining the collar*, narrowing to a point below, reaching the humeral suture above. *No trace of antehumeral band.* Sides of synthorax largely yellow, but the metepisternite entirely black, the black extending to just behind the second lateral suture, so that laterally the synthorax has two yellow areas widely separated from one another by a broad belt of black.

[1] Acinaces = a scimitar.

Ventral surface black, meso and metanotum marked with lemon yellow. Legs entirely black.

Abdomen longer than wings, swollen at its base and again enlarged from segments 7–9. Black in colour. Segments 1–2 with mid-dorsal yellow bands. 3–6 with basal rings of yellow occupying about the basal sixth of each; these rings are contracted in the middle line dorsally. Basal half of seventh segment lemon yellow. First and second segments, including the oreillets, marked with yellow. Eighth segment with basal, lateral spots of the same colour.

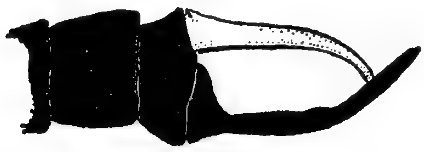


FIG. 20.—Anal appendages of *Onychogomphus*] *acinaces*, sp. nov. ♂, side view.

Anal appendages, upper pair as long as ninth and tenth abdominal segments together, yellow, darker at apex, internally, and ventrally, tapering, parallel, curving downwards in their distal half. Lower appendage one-quarter as long again, its outer four-fifths bifid. The branches are parallel, closely approximated, and curve upwards for their distal half. Seen in profile the lower appendage is rather scimitar-shaped, and projects well beyond the end of the upper pair. They are entirely black.

The venation is that characteristic of the genus. The bases of both pairs of wings are distinctly tinged with dark brown, especially in the sub-costal space, where the colouring extends as far as the first cross-nerve. Antenodals $\frac{16}{11} \Big| \frac{14}{11}$; post nodals $\frac{10}{11} \Big| \frac{12}{12}$.

Length of abdomen 33 mm. +3·75 mm. (lower appendages) of hinder-wing 30 mm.

Apparently related to *O. biforceps* Selys, but with the anal appendages less strongly curved. It differs also in the distinct colouring of the wing-bases, rather unusual in Gomphines, and generally in the great extent of black colouring on the thorax.

The males of the species of this section may be distinguished as follows :—

A. Dorsal stripe confluent with mesothoracic collar; antehumeral stripe absent; anal appendages black, segment 8 of abdomen with a pair of dorsal prominences ... ... *O. camelus* Martin. Tonkin.

B. Dorsal stripes of synthorax isolated.
1. Antehumeral stripe complete ... ... *O. biforceps* Selys. Tonkin; India.
2. Antehumeral stripes absent ... ... *O. acinaces*, sp. nov. W. India.

The small species, *O. modestus* Selys, the hinder-wing of which has a length of 23 mm., would appear to have some right to be included in the present group on account of its generally dark colouration. The synthoracic colour-pattern is in fact very similar to that of *O. acinaces*. De Selys regarded it as allied closley to *O. saundersi*. I have not seen a specimen but am inclined to refer it here, rather than to the *geometricus* group.

Onychogomphus, sp.

1 ♀. Garo Hills, Assam, 1200-1500 ft., June-July, 1917. S. Kemp, (7979/H1).

This specimen is apparently quite distinct from any yet described, its exact position is doubtful, but it seems to me possibly allied to *O. biforceps* hence I describe it briefly here.

Head: upper lip black, base of mandibles yellow, ante-clypeus yellow. Post-clypeus black, frons black with narrow yellow band across its crest, head otherwise black. Posterior margin of occiput slightly elevated in the middle line.

Prothorax black above, yellow below.

Synthorax with a black dorsum, marked with a yellow mesothoracic collar, which is continuous across the mid-dorsal carina, and a pair of narrow, isolated dorsal bands. No trace of antehumeral bands. Sides of synthorax yellow, with a broad black band on the first lateral suture, and a narrower band of grayish brown along the position of the second suture.

Legs black, anterior femora yellow internally, posterior pair yellow extero-laterally.

Abdomen black, sides of first and second segments yellow. Dorsum of first segment yellow, of second segment marked with a longitudinal trilobed band of the same colour. Segments 3–6 with basal ring of yellow, interrupted mid-dorsally, occupying about the first sixth of each segment. In addition segments 3–5 have a median longitudinal mark of yellow on the dorsum. The basal half of 7 is yellow; 8, 9 and 10 are black, but 8 has a small basal lateral mark of yellow on either side. Anal appendages small, brownish-white. Apical half of seventh segment dilated from side to side, the succeeding segments progressively narrower. The sternite of the eighth segment is produced apically in a downward direction, so that it is visible in profile. The vulvar scale, protected by this projection is small, bifid apically.

A similar development of the sternite of the eighth segment of the abdomen occurs in certain species belonging to the *Gomphus* series (e g. *Gomphus melampus* Selys), but I do not know of any other *Onychogomphus* which shows a similar development. Venationally and in colouration, however, I do not doubt but that this specimen is a true *Onychogomphus*.

Length of abdomen 37·5 mm., of hinder-wing 35 mm.

The following species, known only from female examples, resembles this specimen to some extent in the colouring of the synthorax.

O. frontalis Selys, Moolai, "between Burma and Tenasserim."

Dorsal stripes of synthorax isolated, vestige of a juxta-humeral band present. T-shaped mark on dorsum of frons. Occiput yellow. Length of abdomen 29 mm., of hinder-wing 25 mm. From de Selys account I should imagine that the vulvar apparatus of the female did not show the remarkable arrangement found in the female described above from the Garo Hills.

Onychogomphus M-flavum Selys.

1 ♂. Darjiling Dist., 1–3000 ft., May, 1912. Lord Carmichael's collection. (cc/1319).
1 ♀. Gopaldhara, Darjiling district, 1914. H. Stevens.

The synonymy of this species is somewhat obscure. I have no doubt whatever but that the female specimen before me is properly referred to the Selysian species. The remarkable long vulvar scale, reaching to the apex of the abdomen is sufficient to make the determination certain, and the agreement in colouring is precise.

The male is I believe unquestionably conspecific with the female, it differs only in having the costal-vein lined with yellow as far as the nodus. It is immature and badly crushed. I believe the colouring of the costal vein may well be lost in more adult specimens and need not be regarded as a specific character.

A second, more serious difficulty lies in the fact that the male appears identical with that described by de Selys for *O. bistrigatus* (Selys) and figured by Hagen as such in the monograph. This is due to the fact, as I regard it, that the specimen figured in the monograph, and the male described in the second additions to synopsis are not conspecific with the type-specimens of *O. bistrigatus*, but are really examples of *O. M-flavum*, as is also the adult female (imperfect) noted in the monograph, in the Vienna Museum.

Hence in my opinion *O. bistrigatus* remains known only from the type female from 'India.' The figure of the occiput of the female given in the monograph would appear to have been drawn from the Vienna specimen of *M-flavum* as it shows none of the 'dentellures' described for *O. bistrigatus*.

MALE. Dorsal stripes of synthorax meeting mesothoracic collar, mid-dorsal carina marked with yellow for its anterior half. Juxta-humeral stripes complete. Sides of thorax yellow with narrow black bands on the lateral sutures.

Abdomen largely black, with basal rings of yellow, constricted mid-dorsally, on segments 3–6; and a mid-dorsal yellow mark on each of the same segments.

Basal two-thirds of the seventh segment yellow, distal third black. Segments 8, 9 yellow at the sides, dark dorsally, 10 yellow or light brown margined with black.

Anal appendages yellow, upper pair darker apically, the distal third rather sharply angled downwards, and lancet-shaped. Branches of lower appendage about two-thirds length of upper pair contiguous and parallel, curved upwards, with stout dorsal tooth at end of basal third, and smaller tooth at junction of middle and distal thirds (exactly as in pl. i, fig. 3, *Mon. Gomph.*). Segments 8, 9 of abdomen, and distal half of 7 slightly dilated.

Costal nerve lined with yellow as far as the nodus (? colour line disappearing in more mature specimens).

FEMALE. Colouring much as in the male; but the costal nerve is black (the specimen is much more mature than the male) and the dorsum of the tenth segment of the abdomen is black.

The occiput is without dentellations, but has a fringe of long black hairs. The length of the vulvar scale, reaching to the end of the tenth segment, is very remarkable.

Length of abdomen of ♂ ? +3.5 mm., of hinder-wing 32·5 mm.; length of abdomen of ♀ 38 mm., of hinder-wing 34·5 mm.

The two following species are known only from female specimens or from imperfect males, and I have not attempted to place them in any definite group.

O. annularis Selys, North Burma. Dorsum of synthorax with dorsal stripes confluent with the mesothoracic collar, vestiges of the juxta-humeral stripe present. Described from two males, both imperfect. This species may belong to the *geometricus* group. Length of abdomen 37 mm., of hinder-wing 32 mm.

O. maclachlani Selys, North Burma. De Selys suggests that this may be the female of the last species. It is larger, lacks any trace of the juxta-humeral stripe, but otherwise, except for details of colouring of the head, is very similar. Length of abdomen 43 mm., of hinder-wing 38 mm.

Another species, known only from the female, is *O. cerastes* Selys, from Nepal. This from its largely yellow colouring would seem to be rather a 'xerophilous' species, like *O. grammicus*. It is possibly allied to the female next described.

Onychogomphus sp.

1 ♀. Kumaon, W. Himalayas, 22-vii-14. (8343/20) (Lacking abdominal segments 4–10.)

Differs from other species of the genus (except *O. cerastes* Selys, and *O. grammicus* Selys) that I have seen in having many of the cross-nerves of the wing whitish-yellow in colour. This is particularly the case with the rows of cross-nerves in the areas between the subcostal nerve and M_4 proximal to the nodus, and with the cross-nerves of the cubital space.

Head. Upper lip yellow, with fine black line at base. Ante- and post-clypeus yellow, the latter separated from the frons by a transverse black line. Frons yellow, its extreme base black. Vertex black, with a small yellow spot between the posterior ocelli. Occiput yellow, its posterior margin slightly undulated.

Prothorax black, its anterior and posterior margins lined with yellow.

Synthorax. Dorsum black, mesothoracic collar entire, joined by the lower ends of the dorsal stripes. Juxta-humeral stripes complete. Sides of synthorax yellow, with narrow black line on each of the lateral sutures.

Legs yellow, with black spines and tarsi. Anterior surfaces of tibiae black. First pair of femora with black antero-lateral band, which is much reduced on the succeeding pairs.

Abdomen. First segment yellow, second with yellow sides and black dorsal marking enclosing a longitudinal median band of yellow, meeting a narrow apical ring of the same colour. Third segment yellowish-brown, its anterior margin finely marked with black, and with a *lateral* band of black not touching the anterior and of the segment. (The remainder missing.)

Length of hinder-wing 31 mm.

Lastly the N. Burmese species *circularis* Selys, unknown to me except from de Selys' account, is referred by its author to this genus with doubt.

Group HETEROGOMPHUS.

Large insects (h.w. 40 mm. or more). Cross-nerves between M_{1-3} and M_4 of fore-wing as specialized as those of hinder-wing, sectors of arculus approximated at origin, curved, and nearly parallel. Cu_1 and Cu_2 in hinder-wing parallel to wing-margin. M_4 and Cu_1 divergent in the fore-wing. Brace of pterostigma occasionally wanting. Wings long and pointed resembling rather those of *Ictinus*. Hindermost femora when adpressed barely reaching base of abdomen. Abdomen with basal rings on segments 3–7. Colour in some species tending towards a uniform brown. Segments 8 and 9 of abdomen slightly dilated from side to side. Upper anal appendages of male equal in length to the last two segments of abdomen; well separated, parallel and nearly straight. The two branches of the lower appendage also nearly straight, parallel, each carrying an internal tooth near its apex; each is nearly as long as an upper appendage.

Genus **Heterogomphus** Selys.

Genotype : *H. smithii* Selys.
Species studied : *H. ceylonicus*, sp. nov.

Characters of the tribe.

Distribution: Himalayas, Ceylon, Indo-China, S. China, Great Sunda Islands.

Heterogomphus ceylonicus, sp. nov.

1 ♂. Ceylon. Col. Yerbury. Brit. Mus.

Head largely black. Upper lip yellow, margined with black, and with a black projection in the middle line from the base. Ante-clypeus yellow, post-clypeus black, with a lateral yellow spot on either side. Vertical part of the frons black, horizontal part yellow, with narrow black base. Vertex black, occiput black with median yellow spot.

Prothorax black with large lateral spot of yellow and a smaller median paired spot of the same colour.

Synthorax black, mesothoracic collar yellow, interrupted by the black of the mid-dorsal carina in the middle line. Dorsal stripe isolated, broad, elongate oval; antehumeral stripe represented by a small superior spot. Sides of synthorax black with a broad yellow band on the mesepimerite and a second on the metepimerite. These yellow bands are continuous on to the meso- and the metanotum.

Legs black, coxae and anterior surfaces of the femora marked with yellow.

Abdomen black. The first segment has a transverse yellow mark at its base dorsally. The second has a longitudinal dorsal band of yellow which is trilobed. Both these segments are marked with yellow laterally, including the oreillets. The third and fourth segments have a basal ring of yellow, and dorsally, from this a longitudinal basal extending for about half the length of the segment. Segments 5 and 6 have a narrow basal ring only; the basal half of 7 is brownish-yellow, and segments 8 and 9 have dark brown lateral basal marks. The tenth segment is entirely black.

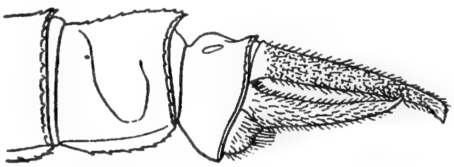


FIG. 21.—Anal appendages of *Heterogomphus ceylonicus*, sp. nov., ♂ from type in the British Museum: side view.

Anal appendages gray-black, upper pair slightly down-curved. Lower appendage with branches about five-sixths the length of upper pair each branch carrying a small internal tooth at about the commencement of its distal quarter.

Antenodals of fore-wing 17, 18, post-nodals 12–14.

Length of hinder-wing 41 mm., of abdomen 42+5·5 mm.

A handsome species rather resembling an *Ictinus* in its proportions. I fancy that the late Mr. Kirby must have overlooked the specimen for this reason when describing Col. Yerbury's collection.

H. ceylonicus is very distinct from other species of the genus in the markings of the synthorax, which are bolder and more sharply contrasted than is usual in the genus. It resembles in size the Malayan species of the genus. These are *H. sumatranus* Martin, from Sumatra and Borneo, and *H. icterops* Martin, from Java and Borneo. The British Museum has a specimen of both these species.

H. smithi Selys, is also represented in the Museum collection, it is very similar structurally to these species though considerably larger, and differs of course in details of colouring. It is found in the Himalayas. *H. cochinchinensis* Selys, is apparently an allied species from Cochin-China. *H. sommeri* Selys, from China is still larger and differs from the other species of the genus in having the upper anal appendages of the male a little incurved to one another apically. *H. unicolor* Martin, from Siam is allied to or identical with *H. sumatranus*. Lastly *H. naninus* Foerster, from Tonkin, which I have not seen, is almost certainly not a *Heterogomphus* at all.

Genus not referred to any of the above defined 'groups.'

Genus **Ophiogomphus**

Species examined: *O. reductus* Calvert.

A genus belonging to the series Gomphus, holarctic in distribution, containing a number of robust species of moderately large size, mostly characteristic of mountainous country, whose larvae live in rapidly running rivers with sandy beds.

Venationally the genus differs from other members of the series noted in this paper by the possession of a small but quite definite 'anal loop.' The arrangement of cross-veins between M_{1+3} and M_4 is constant and specialized; the pterostigma is small and well braced, the triangles of fore and hinder-wings are subequal. The hindermost femora reach to the end of the first segment of the abdomen, and are armed with short black spines arranged irregularly for the basal half of the femur, on the distal half in two rows.

Upper anal appendages of the male as in the group Gomphus; lower appendage not so long as the upper pair, cleft narrowly for about its distal half.

Larvae with wing-sheaths divergent.

This genus may very likely stand as a distinct tribe, but as its distribution is Holarctic and its inclusion in this paper dependant rather on political than on zoogeographical boundaries I leave its exact position to be defined in some more appropriate place.

Ophiogomphus reductus Calvert.

1 ♂. (newly emerged, with exuviae). Kashmir, 1915. H. T. Pease. (890/H1).
1 ♀. Kashmir, 1915. H. T. Pease. (582/1+1).
1 ♀. Jhelum Valley, Kashmir, 5200 ft., July, 1916. H. T. Pease. (4819/1+1).

Length of hinder-wing of ♀ 36 mm., of abdomen 40 mm.

APPENDIX.

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

(Plate XI.)

Since I handed over a collection of Gomphines to Mr. Laidlaw in 1920 I have come into the possession of a further lot collected partly by myself and partly by friends who have kindly placed them at my disposal.

Some of these have already been described, viz. *Stylogomphus inglisi*, nearly related to *Heliogomphus*, *Onychogomphus* sp., and females of two distinct species of *Heterogomphus*, which will appear shortly in the *Memoirs of the Department of Agriculture in India, Entomological Series*. The remainder, some 110 species are now before me and provide new material and add new light to what has already been given above by Mr. Laidlaw. Dr. Annandale has kindly given me this opportunity of adding to the most important paper which has appeared on the Indian Gomphinae since Williamson's paper was published in 1907.

Some of the present genera will have to be further split up, I refer especially to the genus *Onychogomphus*, the larvae of two species of which, *O. biforceps* and *O. lineatus*, are contrasted below. The body of the former is broad and greatly depressed and its antennae broad, flat, triangular plates, the body of the latter is narrow and cylindrical, whilst its antennae conform to such as prevail amongst the majority of known Gomphine larvae (see text-fig., p. 426). With such wide variations in structure, it is impossible to believe that the two insects fall into the same genus.

With a long and wide experience of these insects in their natural habitat, I am able to say that few species occur commonly; a few such as *Cyclogomphus* and *Anormogomphus* are locally common, only two are widely spread, the remainder are come upon at odd intervals and in unexpected places and then only as solitary individuals.

With the exception of *O. lineatus* and *Ictinus rapax* they are single brooded, a few species emerge in swarms, generally after heavy rain and their appearance is of remarkably short duration, two to three weeks being the extent of their life on the wing.

The types of new species described below will eventually be deposited in the national collection in the British Museum, at present they remain in my own collection. I hope to place paratypes in the Indian Museum, at least as far as the Nilgiri species are concerned.

Heliogomphus nietneri Selys.

1 ♂ Kalar, 1000 ft., March 1916, coll. F. C. Fraser.

This specimen differs form the Ceylon form described by Hagen in the same particulars as the Assam species described by Laidlaw except that there are lateral markings as far as abdominal segment 6. The wings are saffronated at the base as far outwards as the node, this colour gradually diffusing outwardly. Stigma pale brown.

Caught in dry jungle a mile or so away from the nearest water.

Heliogomphus pruinans, sp. nov.

A single pair taken together, Burliyar, Nilgiris, 1500 ft., 29·vii·21.

Male. Hindwing 32 mm. Abdomen 42 mm.

Head black, the labrum with two basal greenish spots whose opposing borders are deeply concave; bases of mandibles greenish white; a greenish white band across the frons which is rounded and flattened; occiput depressed, black; eyes bottle green.

Prothorax black, the posterior lobe and an anterior band yellowish green, beneath pruinosed white.

Thorax black on the dorsum marked by a complete, mesothoracic collar and narrow dorsal bands lying close to and parallel to the dorsal crest, both greenish yellow; laterally greenish yellow marked by two narrow black lines on the sutures, confluent above and below. Beneath and on lower part of sides pruinosed white.

Legs black, the hind femora with a row of very closely set and very small spines.

Wings enfumed; stigma blackish brown, braced only in one wing; no basal antenodal of second series; only one cubital nervure to all wings; nodal index $\frac{11-15}{12-11}\Big|\frac{15-12}{12-12}$; trigones of hindwing very elongate, the costal side twice as long as the basal; 3 rows of discoidal cells at level of node; all triangles entire; base of wings very oblique and closely resembling that of *Anisogomphus*; other points as for genus.

Abdomen black marked with pale greenish yellow as follows: a fine, middorsal line extending from segments 1 to 5, thickest at 2; a complete basal annule almost encompassing segment 7 and occupying about the basal third; a minute triangular basal point on the dorsum of 8, the remainder black. Laterally a spot on 1, the oreillet and an apical spot on 2, and small basal spots on 3 to 6.

Anal appendages as for genotype, the superior black at base, pale green to yellow at the apices, which are turned at first in, then up and finally out.

Female very similar to the male but much larger. The occiput simple, depressed, exactly similar to that of the male. Sides of thorax vivid greenish yellow, the pruinescence on the lower part of sides and beneath more marked than in the male.

Wings saffronated at the extreme base. The lateral spots on segments 1 to 3 forming a continuous unbroken line; on segments 4 and 5 the line is interrupted to form two elongate spots, whilst on 6 the line is represented merely by a basal and a subbasal spot.

Legs black, hind femora with a row of long, robust, evenly spaced spines (The sexual differences here are very striking.) Vulvar scale as for *H. nietneri*, but the apex scarcely notched.

The insects are jungle-loving creatures, haunting the rocky beds of wild, mountain streams.

Microgomphus sp.

A single, somewhat teneral female from Rangoon, coll. 1909.

I am satisfied that this specimen is a true *Microgomphus* although it differs from the generic characters given above by Mr. Laidlaw in the two following particulars :—

(i) The proximal angle of triangle in the forewing is not as far distant from the arc as the length of the proximal side of subtrigone.

(ii) There are two rows of cells between Cu_{ii} and the hind margin of forewing.

I have however examined a number of both sexes of *M. torquatus* and find that neither of these two features are constant. As regards the number of rows of cells posterior to Cu_{ii} I find that there are invariably two rows in the female and one in the male. The distance of the proximal angle of the triangle in the forewing is very variable in both sexes, being sometimes more and sometimes less than the length of the proximal side of the subtrigone, so that other generic characters being present one may rightly assume that the specimen is a true *Microgomphus*.

Female. Abdomen 25 mm. Hindwing 22·5 mm.

Head black marked with citron yellow as follows: bases of mandibles, small basal spots joined by a basal streak on labrum, small lateral spots and a very fine streak on upper epistome, a line on the front of frons interrupted in the middle; occiput black with paired minute spines on either side of its middle.

Prothorax entirely black.

Thorax black on the dorsum marked by a narrowly interrupted, citron yellow, mesothoracic collar and an oblique dorsal stripe not joined to the collar; humeral stripe absent. Laterally bright citron yellow, the sutures finely outlined in black.

Legs black, the anterior femora yellow outwardly, the hind femora with about 9 robust spines on either side of the limb.

Wings hyaline, saffronated rather deeply at the base, venation as for genus subject to the exceptions already discussed; stigma pale brown, feebly braced; nodal index $\frac{8\text{–}12}{8\text{–}9}\Big|\frac{11\text{–}9}{9\text{–}8}$.

Abdomen black, marked with yellow as follows: segment 1 all yellow, 2 broadly on the sides, the dorsal carina finely, 3 with a basal dorsal spot and an elongate spot on the middle of dorsal carina, 4 similar but the spots much smaller, 5 to 7 with only the basal spots which are largest on 7; 8 to 10 all black.

Anal appendages yellow. Vulvar scale very small, cleft to its base.

This species is probably the smallest Gomphine known and is smaller than any individual *M. torquatus* which I have examined.

Perissogomphus stevensi Laid.

I have received several specimens of this species from Darjiling and Assam and from an examination of the venation, am able to add the following to the generic characters :—

(i) Usually 1 but sometimes 2 rows of cells between M_i and M_{ia} at the level of the distal end of stigma.

(ii) Triangles of both fore and hindwings of female and also hindwings of male frequently traversed by a nervure.

Concerning the species, whilst the majority of those received have the ground colour yellowish brown, some specimens are a bright greenish yellow and I am satisfied that the former colour is the effect of decomposition and the latter the true colour during life.

Davidius sp.

A single female from Gopaldhara, Assam, coll. H. Stevens.

Abdomen 34 mm. Hindwing 32 mm.

Head glossy black, the bases of mandibles, 2 spots at the base of the labrum and a stripe across the frons citron yellow. Occiput greatly depressed at its centre.

Prothorax black with a small median spot on the posterior lobe, a geminate spot in front of it, the anterior border and a small spot on each side citron yellow.

Thorax black on the dorsum marked with a dorsal stripe parallel to the dorsal carina and connected with an interrupted mesothoracic collar; a triangular spot above and to the outer side of the dorsal stripe; a fine, humeral line separated from the spot, the long axis of the latter being at right angles to it. The sides citron yellow with narrow black stripes on the lateral sutures. Spots of yellow on tergum and at bases of wings.

Legs long and slim, black, the anterior femora yellow outwardly, the hind with a row of very long, robust, widely separated spines, 6 in number, mid femora with a row of closely set, short spines and a single long one at the distal end.

Abdomen black, marked with yellow as follows: a triangular, apical spot on segment 1, the base of the triangle at the apex of the segment, 2 with a bilobed spot on its middorsum, 3 to 7 and base of 8th with a fine, middorsal stripe, segments 1 to 3 broadly yellow at the sides.

Anal appendages small, conical, yellow.

Wings as for type, triangles of hindwings crossed, the left forewing has 2 basal antenodal nervures of the second series (a very rare occurrence), the other wings with one each.

Gomphus sp.

A single female, Gudalur, Nilgiri Wynaad, 3500 ft., 8·vii·21, coll. F. C Fraser.

Female. Abdomen 34 mm. Hindwing 30 mm.

Head black, marked with citron yellow as follows: lateral lobes of labium, 2 large basal spots on labrum and the bases of mandibles. A minute spot in the centre of epistome and a larger one on each side against the eyes; the frons, which is rounded, with a broad stripe on its upper surface; occiput simple, black, fringed thickly with very long black hairs; eyes bottle green.

Prothorax black with a large triangular citron yellow spot on either side.

Thorax black on dorsum with a complete, broadly joined, mesothoracic collar, prolonged slightly upward along the dorsal carina, an oblique, short, dorsal stripe well separated above and below from the alar sinus and the mesothoracic collar respectively. A humeral stripe represented by a small upper spot and a vestigial streak below. Laterally citron yellow, the sutures outlined in black. The thorax is coated with long, rather dense black hairs.

Legs all black, hind femora with a row of 11 to 12 robust, evenly spaced, gradually lengthening spines on either side of the limb.

Wings slightly enfumed, saffronated at the extreme base as far out as the triangles which are all entire; stigma short, reddish brown, braced; no basal antenodal nervure of the 2nd series; 1 to 2 cubital nervures in forewing, only 1 in the hind; 2 rows of cells in the postanal area of forewing, 4 to 5 in the hind; 2 rows of cells between M_i and M_{ia} in all wings; nodal index $\frac{13-15}{13-10}\Big|\frac{15-15}{11-12}$ (two of the postnodals of forewing are connected by a nervure and another is forked); 2 rows of cells as far as the level of node.

Abdomen black, marked with brilliant citron yellow as follows: the dorsum and sides of segment 1 broadly, 2 with a trilobed, dorsal stripe and the sides very broadly, 3 with the middorsal carina finely and two large lateral spots, 3 to 7 with basal annules notched by the black on the dorsum except on 7 where the apical border of the spot is straight, on 8 the basal spot a mere fine line, 9 and 10 with apical annules, broad on 9, narrow on 10.

Anal appendages black; segments 7 to 10 progressively shortening; vulvar scale very tiny, barely evident.

This handsome species will probably prove to be the type of a new genus but until the male is found will have to be confined to genus *Gomphus sens. str.* of which it at present forms the smallest species.

Gomphus nilgiricus Laid.

A single female, Coonoor, June 1917, coll. F. C. Fraser.

Abdomen 43 mm. Hindwing 40 mm.

This specimen was picked up dead, a small army of ants was bearing it away and had somewhat damaged it. I have seen a second female near Gudalur (August 1921) which was ovipositing in wet sand in the half-dried bed of a mountain stream. The insect was quite fearless and flew backwards and forwards several times passing under my outspanned legs. Occasionally it hovered a few inches above the sand and made stabbing motions with the end of its abdomen in the wet sand. The function of its long ovipositor was thus explained. I had no net on this occasion and though I attempted to take it with a sweep of my hand it eluded me.

It differs in the few following respects from the above described male: the abdomen is of nearly even width throughout and perfectly cylindrical, the markings are a greenish yellow and on segments 3 to 5 are of the note-of-exclamation type, the dorsal stripe being swollen and rounded at the base of the segments, tapering pin-like to the apex; segments 6, 8 and 10 are unmarked and 9 has a large, dorsal, yellow mark extending from apex to base in a narrowing point.

Anal appendages small, conical, pointed, black.

Vulvar scale of remarkable length, very narrow and pointed and somewhat analogous to the structure as seen in *Cordulegaster*.

Gomphus o'doneli, sp. nov.

A single male from Hasimara Tea Estate, Duars, Bengal, coll. H. V. O'Donel.

Head very large; labium pale yellow, the middle lobe bordered with black, rest of head black save for two small basal spots on labrum and a narrow stripe across the crest of frons. Occiput curled up at its border and fringed thickly with stiff black hairs.

Prothorax black, the posterior lobe, a small spot on either side of it, a geminate spot in front of it and the anterior border yellow.

Thorax black, marked with yellow as follows: oblique dorsal stripes meeting a slightly interrupted mesothoracic collar, humeral stripe represented only by a small spot above. Laterally a broad, posthumeral stripe and the anterior three-fourths of the metepimeron. On the broad black between these two stripes there are three small yellow spots.

Legs short and robust, entirely black. The hind femora with the surface covered with small spines and a single larger one at the distal end.

Wings hyaline, stigma dark brown, braced, rather small; membrane very narrow, dark brown; 2 nervures between M_{iv} and $M_{i\text{-}iii}$ in the forewing, only 1 in the hind; only 1 row of cells between M_i and M_{ia} at level of distal end of stigma; Cu_i and Cu_{ii} nearly parallel to wing border; nodal index $\frac{9-16}{11-10}\Big|\frac{14-9}{11-10}$; 3 rows of discoidal cells at level of node in the forewing; all triangles entire; 3 to 4 rows of post-anal cells in hindwing.

Abdomen tumid at base, 3 to 7 very narrow and cylindrical, the latter broadening at apex, 8 and 9 very broad, especially the former (but not winged), 10 rather small, segments progressively smaller from 7 to 10.

Abdomen black, marked with yellow as follows: a triangular dorsal spot and a large lateral spot on segment 1; a trilobed dorsal spot, the oreillet and a large apical lateral spot on 2; 3 with the dorsum narrowly at the base and a large lateral basal spot; 4 to 6 with dorsal basal spots meeting rather broadly over the carina; 7 with a broad basal annule prolonged apicalward along the dorsal carina; 8 with a small round spot on the dorsum at the base, the basal part narrowly expanded, also an L-shaped mark on the middle of the side, the "L" lying on its back; 9 with the whole of the lateral border yellow; 10 unmarked.

Anal appendages black, much the same as in the genotype, the superior, however, very broad, hollowed out below and correspondingly domed above.

Hamuli projecting as two long foliate structures directed forwards; lobe of penis of enormous size.

The robust short stature and the general facies of this species are quite unlike any other *Gomphus* I know of from India and recall the size and shape of *Ictinus*.

Burmagomphus pyramidalis, race.

1 ♂ Hasimara Tea Estate, Duars, Bengal, coll. H. V. O'Donel.

Differs from type by the occiput being all black, by the yellow on the labrum being cut up into two spots by the median prolongation of the basal black meeting the bordering black, and lastly by the inferior anal appendages being strongly recurved upwards at their apices almost like a fish-hook.

The size is also much larger: abdomen 36 mm., hindwing 26·5 mm. Wings rather deeply enfumed.

Burmagomphus duarensis, sp. nov.

A single male from Hasimara Tea Estate, coll. H. V. O'Donel, Sept. 21.

Male. Abdomen 34 mm. Hindwing 26 mm.

Head entirely black save for bases of mandibles and a broad, bright yellow line on the upper surface of frons; occiput straight, simple, fringed with a few black hairs.

Prothorax black with a large citron yellow spot on either side.

Thorax black on dorsum with dorsal oblique stripe united to a narrowly interrupted mesothoracic collar; humeral stripe represented only by a small upper spot. Sides citron yellow, the sutures finely outlined in black.

Wings hyaline, saffronated at extreme base; stigma light brown, braced, one or two rows of cells between M_i and M_{ia}; a basal antenodal nervure of 2nd series in both the forewings; nodal index: $\frac{11-15}{11-10}\Big|\frac{16-11}{10-11}$.

Legs entirely black except the anterior pair of femora which are pale whitish green outwardly; hind femora with a row of long robust spines to the number of 6 on the distal half.

Abdomen tumid at base, very narrow and cylindrical from 3 to 6, remaining segments dilated, especially apex of 7 and whole of 8. Black, marked with citron yellow as follows: 1st segment entirely yellow save for two black dorsal spots; 2 with a trilobed dorsal spot the oreillets and an apical spot; 3 to 4 with the dorsal carina finely yellow and a lateral stripe, broadest at the base and not extending quite as far as apex; 5 to 7 with the lateral basal spot meeting over the dorsum and on 7 occupying the basal half of the segment; remaining segments black.

Anal appendages as for type, the superior pale yellow, inferior black.

Indogomphus, gen. nov.

Wings with a basal antenodal nervure of 2nd series to all wings, all triangles entire, the triangles of hindwings elongate, sectors of arc approximating immediately after the arc, 3 transverse nervures between $M_{i\text{-}iii}$ and M_{iv} in forewing, only one in the hind, Cu_i and Cu_{ii} a little divergent in the hindwing, 4 rows of cells posterior to Cu_{ii} in the hind wing, forking of $M_{i\text{-}ii}$ and M_{iii} symmetrical, discoidal field divergent, 3 to 4 rows of cells at level of node, 3 rows of cells between M_i and M_{ia} at distal end of stigma, only 1 row of cells (occasionally 2) at base of forewing, base of wing rather oblique as in *Anisogomphus* and angle not prominent.

Anal appendages of male very similar to those of *Heliogomphus*. Vulvar scale broadly triangular, almost equilateral, the apex with a small rounded notch.

Indogomphus longistigma, sp. nov.

A single pair from the Nilgiri Wynaad, 3000 ft., 14·viii·21, coll. F. C. Fraser.

Male. Abdomen 44 mm. Hindwing 35 mm. Hindwing 37 mm. in the female.

Head entirely black save for a broad greenish yellow line on the frons overlapping the front and a broad line on the occiput of the same colour. The frons finely black at the base and the occiput black at either end and fringed with remarkably long black hairs. Eyes bottle green.

Prothorax black, the posterior lobe and a small oval spot adjoining it anteriorly and a band on its anterior border pale yellow.

Thorax black, marked with bright yellow as follows: a complete mesothoracic collar which sends a prolongation up along the middorsal carina as far as the alar sinus; a narrow dorsal stripe close alongside the middorsal carina reaching the alar sinus above but not meeting the mesothoracic collar; a vestigial antehumeral stripe represented by a subquadrate spot above and a mere trace of a line some distance below it, barely visible to the naked eye; a broad humeral stripe and a very narrow mid-lateral, both disconnected from two larger spots below themselves; finally, the posterior two-thirds of the metepimeron. Beneath black, marked by a fine, V-shaped, yellow spot.

Legs slim, black and very long, the hind femora extending to the apical end of the 2nd segment and furnished with four pairs of very long equidistant black spines The anterior femora are greenish yellow on the flexor surface.

Wings hyaline, long and narrow; stigma pale brownish yellow, that of the hind much larger than that of forewing, 3·5 mm. to 5 mm. in the hind; nodal index $\frac{11-16}{12-11}\Big|\frac{15-12}{10-12}$; membrane absent.

Abdomen a little tumid at the base, segments 3 to 6 slim and cylindrical, the apical part of 7 and segment 8 dilated and with rudimentary lateral leaves, 8 and 9 almost the same length, 10 half the length of 9. Black, marked with yellow as follows: segment 1 with a large quadrate spot on the side and a broad stripe on the dorsum; segment 2 with an L-shaped spot on the side, the underside of the very robust oreillets and a small stripe on the upper surface of the same structure and a trilobed dorsal band; 3 with a lateral basal triangular spot followed by a small oval stripe about the middle of the segment and its dorsum, widely at the basal third but less so afterwards and not extending to the apex of segment; 4 to 6 with the same markings but the lateral stripe absent and a wide gap between the basal, dorsal yellow and that following it (this dorsal yellow is peppered with minute, black spines); segment 7 with nearly its basal half yellow broadly and its middle third narrowly; 8 to 10 with merely the dorsal carina moderately, finely yellow.

Anal superior appendages pale yellow, lyrate, broad at base, tapering to a fine point, a little upturned, at first divergent but then curling in so as to meet at the tips and enclose a circular opening. The outer side with a broad blunt spine. Inferior appendage with widely divergent branches, projecting from below the superior so as to be seen from above, black. (It will be seen from this description that the appendages are very similar to those of *Heliogomphus* to which the genus is closely allied.)

Female very similar to the male, differing as follows: bases of mandibles yellow (occiput similar to the male, simple but with only fine, sparse, short hairs); abdomen with 9th segment about the same length as 8, which is a little dilated, and tapering rapidly to 10, which is very small and narrow (the tapering end of abdomen suggestive of that of *Macrogomphus*).

Anal appendages small, conical, palest yellow, as is also a small, cone-like protuberance between them.

Hind femora with 5 to 6 pairs of long black spines similar to but more numerous than in the male. Between them are numerous smaller, evenly sized spines.

Wings a little enfumed, stigma light brown, the difference in size even more marked than in the male; nodal index $\frac{12-17}{11-10}\Big|\frac{17-12}{11-11}$, otherwise similar to the male.

Onychogomphus bistrigatus Selys.

A single male from Kalar, Nilgiris, 1000 ft., v·1917, coll. F. C. Fraser.

The specimen agrees so minutely with the Selysian description of the type female that there can be no doubt that the insects are conspecific.

Abdomen 38 mm. Hindwing 29 mm.

Abdominal segments 8 and 9 are black with a small basal lateral yellow spot, whilst 10 is all black.

The anal appendages are yellow, the superior tipped with black, the inferior black externally, yellow internally. The superior has a small spine inwardly at the junction of the last two-thirds, the inferior has only a basal tooth at its basal third, otherwise as for *O. uncatus* Selys.

Onychogomphus biforceps Selys.

A single female from Palghat, Malabar Dist., coll. T. N. Hearsey, 16·vi·21.

Female. Abdomen 42 mm. Hindwing 35 mm.

The insect is somewhat stouter and larger than the female of *O. biforceps nilgiriensis* and the markings differ considerably; the 7th and 8th abdominal segments are also more dilated.

Differs in markings as follows: spots on labrum large, in fact it would be more correct to say that this structure is yellow, narrowly bordered with black, the narrow belt of black at base connected narrowly in the middle line with the anterior bordering black; base of mandibles, lower part of epistome and a spot on either side of upper yellow; band on frons complete; occiput yellow at its centre and raised into a single point in the middle (humeral stripe absent, antehumeral oblique, not connected with the mesothoracic collar which is slightly interrupted). Laterally the broad median black stripe is traversed by a narrow irregular yellow stripe.

Legs. Femora yellow mottled with black, the hind femora with a row of closely set, very short, very robust spines, 9 to 10 in number.

Abdominal markings similar but the basal spot on segment 8 very large.

Anal appendage entirely yellow, as is also the apex of the intermediate conical process.

Vulvar scale light reddish brown, very short and broad, deeply notched in the middle, reset in a hollow of the 9th segment.

Wings similar but only a single row of cells between M_i and M_{ia}; nodal index $\frac{10-16}{9-11}\Big|\frac{17-10}{11-11}$ and 3 rows of cells in discoidal field at level of node.

Onychogomphus biforceps nilgiriensis, subsp. nov.

3 ♂ and 1 ♀ Gudalur, Nilgiris, 16·x·21, coll. F. C Fraser. (One male, the type, coll. by T. Bainbrigge Fletcher on the same date.)

Male. Abdomen 35·4 mm. Hindwing 30 mm.

Differs from *O. biforceps* Selys as follows :—

Yellow spot on occiput absent; mesothoracic collar interrupted; humeral stripes entirely absent; a small yellow spot just below wings on the upper part of the broad lateral black stripe; oval dorsal spots on abdominal segments 4 to 6 absent; a minute apical spot in addition to small lateral basal spot on segment 8; superior appendages yellow only on outer side, black inwardly; legs entirely black.

The female of *O. biforceps* Selys has not been described, but is probably somewhat like that of the present species which is as follows :—

Abdomen 36 mm. Hindwing 33 mm.

Colouring similar to the male with the following exceptions: spots on labrum very small; band on frons interrupted by the black in the floor of the suture so as to form two oval spots; occiput with two robust spines situated close together at its middle; antehumeral band not connected with the mesothoracic collar; yellow spots on sides of segment 2 and the oreillets confluent; basal spots on dorsum of 3 to 7 interrupted by the black of dorsal crest; basal spot on 8 very minute and the apical one absent.

Anal appendages rather longer than segment 10, tapering, black with a bright yellow tip, a long triangular protuberance between them; 7 to 10 progressively shortening.

Vulvar scale half the length of segment 9, bifid to its base so as to form two small triangular leaves.

Wings enfumed and distinctly saffronated at the base; nodal index: $\frac{12-14}{11-10}\Big|\frac{15-11}{10-13}$.

Jungle-loving insects, hiding up in shady mountain streams.

Description of larva of *O. biforceps nilgiriensis.*

Total length 23 mm. Length of hind femora 6 mm. Greatest breadth of body at abdomen 9 mm.

Head moderately broad and quadrate, a postocular spine on either side; antennae remarkably specialized, basal segments small, cylindrical, 3rd segment broad, flattened and triangular, sloping downward and forward, 4th segment present only as a rudimentary tiny spine at inner lateral angle of 3rd segment.

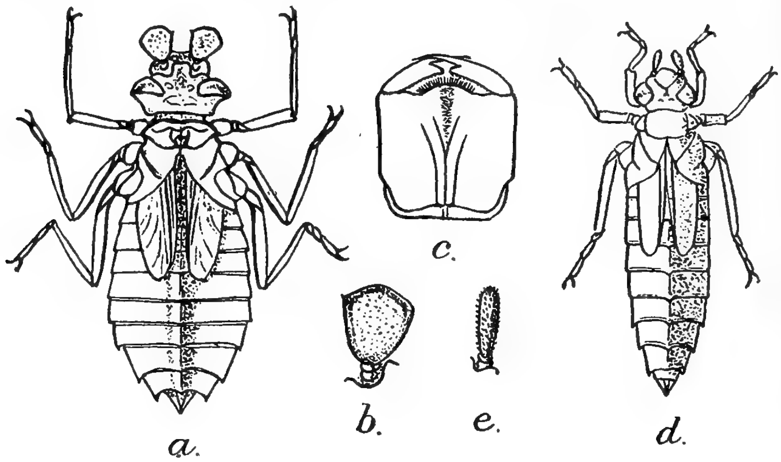
Prothorax small, a double tubercle on its dorsum.

Wing sheaths broad, extending to middle of segment 6 or thereabouts.

Abdomen greatly depressed, segments 7 to 10 with stout apical lateral spines, 4 to 8 with well marked dorsal ridge, raised up as robust spines on each segment.

Mask very short, extending to base of first pair of legs only, middle lobe rounded and fringed with rather long stiff brissae. Mentum angulated, the whole lobe nearly quadrate.

Easily distinguished from the larvae of any other species of Gomphine by the shape of its antennae. Four specimens were



a. Larva of *Onychogomphus biforceps nilgiriensis.* *b.* Antennae of same. *c.* Mask of same.

d. Larva of *Onychogomphus lineatus.* *e.* Antennae of same.

found in the pool of a mountain stream, amongst debris consisting mainly of rotting leaves, twigs, etc., above Gudalur, 26·ii·22.

Five adults insects were taken within 10 yards of this pool and 3 others seen. No other species have been seen or taken over this stream and no other kinds of larvae found, so that there is no doubt as to the species to which they belong. If the breeding out of these larvae prove the correctness of the diagnosis, I propose to remove the group *biforceps* from *Onychogomphus* and erect a new genus for it with the name of *Lamelligomphus*. The head of the larva reminds one irresistibly of that of a cockchafer (*Melolonthidae*).

DESCRIPTION OF PLATE XI.

FIG. 1.—Thoracic markings of *Heliogomphus nietneri* Selys.
,, 2.—Markings of *Heliogomphus pruinans.* Male.
,, 3.—Thoracic markings of *Davidius* sp. Female.
,, 4.—Markings of *Gomphus* sp. Female.
,, 5.—Abdominal markings of *Gomphus nilgiricus* Laid. Female.
,, 6.—Markings of *Gomphus o'doneli.* Male.
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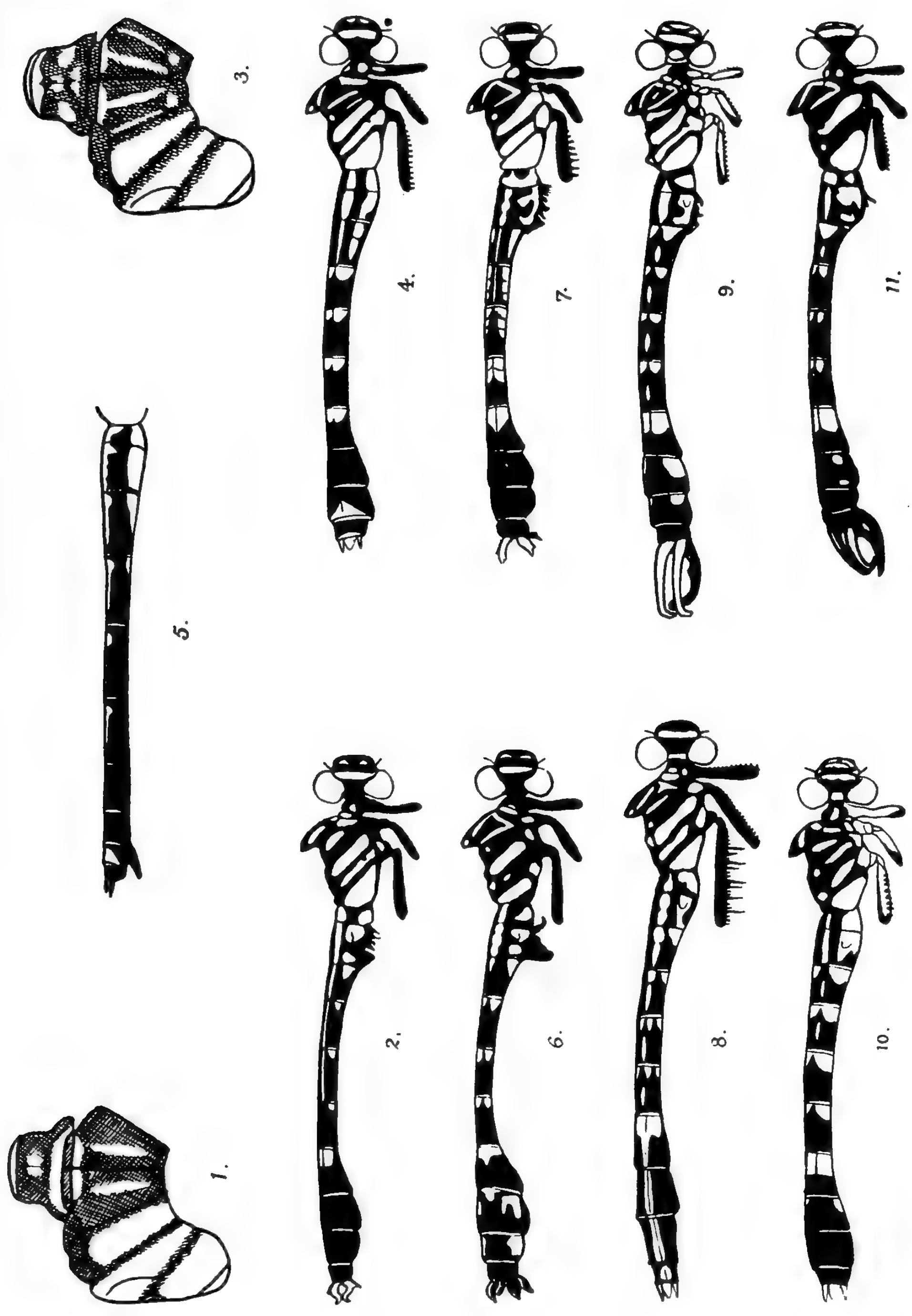
,, 8.—Semi-lateral view of *Indogomphus longistigma.* Female.
,, 9.—Markings of *Onychogomphus bistrigatus* Selys. Male.
,, 10.—Markings of *Onychogomphus biforceps* Selys. Female.
,, 11.—Markings of *Onychogomphus biforceps nilgiriensis.* Male.



Indian Dragonflies of the subfamily Gomphinæ.

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

By J. STEPHENSON, *M.B., D.Sc., Lecturer in Zoology in the University of Edinburgh.*

CONTENTS.

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*) *kempi*, *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 (11) 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.[1]

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.

---

[1] 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 $2\frac{1}{2}$–3 *ab*. The dorsal break is equal to 2–3 *yz* anteriorly, but is much smaller behind the genital region ($1\frac{1}{4}$–$1\frac{1}{2}$ *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 houlleti (E. Perrier).

Bombay. Coll. Prof. J. P. Mullan.
Dehra Dun; compound of Forest Research Institute (serial No. 111 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. 111 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 (ij–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.

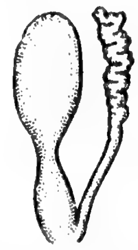

FIG. 1.—*Pheretima suctoria*; spermatheca.

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 dorsoventrally.

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 papilla 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 13μ 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.

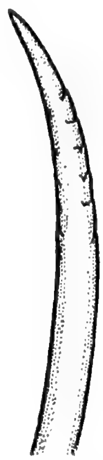

FIG. 2.—*Octochaetus beatrix*; penial seta : ×460.

Genus **Erythraeodrilus** Steph.

Erythraeodrilus kempi 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 *kempi* 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.

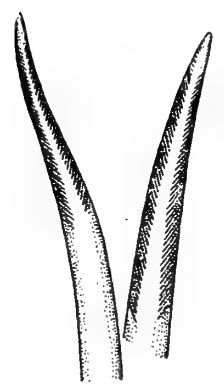

FIG. 3.—*Eutyphoeus orientalis*; penial setae: ×300.

The peculiar penial setae are 2½ mm. long. and 26μ 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 $ab=\frac{1}{4}\ aa=1/3\ bc=4/7\ cd$, 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 ½xiii–½xvii.

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.

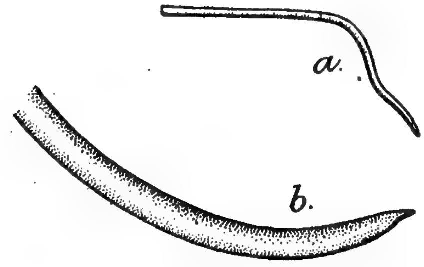

FIG. 4.—*Eudichogaster mullani*; copulatory seta; *a*, whole seta: ×50; *b*, tip of seta: ×300.

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 16μ. 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) kempi, 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 ½, the tongue not cut off behind.

Dorsal pores from furrow 9/10.

The setae are small; anteriorly $ab = 1/3\ aa = \frac{1}{2}bc = cd$; 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 $ab = \frac{1}{2}\text{–}3/5\ aa = 1\frac{1}{4}\text{–}1\frac{1}{2}\ bc = 2\ cd$ or nearly; $dd = 1/3\text{–}2/5$ 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.

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

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).

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 **Octolasium** Örley em. Rosa.

Octolasium 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":—

Gnathophausia calcarata G. O. Sars. (=*G. bengalensis* Wood-Mason.)
Gnathophausia gracilis Will.-Suhm. (= *G. brevispinis* Wood-Mason and Alcock.)
Gnathophausia zoëa Will.-Suhm. (= *G. sarsi* Wood-Mason.)
Eucopia australis Dana.
Eucopia sculpticauda Faxon.
Petalophthalmus armiger 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:—

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

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

Siriella gracilis Dana.
Siriella aequiremis Hansen.
Hemisiriella parva Hansen.
Anchialina grossa Hansen.
Gastrosaccus bengalensis Hansen.
Pseudanchialina pusilla G. O. Sars.
Pseudanchialina inermis 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:—

Anchialina frontalis Zimmer.
Anchialina penicillata Zimmer.
Gastrosaccus bengalensis Hansen.
Gastrosaccus dunckeri Zimmer.
Leptomysis apiops G. O. Sars?
Dioptromysis perspicillata Zimmer.
Uromysis armata Hansen.
Lycomysis pusilla 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:—

Lophogaster intermedius Hansen.
Siriella brevicaudata Paulson.
Siriella quadrispinosa Hansen.
Siriella vulgaris Hansen.
Siriella affinis Hansen.
Siriella dubia Hansen.
Anchialina typica (Kröyer).
Gastrosaccus pacificus Hansen.
Erythrops minuta Hansen.
Hypererythrops spinifera (Hansen.)

The new species described below are:—

Siriella hanseni.
Gastrosaccus kempi.
Erythrops nana
Mysidopsis indica.
Mysidopsis kempi.
Leptomysis xenops.

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

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.
Lophogaster intermedius.	*L. typicus.*
Siriella vulgaris. ,, *affinis.*	*S. norvegica.* *S. clausii.* *S. jaltensis.*
Anchialina typica. ,, *grossa.*	*A. agilis.*
Gastrosaccus dunckeri. ,, *muticus.* ,, *kempi.*	*G. sanctus.*
,, *pacificus.* ,, *bengalensis.*	*G. normani.*
Erythrops minuta.	*Erythrops serrata.*
,, *nana.*	,, *elegans.*

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

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. 1*a*–1*e*.

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 *SIRIELLINAE* Norman.

Genus **Siriella** Dana.

Siriella hanseni, sp. nov.

Text-figs. 1*a*–*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.

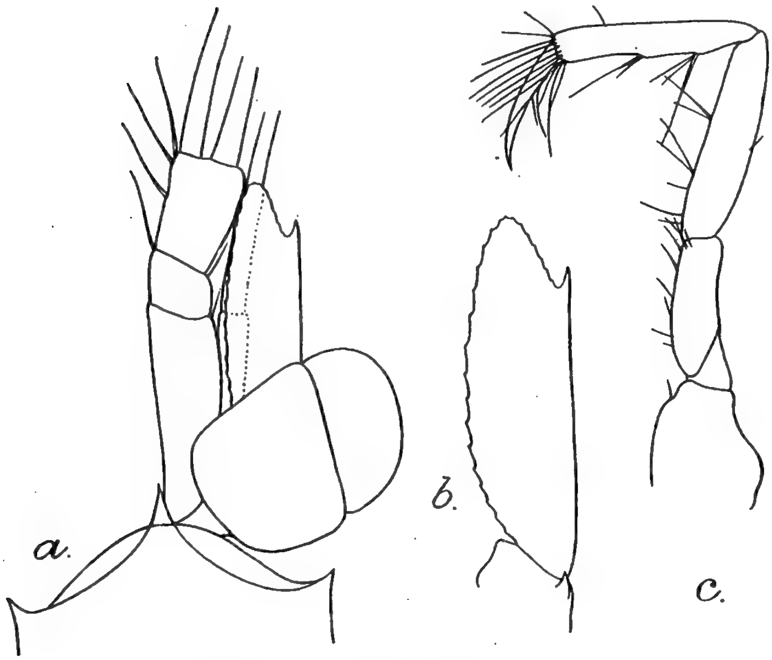
Carapace in both sexes without protuberances or tubercles, hardly at all produced into a frontal plate, anterior margin broadly and evenly rounded, leaving exposed a small spiniform pseudo-rostral process.

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 × 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: × 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. 3*a–h*, 4*a–f*.

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

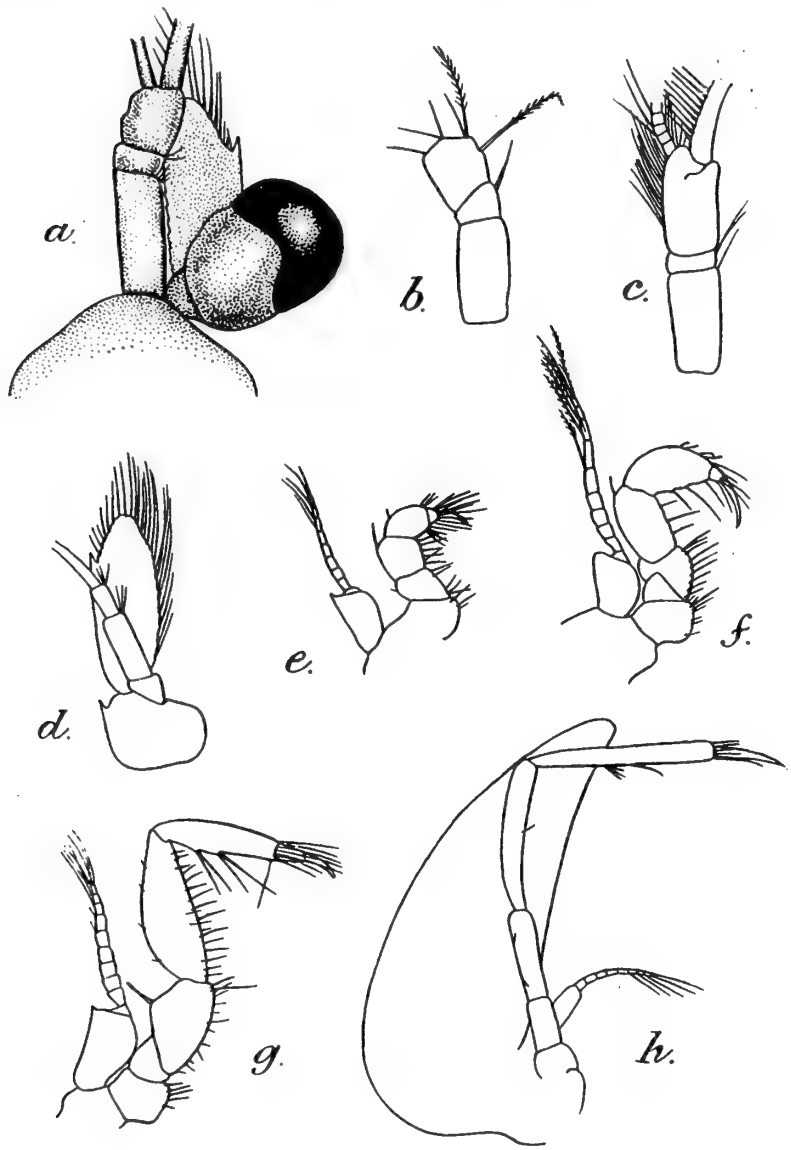
Localities.—Kilakarai and Pamban, Gulf of Manaar, from weeds, 0–2 fathoms, February 12th–25th, 1913. Abundant, adult males and females, 6 mm. long.

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.

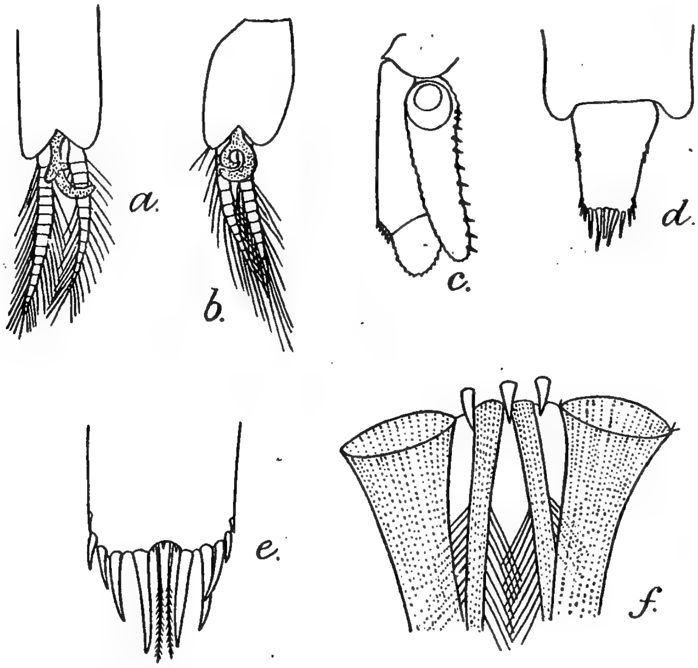
Body moderately robust. Carapace short, leaving the last three thoracic segments exposed in the mid-dorsal line, and barely



TEXT-FIG. 3.—*Striella 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 × 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 that 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* × 33, *e* × 65, *f* × 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 that 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 ($\frac{1}{6}$) 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 that 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. 5*a-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. 2*a–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. 3*a–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.

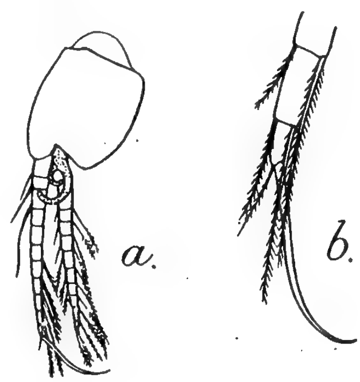
Siriella dubia Hansen.

Text-figs. 5*a*, *b*.

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



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

a, fourth pleopod of the male, × 33; *b*, distal joints of the exopod further enlarged, × 100.

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 4*d*, 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 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, 2*a–c*.
 ,, ,, Colosi, 1918, p. 6.
 ,, ,, Zimmer, 1918, p. 16, text-figs. 5–7.
 ,, ,, Colosi, 1920, p. 236, pl. xviii, figs. 2*a*.

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 interesting 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. 3*a–k*, pl. vii, figs, 1*a–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. 3*a*, *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. 7*a–l*.
Anchialina typica, Hansen, 1910, p. 52, pl. vii, figs. 2*a–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.

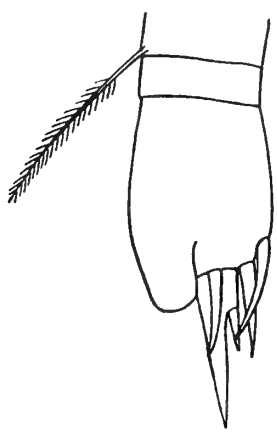
Text-fig. 6.

Anchialina grossa, Hansen, 1910, p. 54 pl. vii, figs. 3*a–n*, pl. viii, figs. 1*a–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 duanckeri, 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. 1*c*.

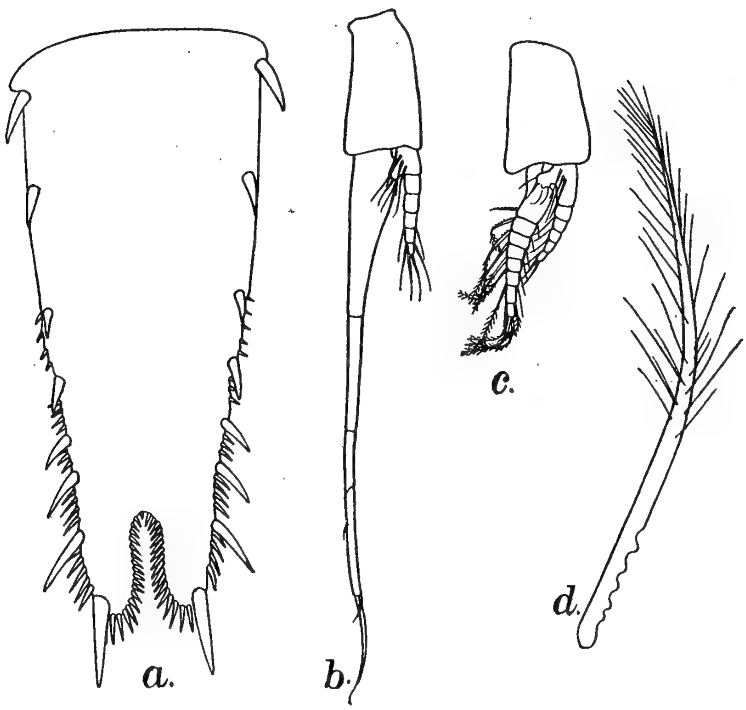
Locality.—Vasco Bay, Mormugao Bay, Portuguese India, one female.

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. 7*a–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, × 65; *b*, third pleopod of male, × 33; *c*, second pleopod of male, × 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.

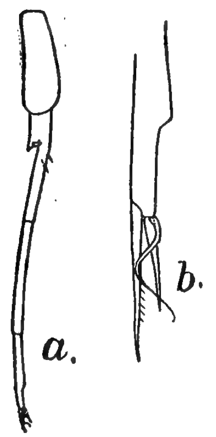
Text-figs. 8*a*, *b*.

Gastrosaccus pacificus, Hansen, 1912, p. 198, pl. 2, figs. 3*a*-*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, × 33; *b*, joint of the same, × 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.

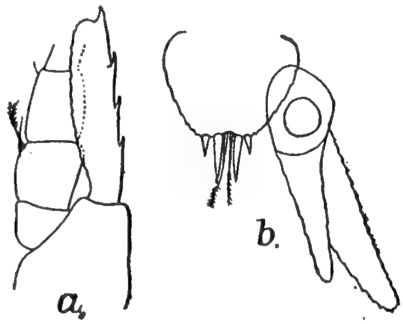
Erythrops minuta Hansen.

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.



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

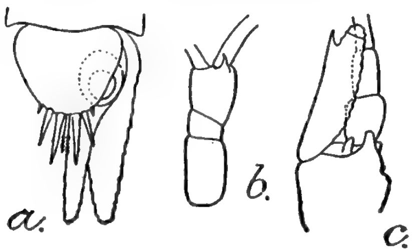
Distribution.—Gulf of Siam (Hansen).

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.



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

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* 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. 11*a–i*.

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

Locality.—Port Blair, Andaman Islands.

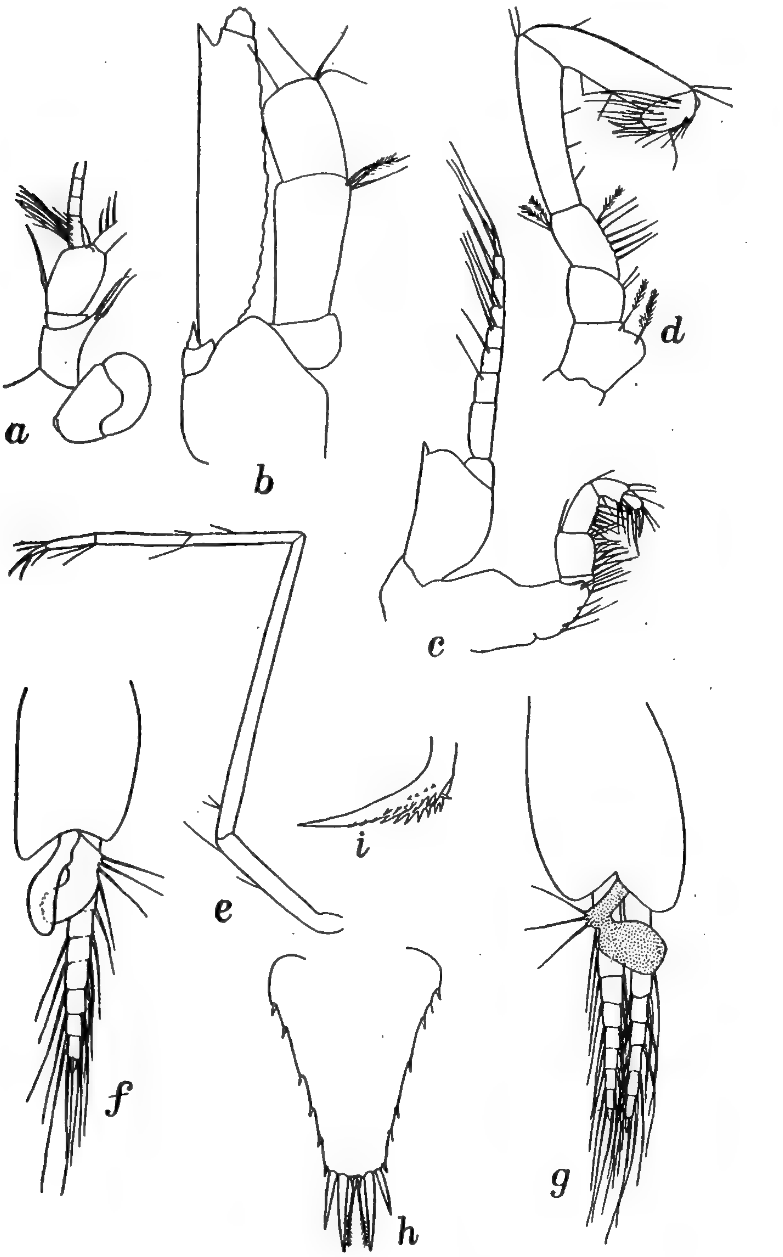
St. 3. Two males, two females.
St. 19. Six males, eight females.

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. 11*h*) 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 Hansens'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 *Hypererythrops* as distinguished from *Erythrops* 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 *Hypererythrops* 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 *Erythrops*. 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.

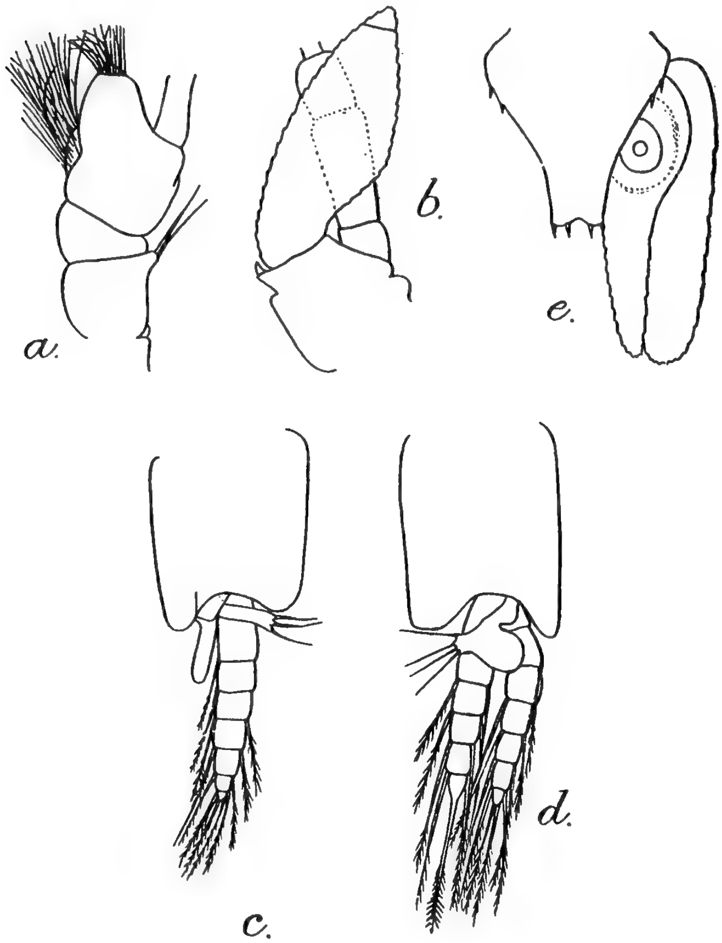
Text-figs. 12*a–e*.

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 × 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 kempi, sp. nov.

Text figs. 13*a*–*g*.

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

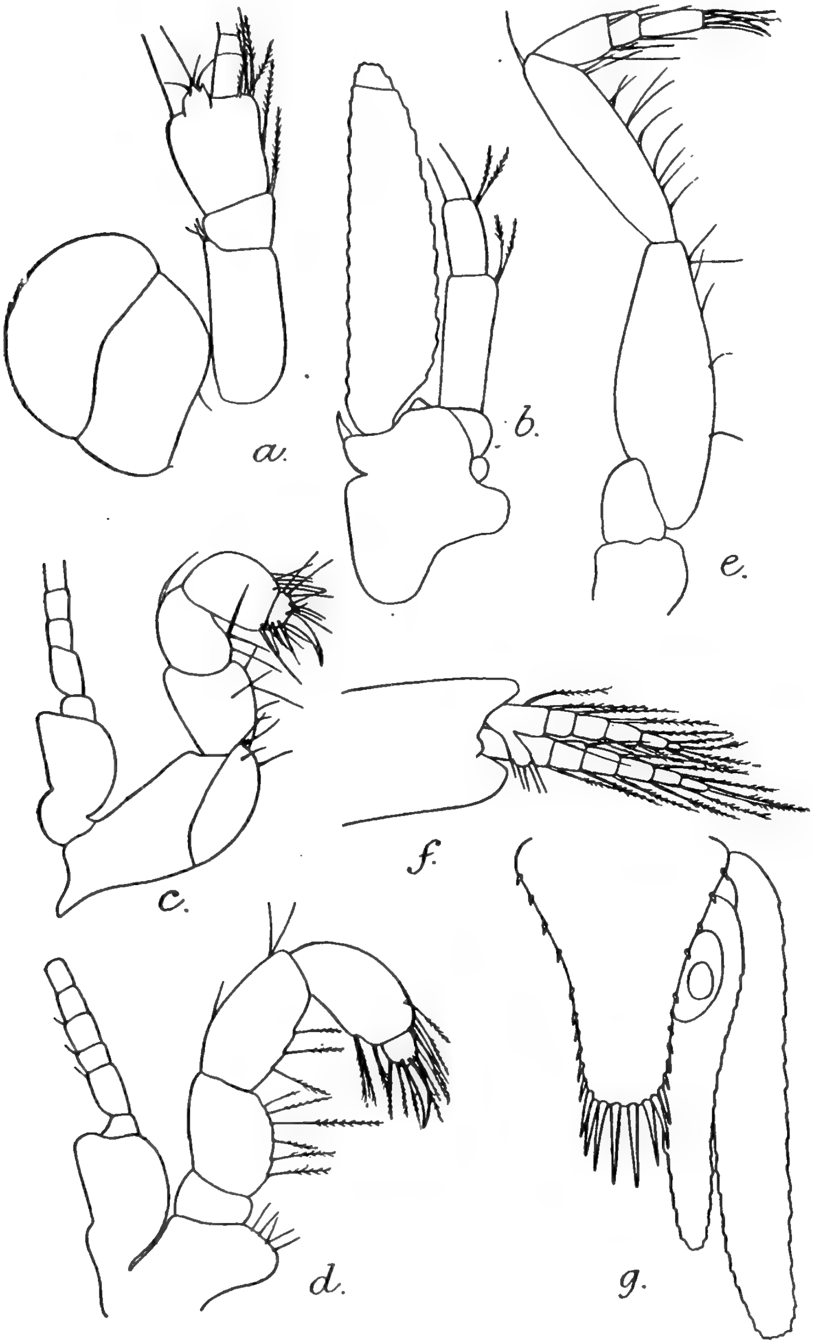
Description :—Carapace leaving the last two thoracic somites exposed dorsally, but laterally covering all but the last somite; produced in front into a short triangular plate with a bluntly pointed apex which does not project forward very much beyond the antero-lateral corners; no tubercles or nodules.

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 × 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. 14*a–g*.

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

Locality.—Port Blair, Andaman Islands.

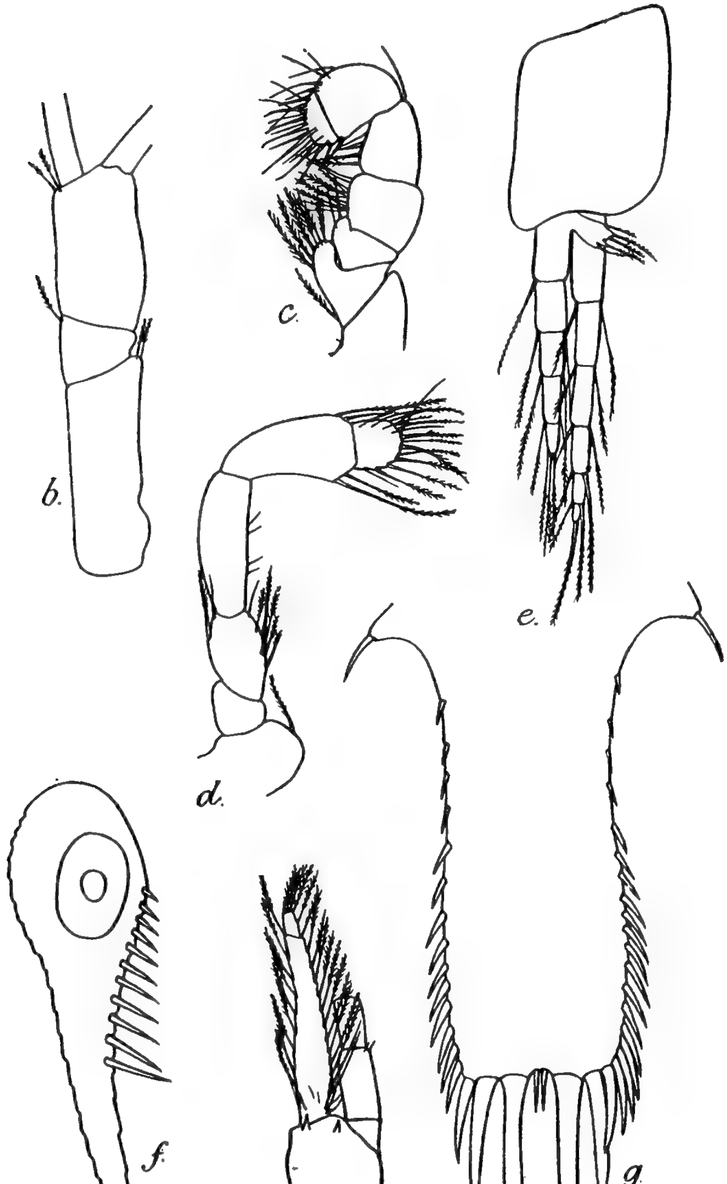
St. 5. Two.

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. 15*a–g*.

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

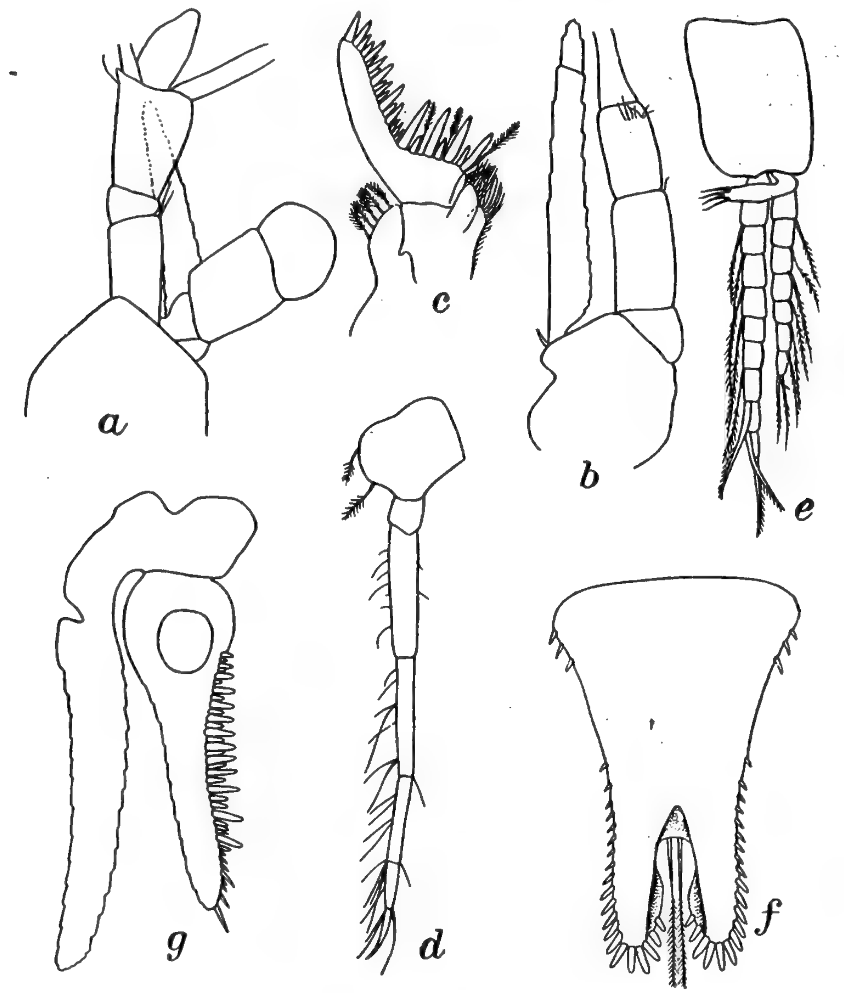
Description.—Body smooth, without spinules; carapace produced into a short triangular rostral plate with an obtusely rounded apex; eye long and narrow, recalling the eye of the genus *Mesopodopsis*, more than twice as long as broad, cornea occupying less than the distal half of each eye and not wider 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, × 33; *b*, antennal scale, × 50; *c*, second maxilla, × 65; *d*, endopod of fourth thoracic limb, × 50; *e*, fourth pleopod of male; *f*, telson, × 50; *g*, uropods, × 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 hansoni*, 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. 16*a-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.

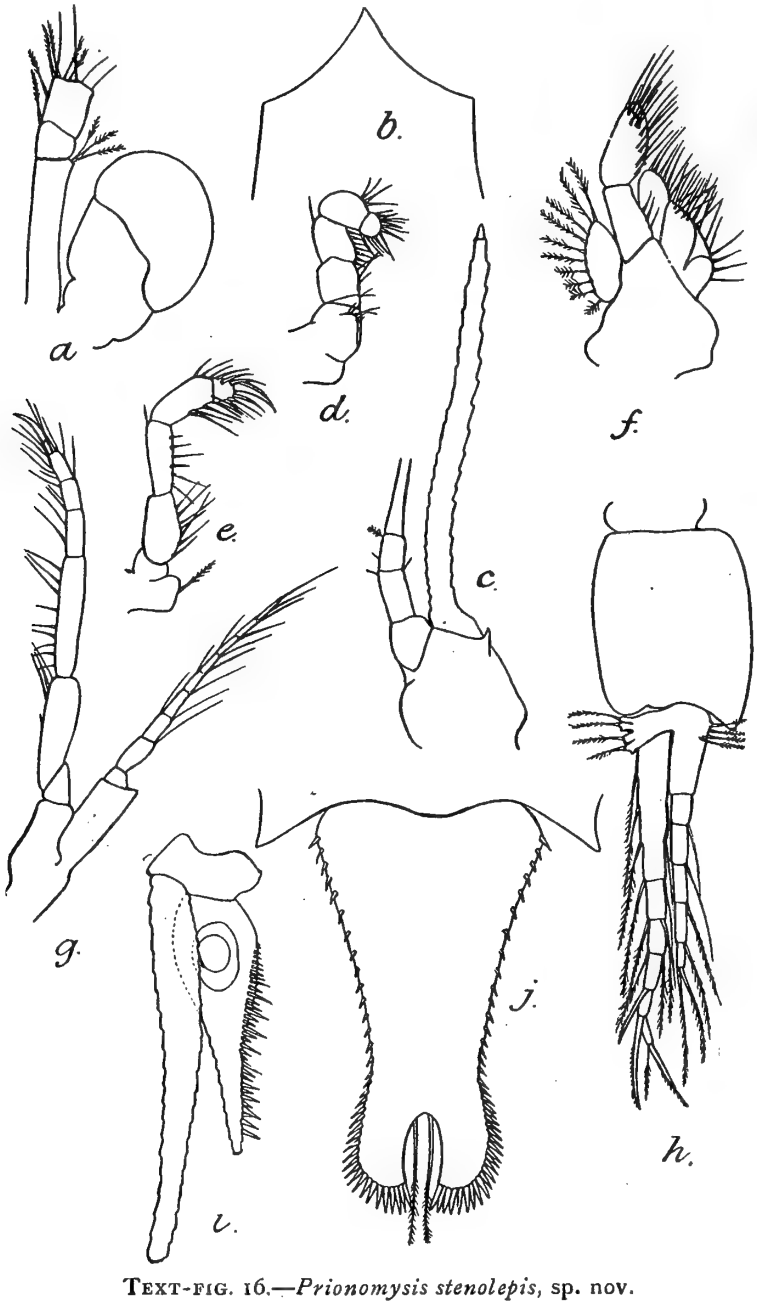
Antennular peduncle with the first joint longer than the remaining two combined; the last joint in the male with a well-developed hirsute lobe of normal form.

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 hansoni* 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, × 30; *b*, rostrum, × 30; *c*, antennal scale, × 30; *d*, endopod of first thoracic limb, × 30; *e*, endopod of second thoracic limb, × 30; *f*, second maxilla, × 60; *g*, third thoracic limb, × 30; *h*, fourth pleopod of the male, × 60; *i*, uropods, × 30; *j*, telson, × 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 **Dioptromysis** Zimmer.

Dioptromysis perspicillata Zimmer.

Dioptromysis 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*" *quadrispinosa*, 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 Leptomysini. 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. 17*a–e*.

Localities.—Port Blair, Andaman Islands.

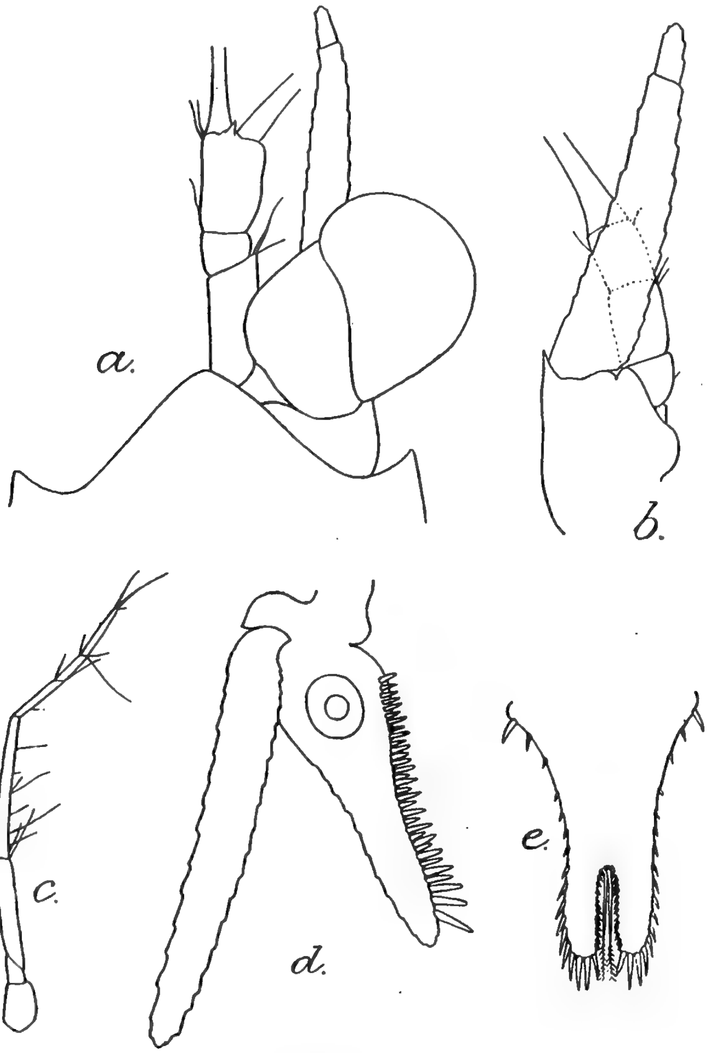
St. 3. Fifteen females, one male, 4 mm.
St. 11. Nine females, one male, 5 mm. (Types.)
St. 19. One male, 4 mm.

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.



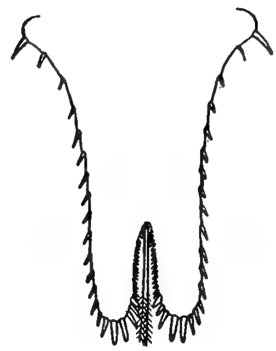
TEXT-FIG. 17.—*Doxomysis littoralis*, sp. nov.
a, anterior end, × 65; *b*, antennal scale, × 65; *c*, endopod of eighth thoracic limb, × 33; *d*, uropods, × 65; *e*, telson, × 65.

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.



TEXT-FIG. 18.—*Doxomysis* sp. Telson, × 65.

Three specimens of a species of *Doxomysis* from Port Blair are held over to await further material. 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. 19*a*–*f*.

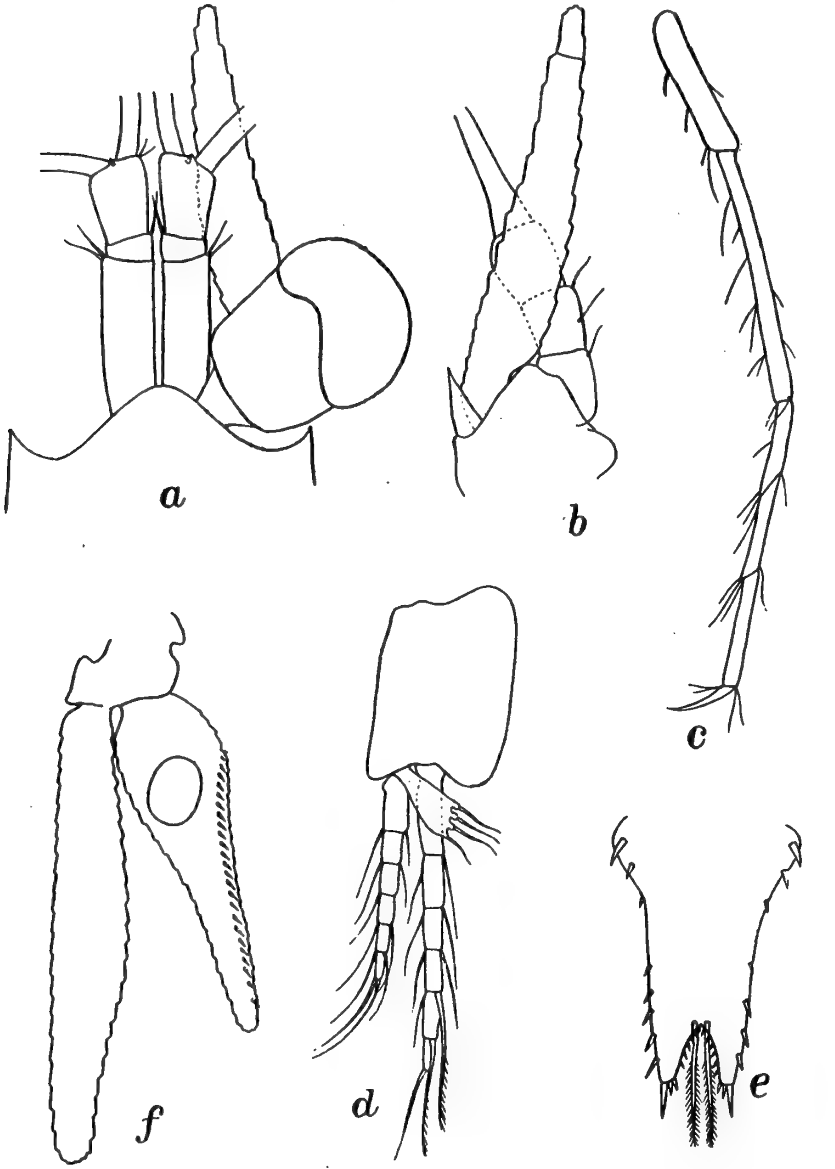
Localities.—Port Blair, Andaman Islands.

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, × 65; *b*, antennal scale, × 65; *c*, endopod of fourth thoracic limb, × 65; *d*, fourth pleopod of male, × 65; *e*, telson, × 65; *f*, uropods, × 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.

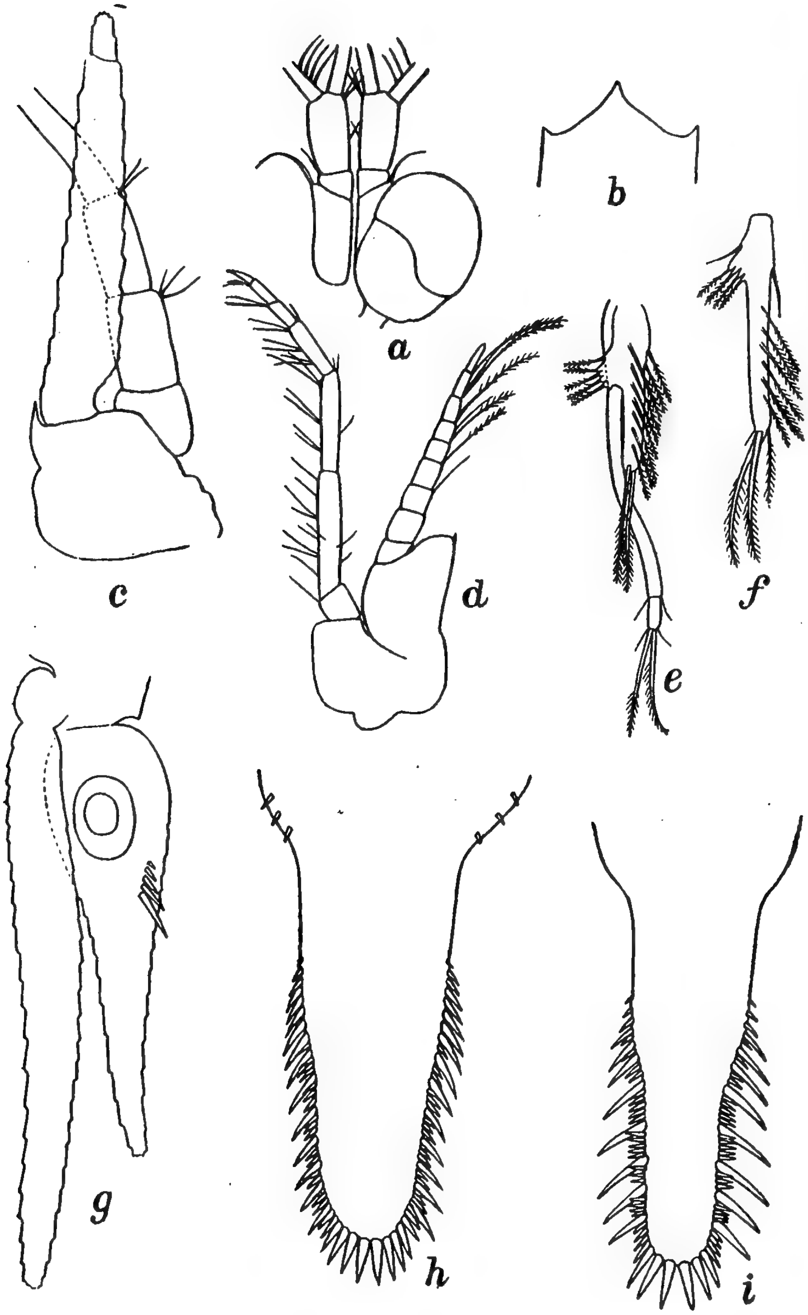
Text-figs. 20*a*–*i*.

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, × 33; *b*, rostrum, × 33; *c*, antennal scale, × 65; *d*. fifth thoracic limb, × 50; *e*, fourth pleopod of male, × 65; *f*, fifth pleopod of male, × 65; *g*, uropods, × 65; *h*, telson of adult, × 65; *i*, telson of young, × 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.

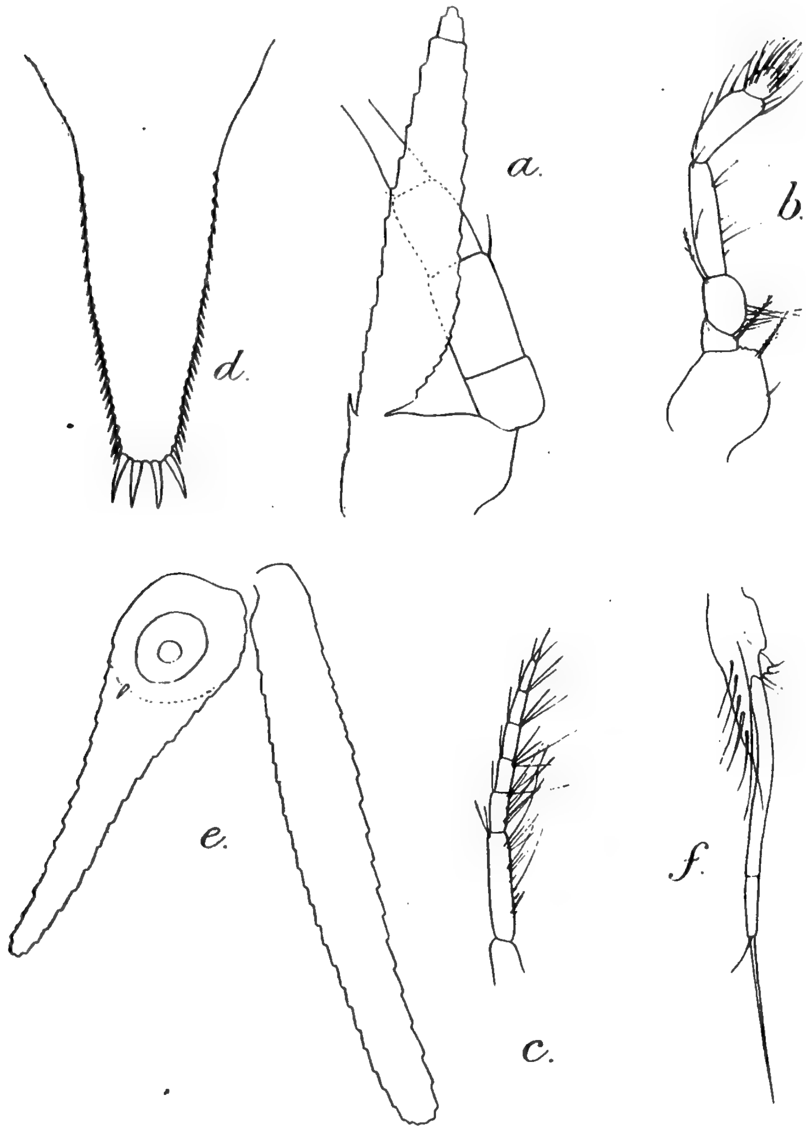
Neomysis hodgarti, sp. nov.

Text-figs. 21*a–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 strong 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 × 57.

Genus **Potamomysis** Czerniavsky.

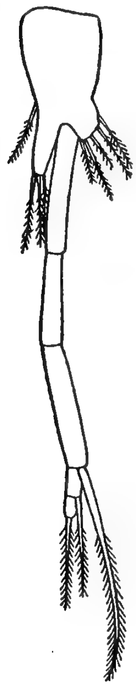
Potamomysis assimilis Tattersall.

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. 23*a*. 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.

Idiomysis inermis, sp. nov.

Text-figs. 23*a–f*, 24*a–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.

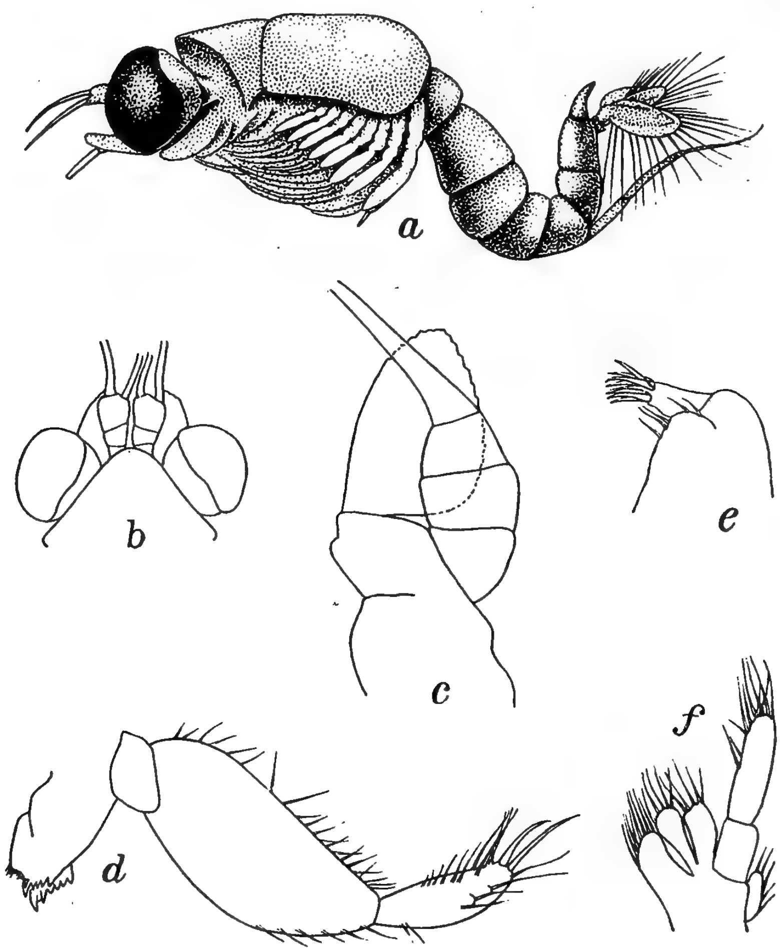
Mandible with a well-developed cutting edge and molar process, second joint of the palp broad. First maxilla with the inner plate reduced in size and tipped by four or five feeble setae.

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

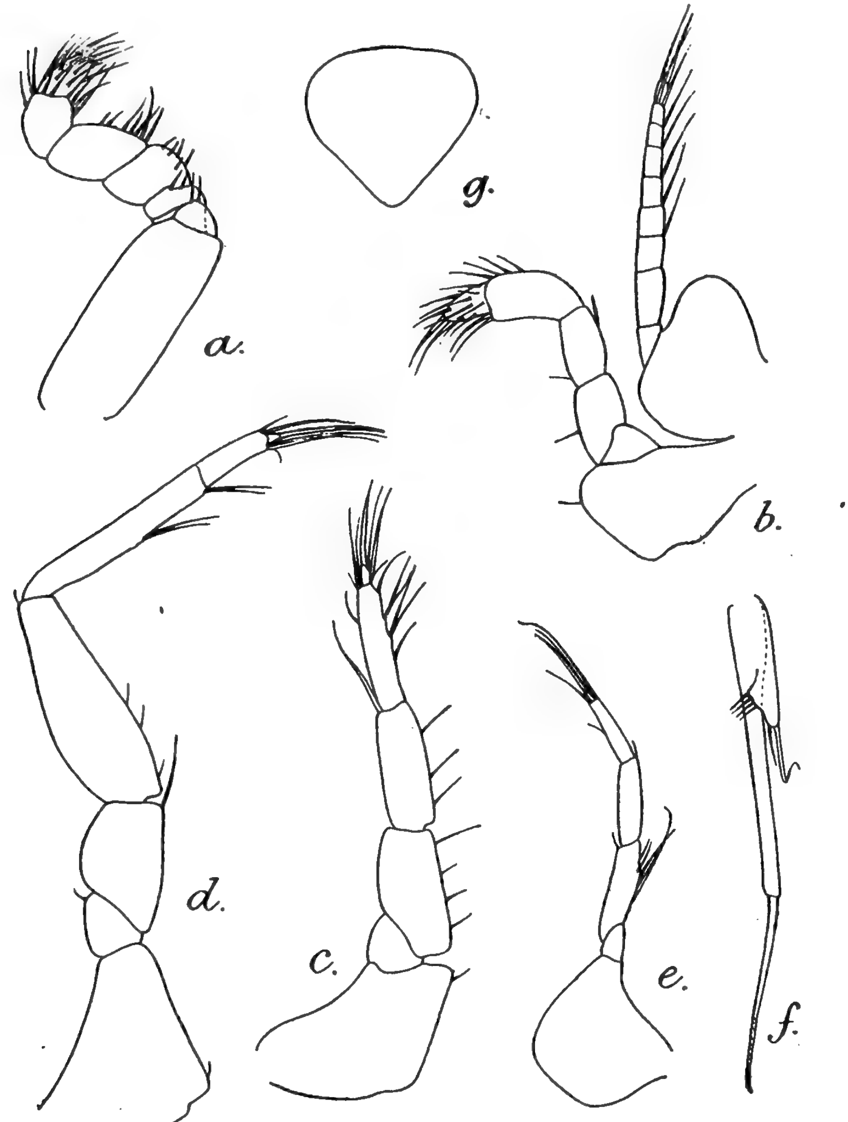


TEXT-FIG. 23.—*Idiomysis inermis*, gen. et sp. nov.

a, lateral view of adult male, × 21; *b*, dorsal view of anterior end, × 22; *c*, antennal scale, × 65; *d*, mandible, × 100; *e*, first maxilla, × 100; *f*, second maxilla, × 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, × 65; *b*, second thoracic limb, × 65; *c*, endopod of third thoracic limb, × 65; *d*, endopod of fifth thoracic limb, × 65; *e*, endopod of eighth thoracic limb, × 65; *f*, fourth pleopod of male, × 65; *g*, telson, × 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.

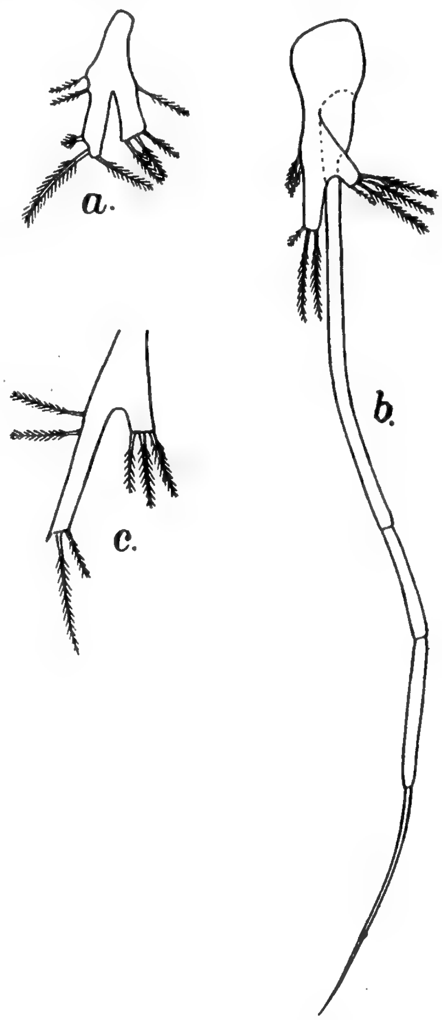
Text-figs. 25*a–c*.

Lycomysis spinicauda, Hansen, 1910, p. 77, pl. xi, figs. 3*a–f*, pl. xii, figs. 2*a–h*.
,, ,, Colosi, 1916, p. 194, text-figs. 1*a–d*.
,, ,, Colosi, 1918, p. 10.
,, ,, Colosi, 1920, p. 251, pl. xx., figs. 10*a–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."



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

a, third pleopod of male, × 100; *b*, fourth pleopod of male, × 100; *c*, fifth pleopod of male, × 100.

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 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 eingliederigen 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 (haupteile). 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 described 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.

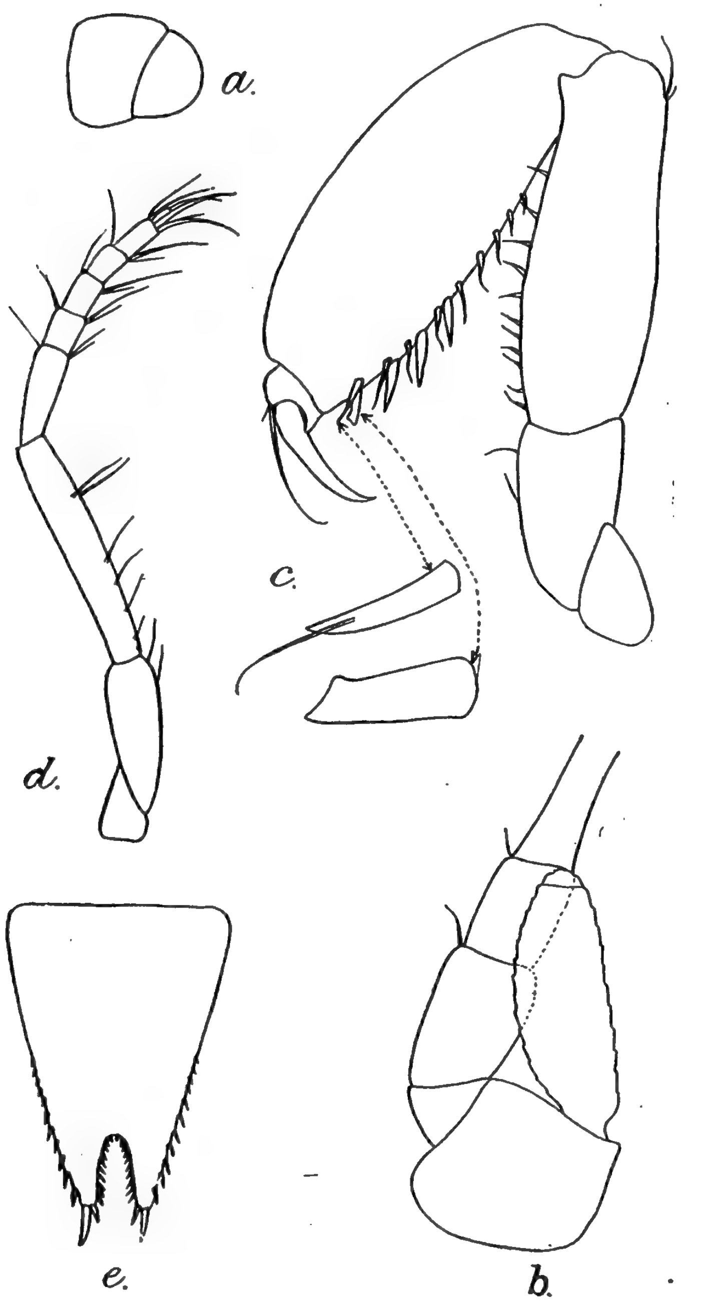
I conclude therefore, that *Gnathomysis gerlachei* Bonnier and Pérez must be considered undoubtedly as a synonym of *Heteromysis harpax* Kossmann, which is almost certainly the same as *H. harpax* Hilgendorf.

Heteromysis proxima, sp. nov.

Text-figs. 26*a–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, × 50; *b*, antennal scale, × 65; *c*, endopod of third thoracic limb of male, × 65; *d*, endopod of fourth thoracic limb, × 65; *e*, telson, × 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. microps* 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. 27*a–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.

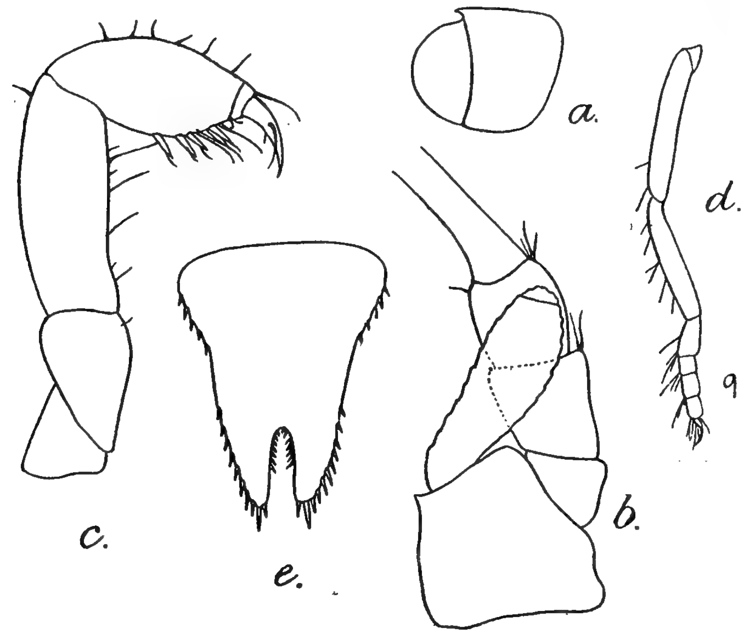
Third thoracic limb with the endopod moderately stout, merus three times as long as broad without process at the distal end of the inner margin, carpus robust, shorter than the merus, twice as long as broad, inner margin armed with four or five spines each with an inserted seta, penultimate joint small 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, × 50 ; *b*, antennal scale, × 65 ; *c*, endopod of third thoracic limb, × 65 ; *d*, endopod of fourth thoracic limb, × 65 ; *e*, telson, × 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. 28*a–e*.

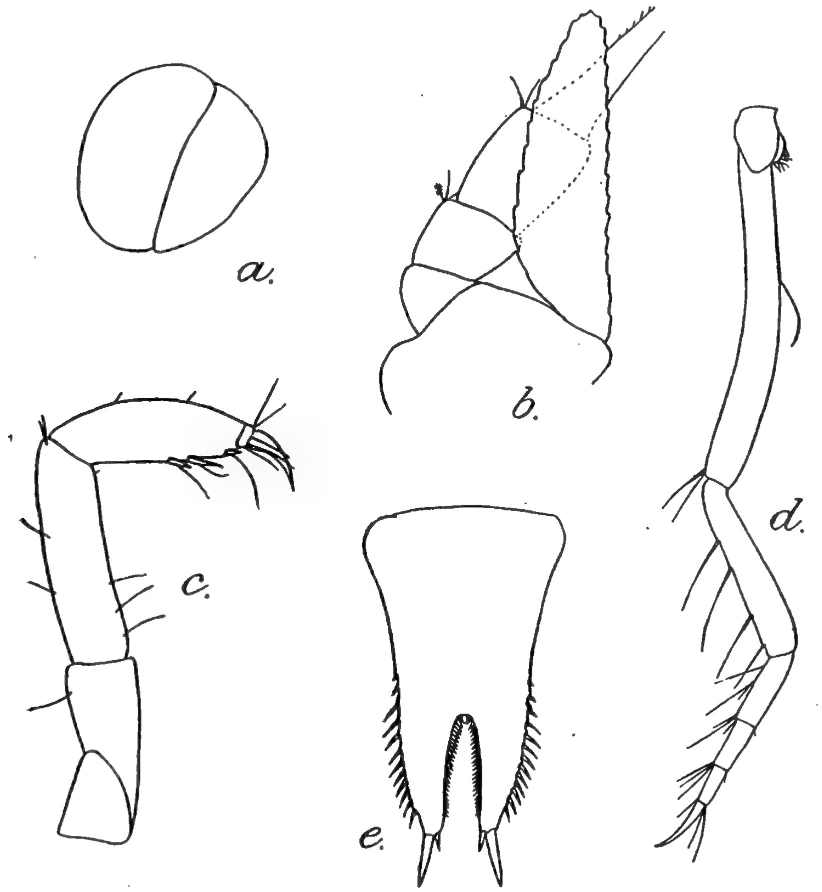
Locality.—Kilakarai, Gulf of Manaar, among weeds, 1–2 fathoms. Five males and two females, 4–6 mm. (Types.)

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, × 50; *b*, antennal scale, × 65; *c*, endopod of third thoracic limb, × 65; *d*, endopod of fourth thoracic limb, × 65; *e*, telson, × 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 [1] has quite recently discussed these modifications in the fish, while the other [2] 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,[3] 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* [4] and that on the mouth of *Microhyla achatina*,[5] or the powerful oral sucker of the tadpole of *Helophryne natalensis* [6] and that of *Bufo penangensis*.[7] 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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[1] Hora, *Rec. Ind. Mus.* XXIV, pp. 31-36 (1922).
[2] Annandale, *Rec. Ind. Mus.* VIII, p. 29 (1912); *ibid.* XV, p. 17 (1918); *Proc. As. Soc. Bengal* (n. s.) XIII, p. clxxxvi (1917).
[3] Boulenger, *Rec. Ind. Mus.* XV, p. 65 (1918).
[4] Hora, *Journ. As. Soc. Bengal* (1922).
[5] Smith, *Journ. Nat. Hist. Soc. Siam* II, p. 37, figs. A_1–A_4 (1916).
[6] Hewitt, *Ann. Natal Mus.* II, p. 477, pl. xxxix, figs. 5, 6, 7 (1913).
[7] Flower, *Proc. Zool. Soc. London*, p. 908, pl. lx, figs. 3, 3*a* (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 [1] 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.[2] 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.[3] 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.[4]

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* [5] 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

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[1] Annandale, *Rec. Ind. Mus.* XV, p. 22, pl. 1, figs. 6, 6*a* (1918).

[2] 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.

[3] Annandale, *Rec. Ind. Mus.* VIII, p. 19 (1912).

[4] Boulenger, *Rec. Ind. Mus.* XX, pp. 100, 168 (1920).

[5] 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[1] 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*[2] 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

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[1] Boulenger, *Rec. Ind. Mus.* XX, pp. 123, 130 (1920).
[2] Annandale, *Rec. Ind. Mus.* VIII, pl. iv, fig. 3*a*.

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 extremeties 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.

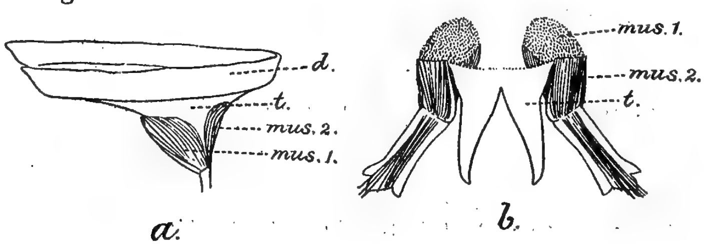


FIG. 1.—Disc and its musculature in *Rana afghana*.
a. Slightly oblique lateral view of disc with its muscles and tendon.
b. Anterior view of muscles and tendon after removal of disc.
d.=disc; *t.*=tendon; *mus.* 1., and *mus.* 2.=muscles of disc.
(cf. *Rec. Ind. Mus.* XXIV, p. 47, fig. 9b.)

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* [1]; 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 paralled to the epidermis, while internally they

[1] 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*.[1] 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

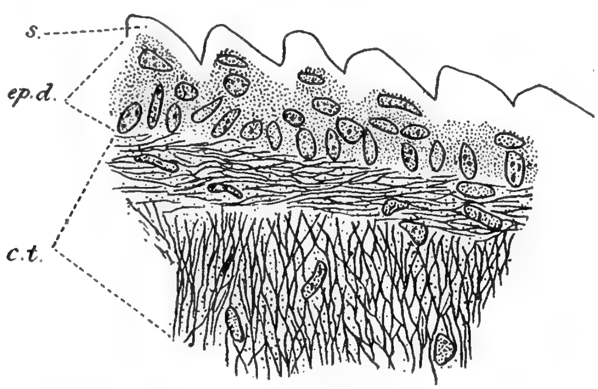


FIG. 2.—Transverse section through free border of disc of *Rana afghana*. (Highly magnified and slightly diagrammatic).
s.=spine ; *ep. d.*=epidermis ; *c. t.*=connective tissue.
(cf. *Rec. Ind. Mus.* XXIV, p. 50, fig. 13.)

genus *Garra* we have before us almost every possible stage alike in postembryonic development, in individual variability and in specific differentiation. One[2] 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.

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

[2] *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.*

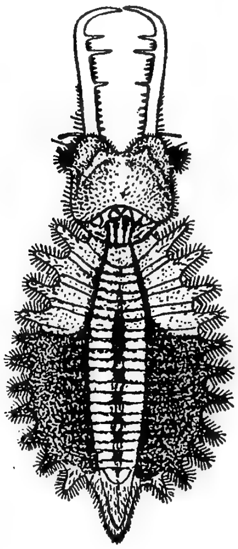
With one exception, the whole of the specimens dealt with in this paper are from within the limits of the Indian Empire. Four new species are dealt with, of which one is from Siam and the other three from purely Indian localities. The types of these will be preserved in the Indian Museum.

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.

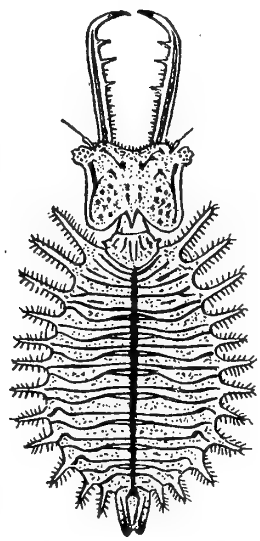
Prothorax very short and rather hidden, with no definite tubercles on the outer side.

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.)



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

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

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

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.

Suphalomitus serratus sp. nov.

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

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. Neur.*, no. 36, p. 426 (1853).
Ascalaphus profanus, Walk., *l.c.*, no. 39, p. 428 (1853).
Helicomitus verbosus, MacLach., *Journ. Linn. Soc., Zool.*, XI, p. 262, no. 4 (1871).
Helicomitus profanus, 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. *Hannyngton*, 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 procax, 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 **Suhpalacsa** Lefebr.

Suhpalacsa 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** Lefebr.

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 4/5ths 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 Minius, Walk.

Ascalaphus minius, Walk., *l.c.*, p. 429, no. 40 (1853).
Ascalaphus luctifer, Walk., *l.c.*, p. 432, no. 46 (1853).
Siphlocerus minius, 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 tesselatus, 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 kempi, sp. nov.

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

Male.

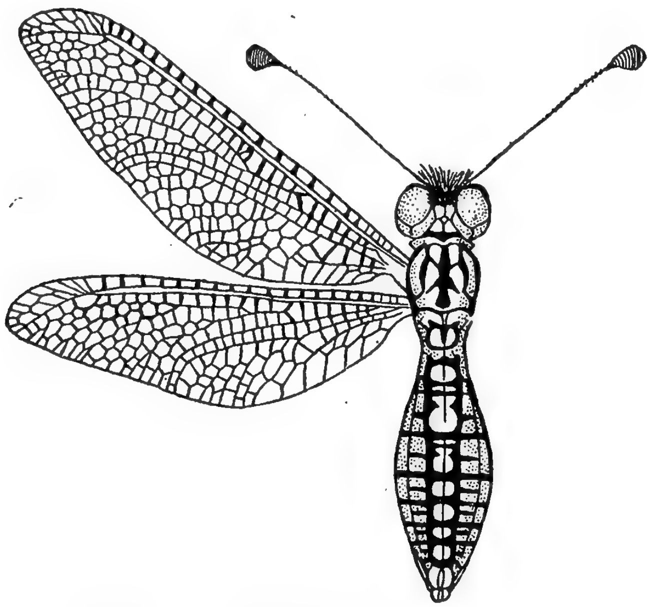
Antennae bright yellow, a little longer than half the length of the wing; club broad, dark brown.

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 kempi*, 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.
Placobdella 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).

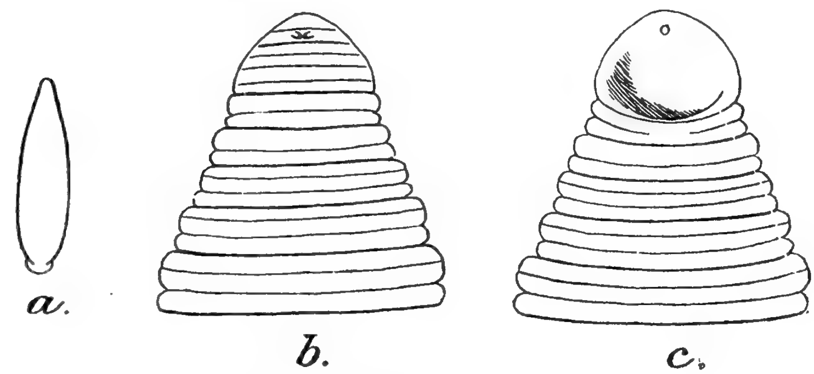
Shape and dimensions. As shown in fig. 1 the form is rather slender for a *Glossiphonia*, being from 3 to 4 times as long as wide in moderately contracted specimens. The broadest part lies posterior to the middle, from where the body tapers very gradually toward both ends. Both the dorsal and ventral 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: ×3.
b. Somites i–ix, dorsal view: ×30.
c. Somites i–ix, ventral view: ×30.

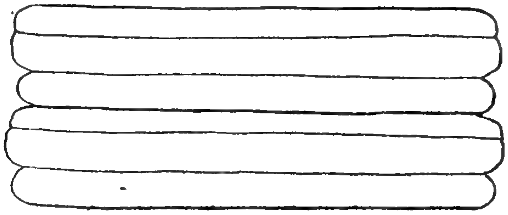
which are double in larger specimens, as two. Both pores are small and inconspicuous. In most of the specimens the clitellum was not distinguishable from the rest of the body.

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.

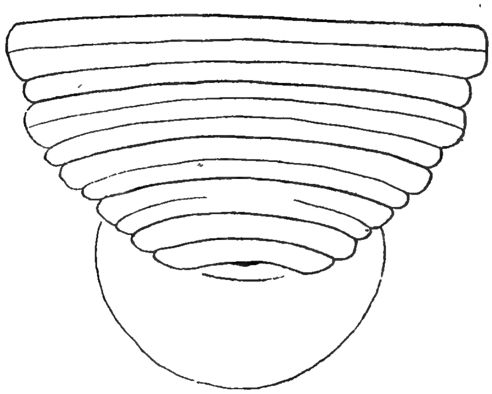
The hinder sucker is directed ventrally and is attached to the body by the ventral surface of the last three or four annuli.

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 *Hemiclepsis 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 : ×30.
b. Somites xxii–xxvii, with sucker : ×30.

last pair which have three metamerically 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. 2*a*) 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.

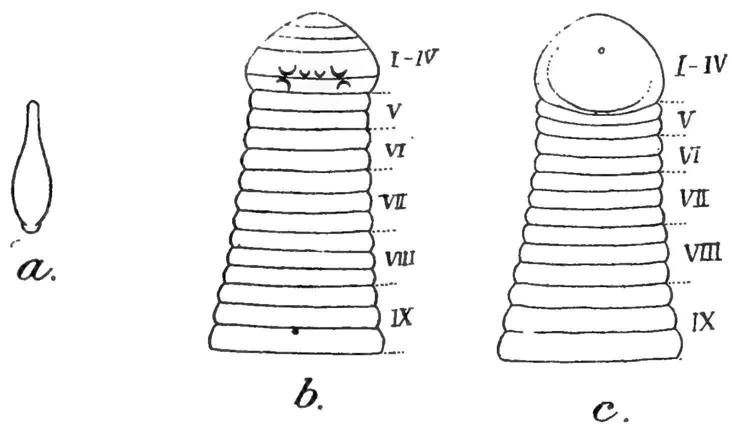
This species presents a certain resemblance to the diagrammatic figure of *Placobdella emydae* Harding (9), with which it agrees in the number of crop diverticula, the testes, and the position of the genital openings. Both forms were also found attached to chelonians. In reality, however, the difference 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: ×3.
b. Somites i-ix, dorsal view: ×30.
c. Somites i-ix, ventral view: ×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.

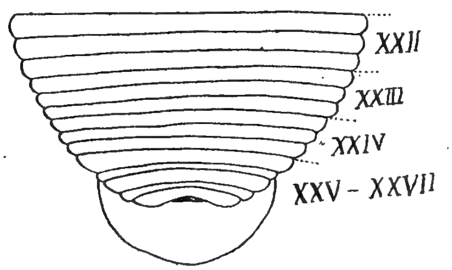
External features. The surface of the body is on the whole smooth, all the papillae being low and insignificant. Neither transverse nor longitudinal rows of particularly large papillae could be observed.

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 Glossiphonidae. Two pairs are situated in the posterior 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 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.



TEXT-FIG. 4.—*Glossiphonia annandalei*, sp. nov. Somites xxii–xxvii with sucker : ×30.

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.

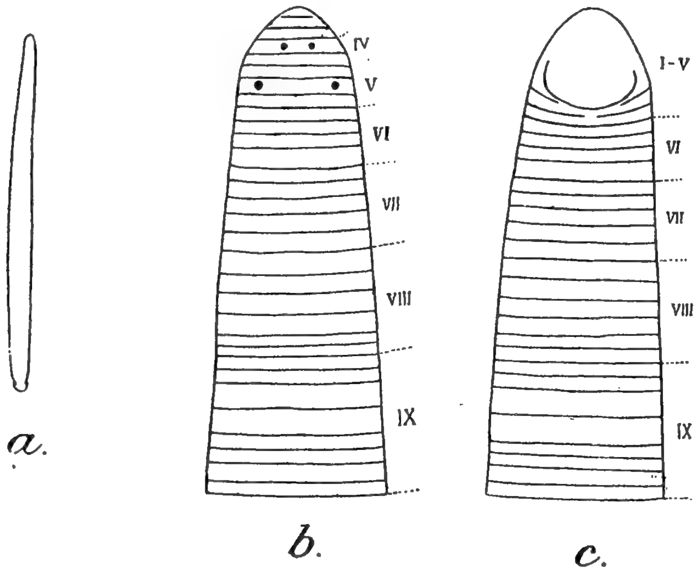
Shape and dimensions. Both specimens are small and seem to be immature. The body is long and slender, almost cylindrical, being only slightly wider in the middle than near the extremities. The head is rounded in front, forming the anterior lip of the spacious mouth. The hinder sucker is almost circular, 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.



a. b. c.

TEXT-FIG. 5.—*Trocheta quadrioculata*, sp. nov.

a. Outline of entire animal: ×3.
b. Somites i–ix, dorsal view: ×25.
c. Somites i–ix, ventral view: ×25.

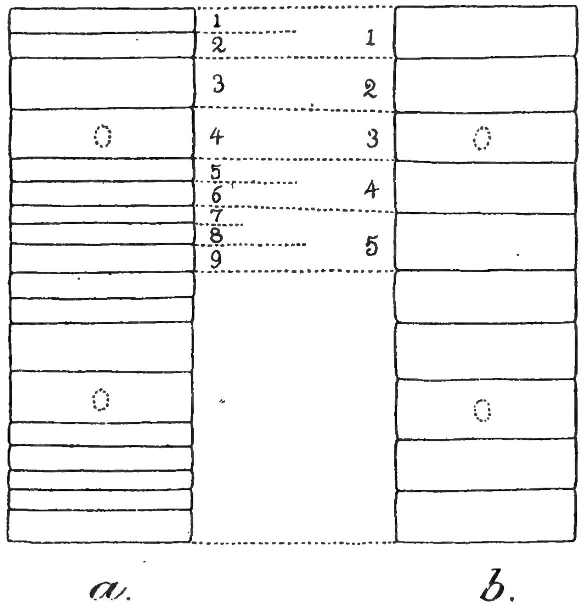
on ring 6. There is no marked difference in size between the anterior and posterior pairs.

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* Dutrochet.

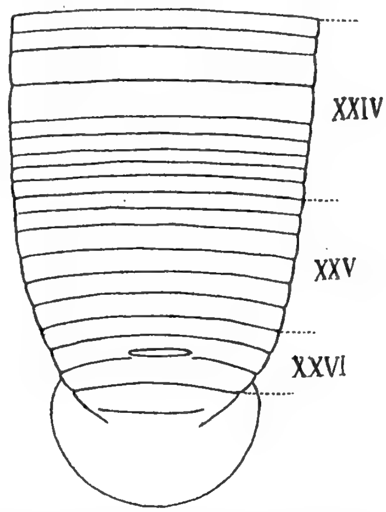
Annulation. The study of the annulation of this leech presented a very great difficulty. Observed in alcohol, the furrows were almost invisible, the integument appearing entirely smooth throughout the whole extent of the body. It was necessary, therefore, to examine the specimens placed on a piece of blotting paper and illuminated from the side, when the furrows became visible as faint lines on the half-dried surface.



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 : × 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 breviore 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 aeque longa atque lata, antennis 14-articulatis, articulo tertio quam secundus parum breviore et quartum longitudine subaequante.

Pronotum lobi antici margine supero rotundato, meso- et

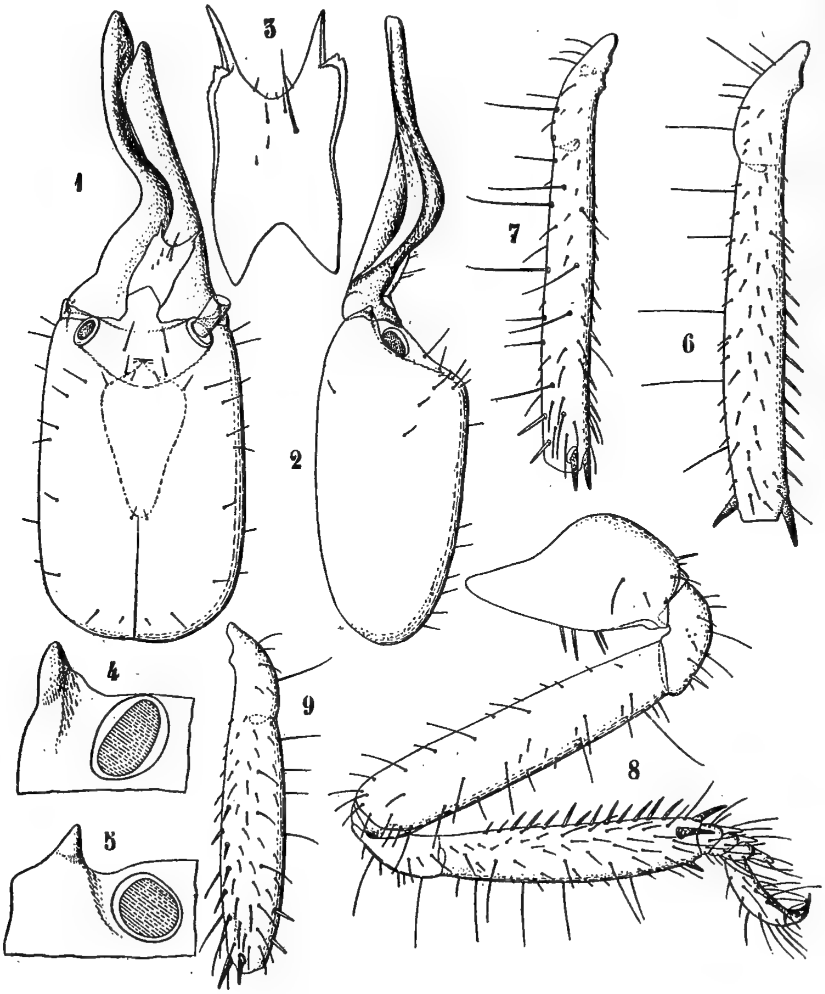

FIG. I.—*Capritermes gravelyi*: 1. militis caput pronum; 2. idem lateraliter inspectum; 3. labrum; 4. epicranii pars antica lateralis laeva prona; 5. eadem lateraliter inspecta; 6. tibia primi paris; 7. tibia secundi paris; 8. operarii pes primi paris; 9. operarii tibia secundi paris.

metanoti margine postico et pedibus eisdem militis similibus sed pedum primi paris coxis tantum setis externis 3–4.

Abdomen setis numerosis quam eaedem 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. 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, epicranii margine antico sublaterali ad mandibularum basim in processum brevem conicum producto, labro longo a media basi ad medium marginem anticum menso 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 2/3 breviore, 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. 1/3 breviore 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.

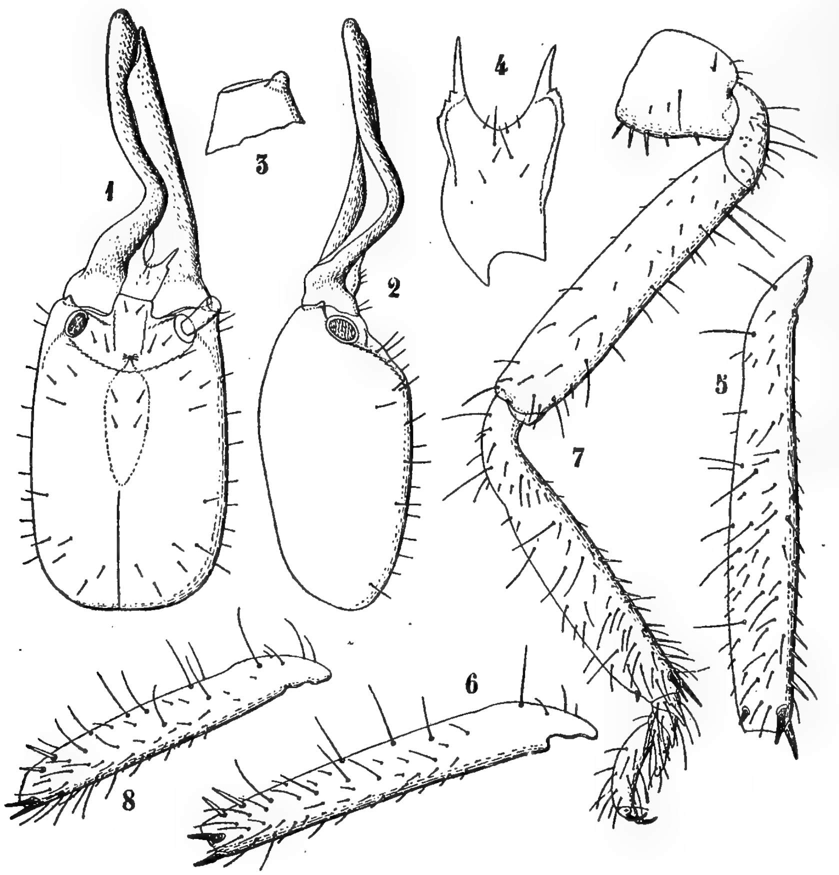

FIG. II.—*Capritermes longirostris* var. *cornutella* : 1. militis caput pronum ; 2. idem lateraliter inspectum ; 3. epicranii pars antica lateralis dextera parum oblique inspecta ; 4. labrum ; 5. tibia primi paris ; 6. tibia secundi paris ; 7. operarii pes primi paris ; 8. operarii tibia secundi paris.

Habitat. Milites duos et operarios pauces 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 1/4 et quam quartus fere duplo longiore.

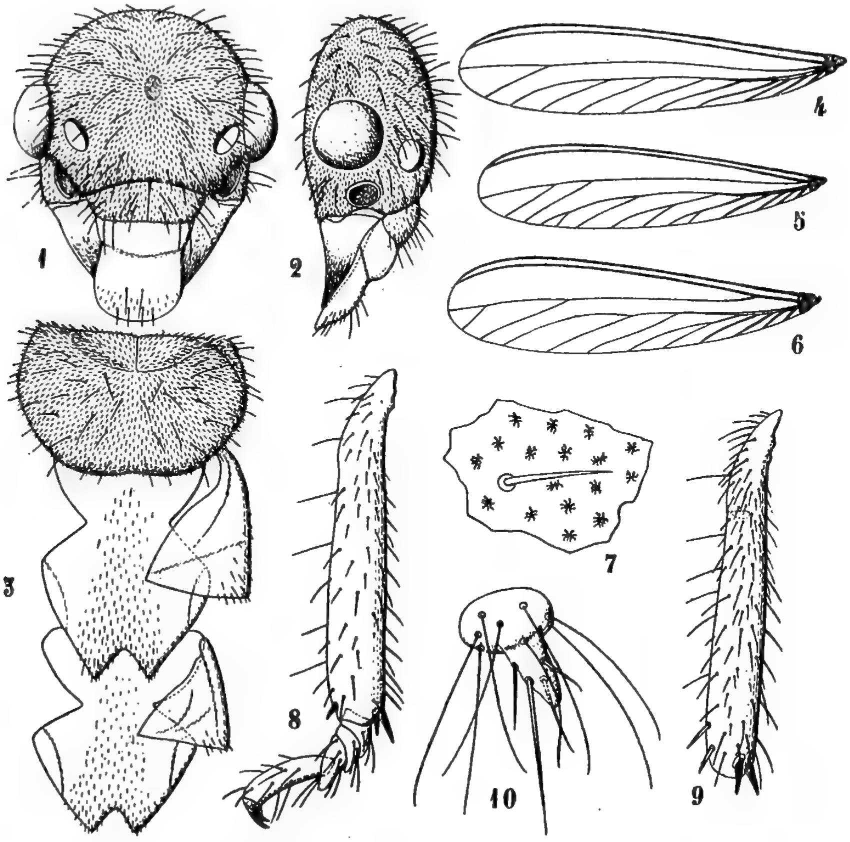

FIG. III.—*Capritermes santschii*, alatus: 1. feminae caput pronum; 2. idem lateraliter inspectum; 3. thorax pronum; 4–5. ala interior et ala posterior; 6. ala anterior anomala; 7. alae particula multo ampliata; 8. pes primi paris a tibia; 9. tibia secundi paris; 10. cercus.

Pronotum quam caput cum oculis ca. 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 breviore, 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,

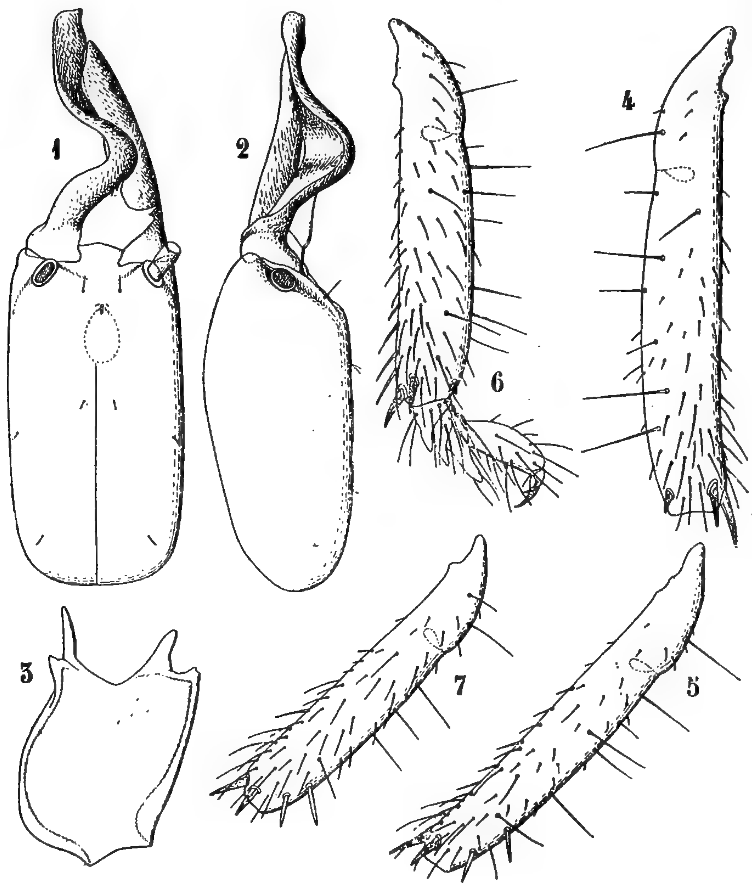

FIG. IV.—*Capritermes santschii*: 1. militis caput pronum; 2. idem lateraliter inspectum; 3. labrum; 4. tibia primi paris; 5. tibia secundi paris; 6. operarii pes primi paris a tibia; 7. tibia secundi paris.

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 aeque longo (processibus anticis exceptis) atque lato, latere laevo convexiusculo, dextero parum obliquo, angulis anticis processuum instar 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. 1/4 breviore, antennis 14-articulatis, articulo tertio quam secundus paullum et quam quartus ca. 1/3 longiore.

Pronotum quam caput ca. 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 breviore, 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 1/3 breviore 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 paullum longiore quam latiore, oculis parvis bene convexis et prominulis, ocellis ab oculis quam ocelli diametros transversalis paullum minus distantibus, antennis 15-articulatis, articulo tertio quam secundus parum magis quam dimidium breviore et quam quartus parum breviore.

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.

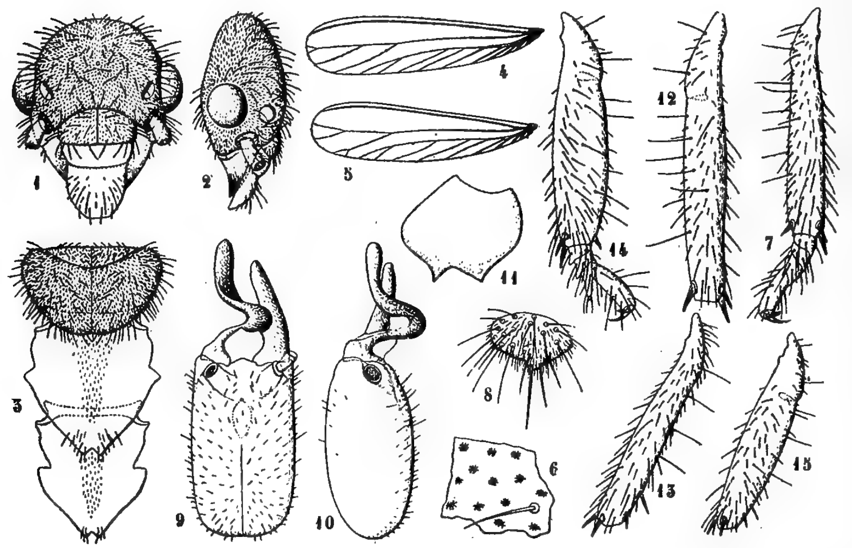

FIG. V.—*Capritermes distortus*: 1. feminae caput pronum; 2. idem lateraliter inspectum; 3. thorax pronum; 4–5. ala anterior et ala posterior; 6. alae particula multo ampliata; 7. pes primi paris a tibia; 8. cercus; 9. militis caput pronum; 10. idem lateraliter inspectum; 11. labrum; 12. tibia primi 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 paullum breviore, secundi paris tibia spinis externis duabus distalibus sat robustis.

Abdominis tergita et sternita setis brevibus sat numerosis et setis brevioribus pernumerosis instructa, pleuris setis brevioribus numerosis. Cerci breviores.

Long. corp. cum alis mm. 10, sine alis 6, long. capitis 0·86, ejusdem lat. inter ocules 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 discendens, 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 breviore, subacuta, mandibula laeva quam caput 1/3 breviore, forma vide fig. V, 9–10, antennis ? (in exemplo typico articulis a decimo abruptis), articulo tertio quam secundus vix breviore et quam quartus aliquantum longiore.

Pronotum quam caput ca. 1/3 minus latum, lobi antici 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 aeque 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 breviore et quam quartus aliquantum longiore.

Pronotum lobi antici 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 nunnullis longis instructo, mandibula laeva quam dextera aliquantum longiore et quam caput fere 1/3 breviore, forma vide fig. VI, 1–2, antennis 14-articulatis, articulo tertio quam secundus paullum breviore et quam quartus parum longiore.

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 breviore, secundi paris tibia spinis externis duabus robustis (in pede nonnullo spina tantum una sistente).

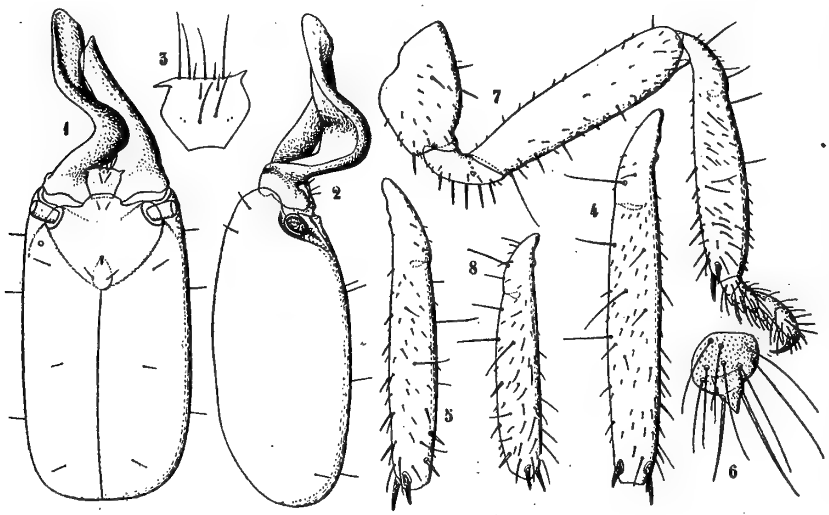

FIG. VI.—*Capritermes tetraphilus*: 1. militis caput pronum; 2. idem lateraliter inspectum; 3. labrum; 4. tibia primi paris; 5. tibia secundi paris; 6. cercus; 7. operarii pes primi paris; 8. tibia secundi paris.

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. 1/3 breviore et quam quartus ca. 1/3 longiore.

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 breviore, secundi paris tibia spinis externis parum robustis inter sese remotis (in pede nonnullo 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 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 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 breviore.

Long. corp. mm. 3·6, long. capitis 0·95, ejusdem lat. 1·04, long. antennarum 1·70, tibiae III, 1·30.

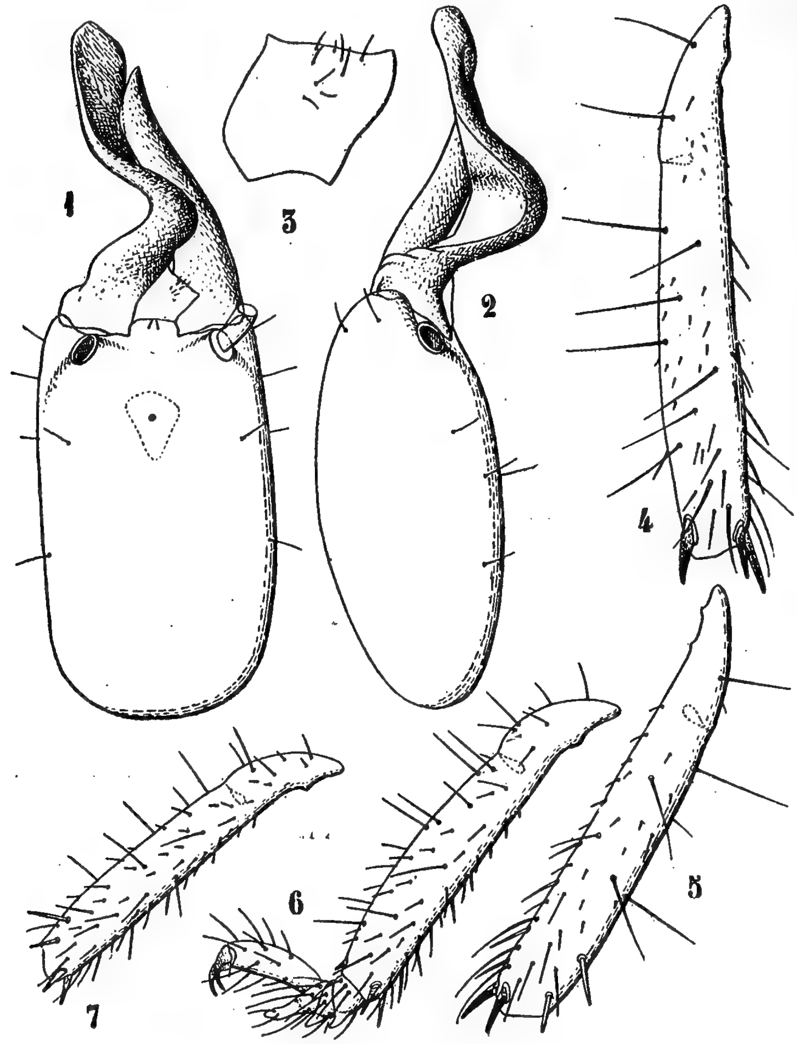

FIG. VII.—*Capritermes modiglianii*: 1. militis caput pronum; 2. idem lateraliter inspectum; 3. labrum; 4. tibia primi paris; 5. tibia secundi paris; 6. operarii pes primi paris a tibia; 7. tibia secundi paris.

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. salfem statura minore etiam distincta est.

RECORDS

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Appendix A.

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LIST OF LITERATURE REFERRING TO INDIAN ZOOLOGY (EXCLUDING INSECTA) RECEIVED IN CALCUTTA DURING THE YEAR 1922.

Compiled by Sunder Lal Hora, *D.Sc., Assistant Superintendent, Zoological Survey of India.*

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