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NOTES ON THE INDIAN FLYING FISHES OF THE GENUS *CYPSELURUS* SWAINSON.

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INTRODUCTION.

While studying the collections of flying fishes during my routine work as Reference Collection Officer, Central Marine Fisheries Research Station, between 1948-49, several new points of systematic importance of this group were observed. These points are analysed and the results are set forth in this paper.

I am deeply grateful to the Chief Research Officer, Central Marine Fisheries Research Station for placing its entire collection of flying fishes at my disposal and also for helpful suggestions. My sincere thanks are also due to the Curator, Prince of Wales Museum, Bombay and to the Institute of Science, Bombay for facilities afforded to study their collections of flying fishes. It gives me great pleasure to record my thanks to Dr. S. L. Hora and to Dr. K. S. Misra of the Zoological Survey of India for various suggestions in the final preparation of the paper.

GENERAL ACCOUNT OF THE GENUS *CYPSELURUS* IN INDIAN WATERS.

The family Exocoetidae of the order Synentognathi Gill (Beloniformes Berg 1948) comprises of several genera, of which *Cypselurus* is an important and large one. This genus is found to inhabit the tropical and sub-tropical parts of Indian, Pacific and Atlantic oceans. In Indo-Australian zone alone 17 species of *Cypselurus* are recorded (Weber and de Beaufort, 1922), of which 7 also occur around the coast of India.

The earliest reference to the Indian species of flying fishes is by Day (1877). He classified them under the family Scombresocidae, genus *Exocoetus* (Artedi) synonymous with *Cypsilurus* Swains, *Halocypselus* Weinland and *Parexocoetus* Bleeker. Six species, *viz. micropterus, poeci lopterus, volans, furcatus, bahiensis* and *mento* were included by Day under the single genus *Exocoetus* which later on proved to be a composite one. Subsequently this was split up into several distinct genera, *viz. Cypselurus, Exocoetus, Evolantia* and *Parexocoetus,* the classification being based on the teeth and the length of pectoral and ventral fins. Thus the genus *Cypselurus* is differentiated from other genera mainly on the length of the ventrals and their origin or location on the body.

The species of *Cypselurus* recorded, to date, in India are C. *speculiger, exsiliens* (nigricans), *bahiensis, spilopterus, oligolepis, astriginis, nigripennis, bilobatus, furcatus* (*altipinnis*), *cyanopterus?* and *coromandelensis* (sp. nov.). Besides these, Smith (1949) mentions the occurrence of *C. hewetti* in Indian ocean around S. Africa.

Comparatively, *Cypselurus* is a large sized flying fish, some of the species attaining a length of 475 mm. They are mostly warm open-sea dwellers but appear along the coast during breeding seasons in large shoals, providing special fisheries along the Coromandel coast in India, as in Cebu in Philippine Islands and other places.

*Key to the Identification of Species.**

1. Pectoral fin *with* spots	*spilopterus.*
2. Pectoral fin *without* spots .	3
3. Palate *with* teeth .	4
Palate *without* teeth .	5
4. Palatine patch of teeth *long and club-shaped* ; L. L. 39-40	*oligolepis.*
Palatine patch of teeth *small and oblong* ; L. L. 45-46	*exsiliens.*
5. Eye-diameter 3 in head length ; pre-dorsal scales 28-32 .	*coromandelensis*
Eye-diameter more than 3 in head length ; pre-dorsal scales 34-36.	*C. sp.*

Systematic Account.

Cypselurus spilopterus Cuv. and Val.

1846. *Exocoetus spilopterus*, Cuv. and Val., *Hist. nat. Poissons* XIX, p. 113.

1866. *Exocoetus spilopterus*, Bleeker, *Ned. Tijdschr Dierk.* III, p. 116 Atl. Icth. VI. 1866-1872, p. 74.

1866. *Exocoetus spilopterus*, Günther, *Cat. Brit. Mus.* VI, p. 292-*Fische der Sudsee, Heft.* VIII, 1909, p. 368.

1878. *Exococtus poecilopterus*, Day, *Fish. India*, p. 518.

1913. *Exocoetus spilopterus*, Max Weber, *Siboga—Expeditie, Fische*, p. 126.

D. 12-13 ; A. 10 ; P. 1.13-14 ; V. 6 ; L. 1.50-55 ; L. tr. 7.

Height 5-5. 3, (6·5-7 in total length). Head 4-4·3 (5-5·5 in total length). Eye 2·6-3 in head. Teeth comparatively well-developed, simple, in a few rows on the jaws ; a few teeth on each side on the palatines. Origin of anal opposite to 6th ray of dorsal. Pre-dorsal scales 30-32. Pectorals reaching to posterior part of dorsal or farther. Ventrals longer than head or scarcely so, reaching to middle of anal or not so far. Pectorals blackish, with a narrow hyaline hind border and an indication of a hyaline transverse band and provided with more or less numerous black, round spots. Other fins hyaline, caudal dusky. Ventrals and dorsals sometimes with a black spot posteriorly. Gill-rakers 15/6.

Species question of the Indian Spotted Flying Fish, Cypselurus spilopterus C. and V.

The large variety of flying fish with spotted pectoral fins, has erroneously been identified by Day as *Exocoetus poecilopterus*. While studying the collection of flying fishes from the Coromandel coast and comparing them with other species it became clear that our spotted variety is not *E. poecilopterus*. Weber and de Beaufort have noted this mistake by Day and remarked: "The fish described by Day (*Fish. India*, 1878-1888, p. 518) as *E. poecilopterus* seems to be *Cypsilurus spilopterus* C. and V., a species with smaller scales".

*The key is only for the species mentioned in this paper.

The spotted flying fish of India conforms in every detail to *spilopterus*, whose characters are tabulated below in order to bring out clearly the distinguishing features in which this species differs from *C. poecilopterus*.

	C. spilopterus.	*C. poecilopterus.*
Anal rays . . .	10 . . .	7-8.
Pectoral rays	1·13-14	1-14-15.
Number of scales along lateral line.	50·55	45.
Number of scales along transverse series.	7/1/3	8/1/2½.
Distance between origin of dorsal fin and base of caudal.	Equal or scarcely longer than head.	Much more than head.
Pre-dorsal scales .	30-32 . . .	25-27.
Gill-rakers .	15 : 6 . . .	?
Colour and pattern of pectorals	Scattered round black spots	Large oval, black, spots, arranged in transverse bands.
Distribution .	Malay Archipelago Seas of India, Tahiti.	Malay Archipelago, Japan.

It is evident from the above that the spotted form seen along our coast is, undoubtedly, *Cypselurus spilopterus* C. and V while *C. poecilopterus* is confined to the seas of the Malay Archipelago and Japan.

Cypselurus oligolepis Bleeker.

1866—72. *Exocoetus eligolepis*, Bleeker, *Ned. Tijdschr Dierk. III*, p. 109-*Atl. Ichth*, p. 69.

1866. *Exocoetus oligolepis*, Günther, *Cat. Brit. Mus.* VI, p. 296-*Fische der Sudsee. Heft*, VIII, 1099, p. 370.

1907. *Cypsilurus brachysomus*, Jordan and Seale, *Bull. Bur. Fish. Wash.* XXVI, p. 9.

1913. *Exocoetus brachysoma*, M. Weber, *Siboga-Expeditie, Fische*, p. 125.

D. 11-13 ; A. 8-9 ; P. 1·13-14 ; V. 6 ; L. 1·39-40 ; L. tr. 7.

Head 4 in standard and 5 in total length. Height 5 in standard and 6 in total length. Eye-diameter 2 in length of head, ¾ in snout and 1 in inter-oribital space, which is concave. Band of teeth on jaw disposed in 2 or 3 rows. Each tooth small and with 3 cusps, a median, large one and 2 lateral small ones. Palatine teeth arranged on long spindle-shaped patch on each side, bordering the upper jaw. (Text fig. 1c). Eyes very large. Fins : Pectorals reach the end of dorsal. Anal originates behind the dorsal fin.

Remarks.—Two specimens of a flying fish 160 and 180 mm. respectively in length obtained from the Institute of Science, Bombay and specimen 192 mm. in length collected from Ratnagiri were identified as *Cypselurus oligolepis*. So far this species is known from Zanzibar, Singapore, through Malay Archipelago on to Philippines, China and Tahiti. Its ptesent

record from Bombay Coast extends its range of distribution to Indian waters.

Cypselurus exsiliens Linnéaus.

1771. *Exocoetus exsiliens*, Linne, *Manitssa plantarum*, p. 529.

1846. *Exocoetus bicolor*, Cuvier and Valenciennes, *Hist. Nat. Poissons*, XIX, p. 111.

1866. *Exocoetus nigricans*, Günther, *Cat. Brit. Mus.* VI, p. 290.

1872. *Exocoetus nigricans*, Bleeker, *Atl. Ichth.* VI, p. 73.

1896. *Exocoetus nigricans*, Jordan and Evermann, *Fishes N. America* 1, p. 737.

1922. *Cypselurus nigricans*, Weber and de Beaufort, *Fish. Ind. Austr. Archip.* IV, p. 183.

1934. *Cypselurus exsiliens*, Brünn, *Journ. Linn. Soc.* XXXIX, p. 34.
D. 14 ; P. 1-14 ; A. 8-11 ; L. I. 45-46 ; L. tr. 6-8.

Cypselurus exsiliens Linné is recorded here for the first time from the Bay of Bengal and Arabian Sea. It has so far been known only from the Malay Straits, Java seas, Bay of Batam, Pacific, Atlantic and Indic. (Weber and de Beaufort, IV, p. 183). A brief description of the species is given below.

Head 4·5-5, height 6 in standard length. Eye-diameter 3 in length of head, $\frac{3}{4}$ in snout, $1\frac{1}{4}$ apart. Teeth on jaws conical, pointed, in 3-4 rows in both jaws. Palatine teeth[1] disposed in an oblong patch on each side. These patches are very small and about the size of the nostril.

Pectoral fins large, reaching to posterior part of dorsal or base of caudal. Dorsal fin anterior to anal fin, which starts at about the 6th dorsal ray. Ventrals as long as head, their origin is about midway between the operculum and base of caudal. Caudal deeply forked.

Pre-dorsal scales 26-29 in number. Vertebrae 44-45, Gill-rakers 4-6/16-17.

Colouration of the preserved specimen brownish above, silvery yellowish below. The pectorals are black, especially their dorsal surface. Posterior half of dorsal and inner distal end of ventrals black ; anal is white, caudal rather deep brown.

The description of the species is based on four specimens, measuring 194 mm. to 240 mm. in standard length, three of which were obtained from the Southern section of Coromandel coast and one from the Bombay coast.

Redescription of **Cypselurus coromandelensis** Hornell.

The material for this section of the paper came from a large collection of flying fishes made at Nagapatanam, Tranquebar, Cuddalore, Madras

[1]Bleeker states that there are no teeth on the palate. Weber and de Beaufort describe the teeth as two small oblong patches. Brünn (1935) comments : " teeth are present on the jaws and palatine but it may be noted that the palatine teeth are often but few in number, 6-10 on each side and in a few cases they seem to be quite wanting, though it is not possible to distinguish such specimens from others with teeth. The few individuals without teeth belong however, among the largest so that this is perhaps a character that varies with age ". The three specimens, from Rameswaram Road in the Central Marine Fisheries collection, have been observed to have no teeth on the palate. These specimens are comparatively smaller in size to the specimen from Ratnagiri, which possesses these teeth. It is, therefore, doubtful whether the variation in teeth can be ascribed to age.

and Mandapam by the Fishery Survey division of the Central Marine Fisheries Research Station during 1949-51. The size of the individuals ranged from 170-225 mm., including the upper caudal fin-lobe.

Along the Coromandel coast, there is an annual season from middle of May to middle of June, when this species of flying fish appears in large shoals, for the purpose of breeding in the Sargassum beds off the sea-shore.

In my attempt at identification the fish in question proved problematic, as I found that it did not conform to any of the species so far known. However, Hornell[1] had noticed this species as early as 1922 and had given a brief description of the same. He stated (p. 100): " Two species of flying fishes are recognized by the fishermen, a larger called distinctively Thai-Kola ("Mother Kola") and a smaller one, usually called simply Kola. The former has spotted pectorals and is *Cypselurus poecilopterus* (C. and V.). .. The smaller species, which runs generally 8-9 inches in extreme length is also a *Cypselurus*; the species remains to be identified" Later (Hornell, *loc. cit.* p. 107) he added: " The smaller species, where the pectorals in life are dark purple in tint with a narrow hyaline margin above and a wider one below, has not yet been identified. It does not appear to belong to any of the species of Exocoetidae described by Day or by Weber and de Beaufort..... Should the species prove to be a new one, I propose that it be called *Cypselurus coromandelensis*" My study of a large number of this flying-fish has proved that this is a distinct species and I shall redescribe it here under the name *Cypselurus coromandelensis*, proposed for it by Hornell.

Cypselurus coromandelensis Hornell.

1922. *Cypselurus coromandelensis*, Hornell, *Madras Fish Bull.* Vol. XV, (4), p. 100.

D. 9-11 ; P. 1-15 ; V. 6 ; A. 10-12 ; C. 17-19 ; L. l. 42-49 ; L. tr. 7.

The body is fairly slender and compressed laterally. Unlike most fishes, the flying fish is broad and flat dorsally as well as ventrally, rendering the shape of the body not elliptical, but somewhat quadrangular in cross-section. The height of body is $6\frac{1}{2}$-7 in total, 5-$5\frac{1}{2}$ in standard length. Head is 5 in total length, $4\frac{1}{2}$ in standard length. Eye-diameter is 3 in the length of head, 1 from snout and 1 apart. Inter-orbital space is somewhat depressed with a pair of grooves on each side, starting from the level of the posterior nostrils to the region of the occiput. The lower jaw is slightly more prominent than the upper jaw. Teeth are present on both jaws but they are absent on the palatines. Teeth are arranged in two or three rows and are just visible as minute specks of vitreous matter to the naked eye. Each tooth has a flat base which is the point of attachment to the jaw-bone, and has a somewhat conical body, which tapers to a point at the free end (Text. fig. 1a and b).

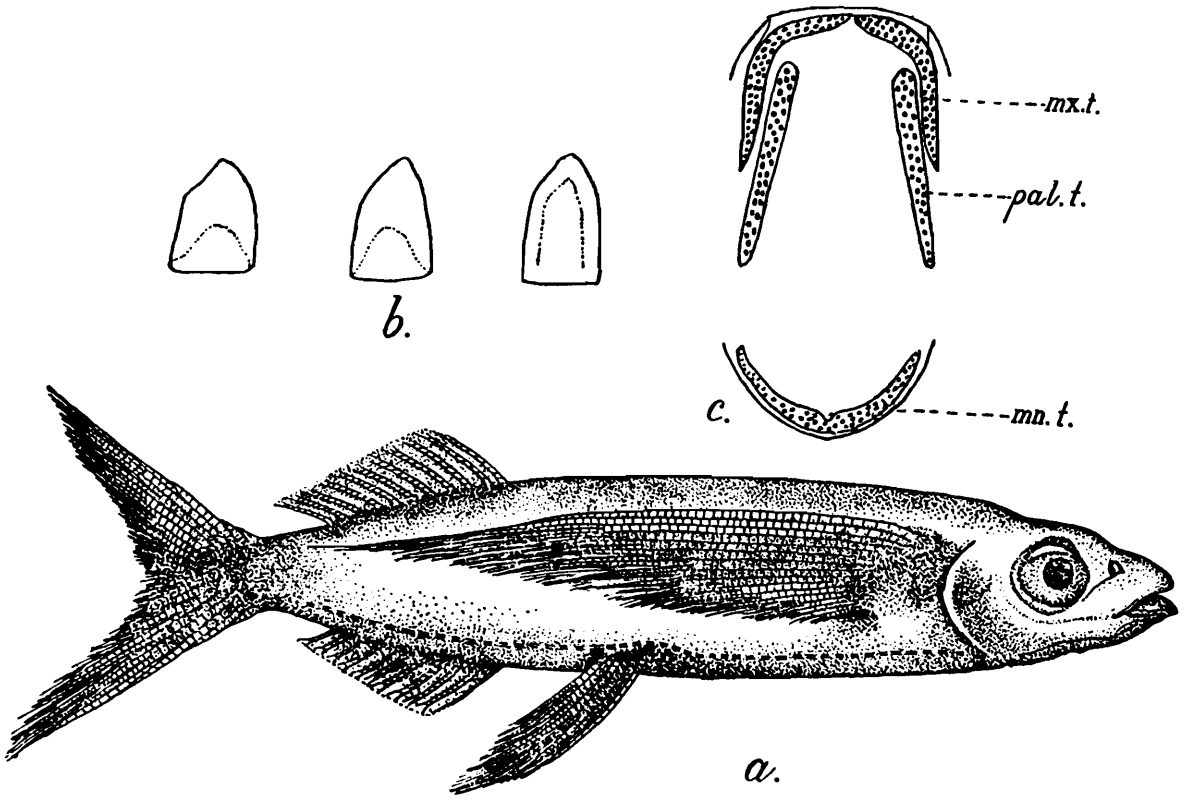
The dorsal fin originates at the same level as the anal ; it is separated from the occiput by 28-32 scales. The distance from the origin of the dorsal fin to the origin of the caudal fin is approximately equal to length

[1]Hornell, J.—Flying fish Fishery of the Coromandel Coast, Madras, Fish. Bull. Vol. XV, (4), 1922.

of head. Dorsal and anal fins are alike in height and disposition. The pectorals are very long, 1·6 times in standard length. The ventrals are moderately long, 4 times in standard length, the middle fin rays being the longest and reaching to the middle or even two-thirds of anal. The ventrals originate roughly mid-way between the operculum and the base of caudal fin. The caudal fin is forked, the lower lobe being longer.

Gill-rakers 8/20-23. Vertebrae 43.

Hornell noted : " The colouring of the body in life is deep blue above silvery below. Pectoral purplish, with a hyaline margin, that along the posterior edge the wider. Dorsal dusky owing to the presence of innumerable minute dark dots. Ventrals similarly dusky in the outer portion (half to three-fourths of the fin). Anal colourless. Caudal dusky "



TEXT-FIG. 1.—*a*.

a. Lateral view of *Cypselurus coromandelensis* Hornell ;
b. Isolated teeth from the upper jaw of the same ;
c. Dentition of *Cypselurus oligolepsis* Bleeker.
mx. t., maxillary teeth ; *pal. t.*, palatine teeth ; *mn.* t. mandibular teeth.

The preserved specimens are blue-black above and silvery below. Pectorals are deeply pigmented in the posterior half, but hyaline in the upper and lower margins. Dorsal, ventral and caudal are dusky.

Remarks.—Hornell (*op. cit*) gave a brief description of the single specimen he obtained from Nagapatanam and five specimens from Madras and suggested that it might prove to be a new species if further study were done. It has now been possible to establish it as a distinct species and designate it as *Cypselurus coromandelensis*, the name suggested by Hornell. This species approaches to *Cypselurus oxycephalus* Bleeker and *Cypselurus speculiger* (C. and V.) in that the second pectoral fin ray is divided, the first remaining undivided and the anal originating opposite

to that of dorsal. *Cypselurus coromandelensis* can, however, be easily distinguished from all other species in having 42 to 49 scales along the lateral line and 7 (above lateral line) along the transverse series; also that the teeth on the maxilla being arranged in 2-3 rows and the palatal bones being edentulous. The colouration is also very characteristic of the species.

TABLE I.—*Measurements in millimetres and scale counts in 6 specimens of Cypselurus coromandelensis.*

	1	2	3	4	5	6
Total length	170	178	190	200	180	180
Standard length	151	157	166	168	152	160
Length of head	37	37·5	40	42	37	39
Width of head	21	21	22·5	22	21	22
Height of head	21	21	23	26	21	24
Diameter of eye	14	13	15	14	13	14
Length of snout	9·5	8·5	12	11	10	10
Inter-orbital width	14	14·5	16	15	14	13
Depth of body	27	26	33	31	28	29
Breadth of mouth	8	8·5	11	11	7	10
Length of pectoral fin	96	99	105	110	100	103
Length of ventral fin	39	40	41	41	37	40
Length of caudal peduncle	12	15	15	14	13	12
Least height of caudal peduncle.	11	10	12	11	10	11
Number of scales along lateral line.	42	42	47	43	42	43
Pre-dorsal scales	28	29	30	29	28	30

Cypselurus sp.

During the course of examination and identification of the collection of flying fishes from the Prince of Wales Museum, Bombay, I have come across a specimen, which differs from all the so far known species of *Cypselurus* recorded in Indian or Indo-Australian waters. As there is only one specimen, which is unfortunately in a bad state of preservation I desist from creating a new species to accommodate the specimen. I have given below a brief description of the species.

D. 13 ; P. 1·12 ; A. 11 ; L. 1·43 ; L. tr. 7.

Head 4, height 5 times in standard length. Eye-diameter $3\frac{1}{2}$ in length of head, 1 in snout and $1\frac{1}{4}$ apart. Teeth villiform on both jaws. Palate edentulous. Anal fin commences opposite the 7th dorsal ray. Pre-dorsal scales 34-36 ? Fins with no patterns, uniformly coloured like straw in preserved specimen.

Standard length :—285 mm.

The specimen varies from all other known species of *Cypselurus* in having a different proportion of eye in relation to length of head and in the number of pre-dorsal scales being 34 to 36.

Locality :—Not known.

Conclusion.

Our knowledge of the flying fishes of the extensive coast of India is based on the brief account of Day. Since then, with the growth of navigation and oceanographic expeditions, collections of flying fishes of the world and their systematic data have increased. Weber and de Beaufort (1922) have listed a good number of species from Malaya and East Indian Archipelago. Brünn (1935-37) has added substantially to the knowledge of the flying fishes of the Atlantic. Mention should also be made to the work of Herre (1945) on Pacific species in the Philippine seas, Hubb (1946) on Californian species and Smith (1949) on Indian species around South Africa. In the light of these it is obvious that a revision of the taxonomy of Indian species is desirable. In this paper, I have been able to observe some points in taxonomy and distribution of few of the flying fishes of India of the genus *Cypselurus* which are advancement to the existing knowledge. They are :—

1. Re-discovery of a new species from the Coromandel coast.

Hornell (1922) described a species which he pointed out as possibly new. I have confirmed it as a distinct species and named it *Cypselurus coromandelensis* Hornell.

2. The erroneous identification by Day (1877) of the common spotted variety of the Indian seas has been corrected and it has been assigned to *C. spilopterus* C. and V

3. *C. exsiliens* Linne and C. *oligolepis* Bleeker have been recorded by the author for the first time in India, thus extending their range of distribution.

4. A brief description of a specimen of flying fish from Bombay is given. This may prove to be a distinct species.

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ON A NEW SPECIES OF THE GENUS *ACANTHOCEPHALUS* FROM *RANA* SP. AND A NEW HOST RECORD OF *CENTRORHYNCHUS CINCTUS* (RUDOLPHI).

By M. N. DATTA, *M. Sc., Assistant Superintendent*, and T. D. SOOTA, *M. Sc., Zoological Assistant, Zoological Survey of India, Calcutta.*

The present communication is based on the study of four specimens of *Acanthocephalus* Luhe 1911 and three specimens of *Centrorhynchus* Luhe 1911. The former (*A. kabulensis*) were collected by Mr. Ali Akhtar from the intestine of *Rana* sp. at Kabul, Afghanistan. Of these, only two (a male and a female) are fully developed. The specimens of the latter (*C. cinctus*) were obtained by one of us from the intestine of *Ptyas mucosus* (Linn.) at Banaras. All the three (one male and two females) are not fully developed.

The specimens obtained from *Rana sp.* were found to be different from all the hitherto known species of the genus *Acanthocephalus* and accordingly have been placed in a new species. Those from *Ptyas mucosus* (Linn.) were identified as *Centrorhynchus cinctus* (Rudolphi[1] 1819) with some variations of little significance. This species was previously reported from *Coluber viridiaeneus* from Italy, while the present report is from host so far unrecorded. In view of this new host record we have added a detailed description for this species also in this paper.

Acanthocephalus kabulensis, sp. nov.

Male.—The body is almost cylindrical, the anterior region being broader than the posterior. The worm is 4·38 mm. in total length and 1·02 mm. in maximum width anteriorly. The body gradually narrows down posteriorly.

The proboscis is 0·32 mm. long and 0·28 mm. wide. There are 7-9 longitudinal rows of hooks width 4-7 hooks in each row. The hooks measure 0·06-0·08 mm. in length. The proboscis sheath is 0·81 mm. long. The lemnisci are longer than the proboscis sheath. The nerve ganglion is situated in the posterior region of the proboscis sheath and 0·85 mm. from the anterior end.

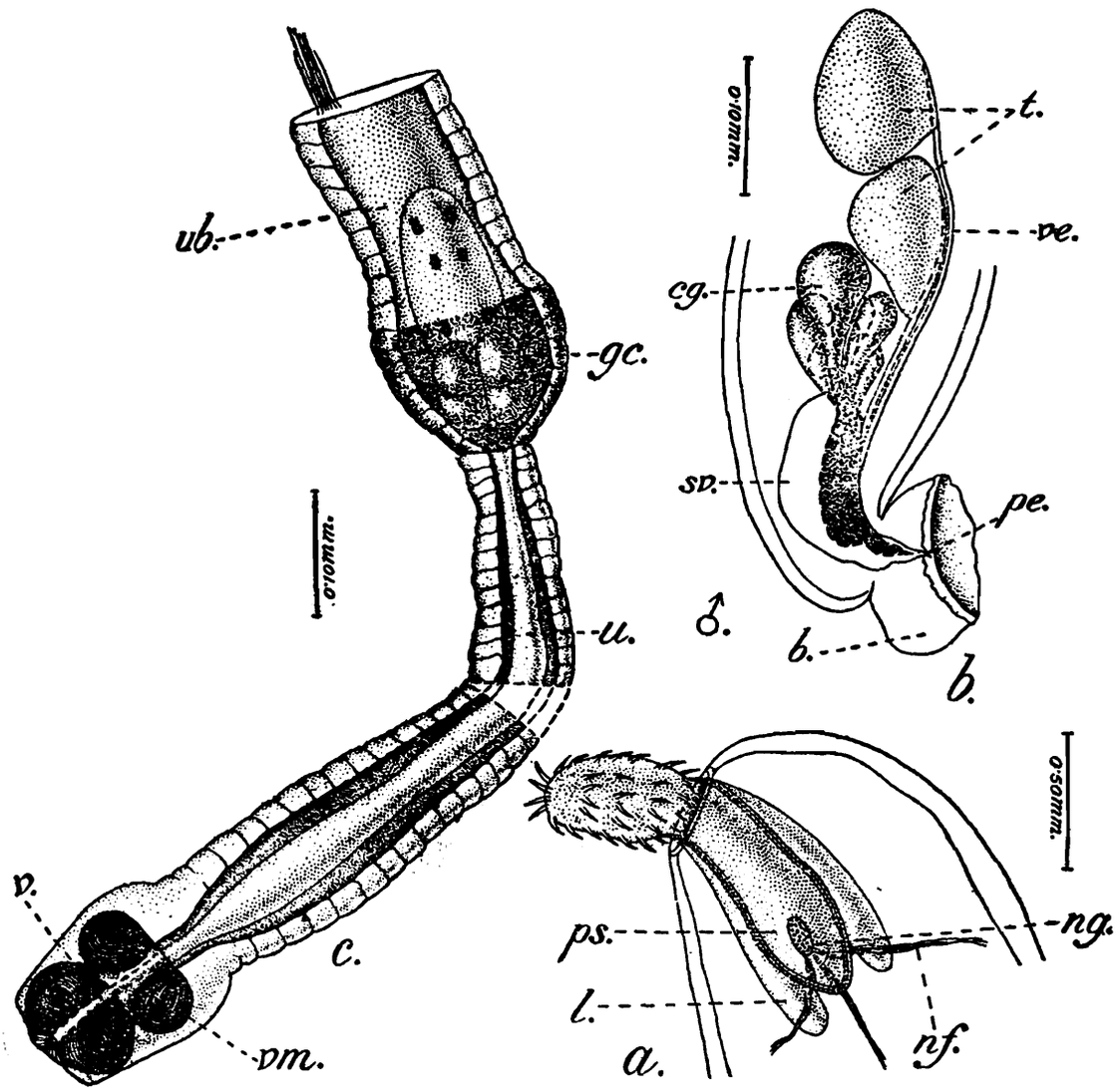
The testes (text-fig. 1*b*.) are unequal; the anterior bigger measures 0·58×0·43 mm., while the posterior smaller measures 0·55×0·39 mm. The former begins 2·06 mm. from the anterior end. The cement glands are six in number and pyriform in shape. They are situated behind the posterior testis partly overlapping it. They are massed together and the entire mass measures 0·58×0·37 mm. Seminal vesicle is approximately 0·65 mm. long. Bursa is protruded out.

[1]Meyer, A. "Acanthocephala". In Bronn's Klassen und Ordungen Das Tierreiche "P. 105. (1932)".

Female.—The body is similar to that of male. It measures 6·17 mm. in length and 1·19 mm. in maximum width in the anterior region.

The proboscis is 0·49 mm. in length and 0·41 mm. in width. The number and the arrangement of hooks is the same as in male. The hooks measure 0·07-0·09 mm. in length.

The body is full of ova which measure 0·09—0·11 × 0·05—0·08 mm. The uterine bell (text-fig. 1*c*) is 0·29 mm. long. The uterus along with the vagina measures 0·58 mm. in length. Guard cells are five in number, the anterior-most is the biggest and contains six nuclei.



TEXT-FIG. 1.—*Acanthocephalus kabulensis*, sp. nov.

a. Anterior region of male ; *b*. Male genital organs ; *c*. Female genital organs.

b., bursa ; *cg*., cement glands ; *gc*., guard cells ; *l*., lemnisci ; *nf*., nerve fibre ; *ng*., nerve ganglion ; *pe*., penis ; *ps*., proboscis sheath ; *sv*., seminal vesicle ; *t*., testis ; *u*., uterus ; ub., uterine bell ; *v*., vagina ; *ve*., vasa efferentia ; *vm*., vaginal muscles.

We give the following statement in order to indicate clearly the characters in respect of which the present species agrees or differs from its nearest allies *viz. Acanthacephalus minor* Yamaguti [1], [2a]) 1935 and *Acanthacephalus opsariichthydis* Yamaguti [3], [4a]) 1935.

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1. Yamaguti, S., *Jap. Journ. Zool.*, VI, pp. 253-254, figs. iii-v (1934).
2. Yamaguti, S., *Jap. Journ. Zool.*, VIII (3), pp. 320-321 (1939).
3. Yamaguti, S., *Jap. Journ. Zool.*, VI, pp. 254-256 (1934).
4. Yamaguti, S., *Jap. Journ. Zool.* VIII (3), pp. 322-323.

	A. minor Yamaguti.	*A. opsariichthydis* Yamaguti.	*A. kabulensis*, sp. nov.
1. Length of body .	♂2·7-3·4 mm. . ♀3·0-3·7 mm. .	♂1·8-5·6 mm. ♀2·1-7·2 mm.	♂4·38 mm. ♀6·17 mm.
2. Width of body .	♂0·6-1·0 mm. ♀0·8-1·2 mm. .	♂0·42-1·0 mm. ♀0·46-1·3 mm.	♂1·02 mm. ♀1·19 mm.
3. Proboscis . .	♂0·25-0·4 × 0·14-0·21 mm. ♀0·5-0·55 × 0·21-0·28 mm.	0·4-0·65 × 0·08-0·18 mm.	♂0·32-0·28 mm. ♀0·49 × 0·41 mm.
4. Number of longitudinal rows of hooks.	13-14 . . .	8-9 . . .	7-9.
5. Number of hooks in each row.	♂7-8 . . . ♀6-7	5-7 . . .	4-7.
6. Length of hooks .	♂Largest subapical hooks 68-75μ Smallestbasals 25-50μ ♀Below apex of proboscis 85μ Basals 30-35μ .	Largest hooks 150μ Smallest basals 25-51μ	♂0·06-0·08 mm. ♀0·07-0·09 mm.
7. Host . .	*Fishes* . . .	*Fishes* . .	*Amphibia.*

Specific diagnosis.—Body almost cylindrical with the anterior region broader than the posterior ; proboscis with 7-9 longitudinal rows of hooks with 4-7 hooks in each row ; cement glands massed together and not in two longitudinal rows of three each.

Regd. No.—W3832/1, Zoological Survey of India.

Host.—Rana sp.

Locality.—Kabul, Afghanistan.

Remarks.—A. kabulensis resembles *A. minor* Yamaguti in respect of the body shape and the arrangement of prostate glands but differs from it in the size of the body, the number of longitudinal rows of hooks and the number of hooks in each row. It almost agrees with *A. opsariichthydis* Yamaguti in respect of the body shape, the number of longitudinal rows of hooks and the number of hooks in each row but differs from it in the arrangement of the prostate glands.

Centrorhynchus cinctus (Rudolphi 1819).

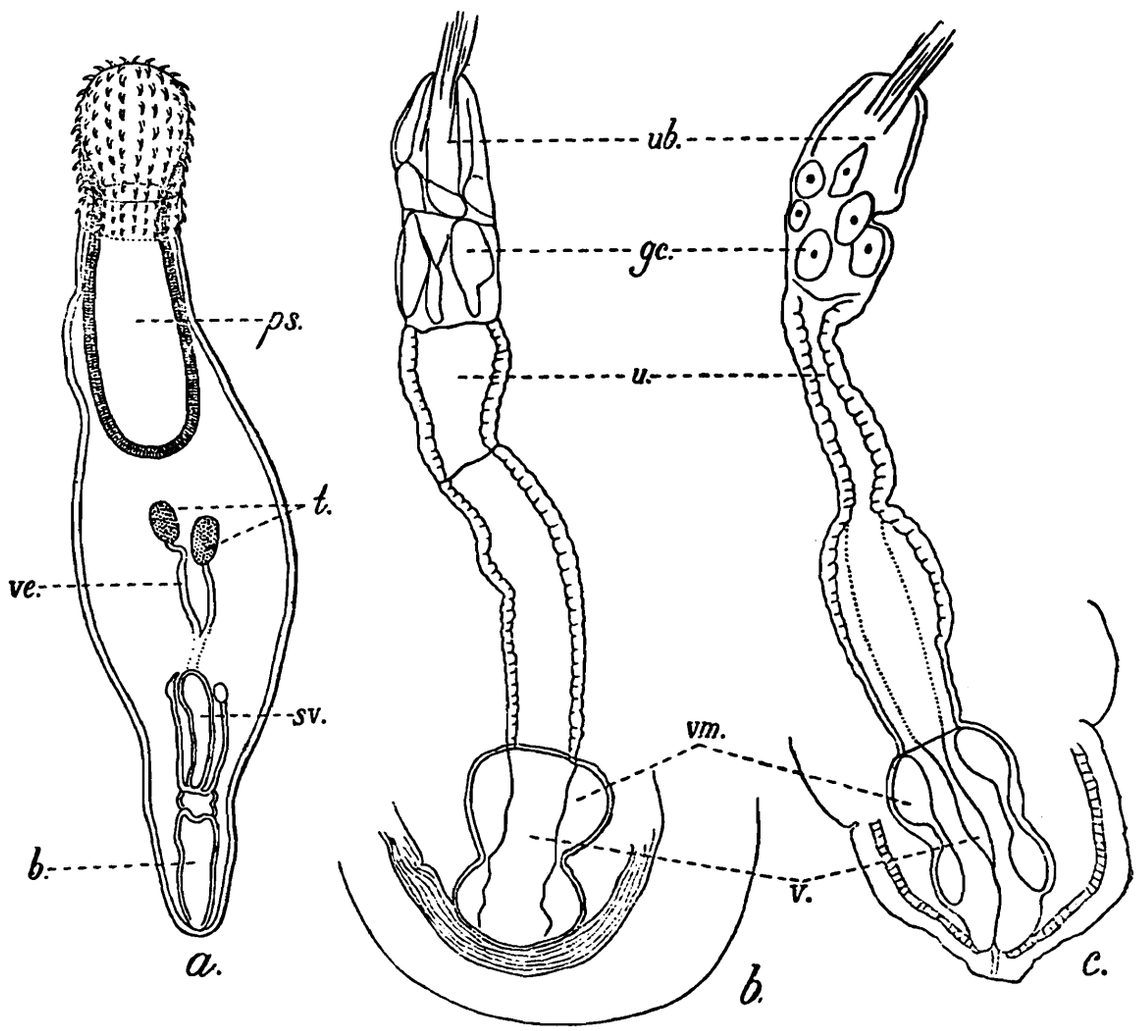
Male.—The body is buldged in the middle gradually narrowing towards the ends—the posterior end being narrower than the anterior. The entire length of the worm is 3·19 mm. The width in the middle is 0·77 mm.

The proboscis is 0·58 mm. in length and 0·37 mm. in width. The number of longitudinal rows of hooks is 30-32 and the number of hooks in each row is 12. The hooks in longitudinal rows are divisible anteroposteriorly into three groups of 5, 4 and 3 respectively depending on their shapes and roots. The hooks are 0·02-0·05 mm. in length. The proboscis sheath is 0·96 mm. long.

The testes (Text-fig. 2*a*) are unequal ; the anterior testis is a little smaller than the posterior and is situated 1·55 mm. from the anterior end. The former measures 0·15 × 0·09 mm. and the latter 0·17 × 0·09 mm.

In the only male specimen available for our study the two vasa efferentia arising from their respective testis are clearly visible and traceable upto their junction with each other but after this the material gives no clear indication of their further course upto the region of seminal vesicle. The prostate glands also are similarly obscure. The seminal vesicle is 0·33 mm. long. The bursa along with the mascular capmeasures 0·66 mm. in length.

Female.—The body is similar to that of the male. The largest worm is 3·38 mm. in length and 0·75 mm. in width in the middle of the body.



TEXT-FIG. 2.—*Centrorhynchus cinctus* (Rudolphi 1819).

a. Entire male ; *b.* and *c.*, Female genital organs.

b., bursa ; *gc.*, guard cells ; *ps.*, proboscis sheath ; *sv.*, seminal vesicle ; *t.*, testis ; *u.*, uterus., *ub.*, uterine bell ; *v.*, vagina ; *ve.*, vasa efferentia ; *vm.*, vaginal muscles.

The proboscis is 0·75 mm. in length and 0·38 mm. in width. The number and the arrangement of the hooks is similar to the male. The proboscis sheath is 0·96 mm. long.

The uterine bell (Text fig. 2*b*, 2*c*) measures 0·16 mm. in length. The uterus along with the vagina is 0·41 mm. long. Guard cells are seen there.

Reg. No.—W3833/1, Zoological Survey of India.

Host.—*Ptyas mucosus* (Linn.).

Locality.—Banaras (U. P.).

A NEW SPECIES OF COCCINELLIDAE (COLEOPTERA) PREDACIOUS ON THE CITRUS WHITE-FLY IN INDIA.

By A. P. KAPUR, *M.Sc., Ph.D. (London), D.I.C., F.R.E.S., F.E.S.I.*
Zoological Survey of India, Calcutta.

The natural enemies of the citrus white-fly, *Dialeurodes citri* (Ashmead), and other Aleyrodidae in India and other parts of Asia have received particular attention from several American and European entomologists who have been interested in the biological control of insect pests. Woglum (1913) visited India and the Orient in search of the natural enemies of the citrus white-fly while Silvestri (1927) published extensive information on parasites and predators in his account of the Aleyrodidae infesting citrus trees in the Far East. From 1929 to 1931 inclusive, Clausen (1934) made extensive observations on the natural enemies of Aleyrodidae in Malaya, Java and Sumatra and to a lesser extent in the Philippine Islands, Siam, Burma and Ceylon. In his list of the host species of Aleyrodidae and their respective natural enemies as recorded in literature or discovered by himself, Clausen (p. 256) mentioned the following three species of predators of the citrus white-fly.

1. *Brumus suturalis* Fabricius. Coccinellidae.
2. *Cryptognatha flavescens* Motschulsky. Coccinellidae.
3. *Serangium* sp. Coccinellidae.

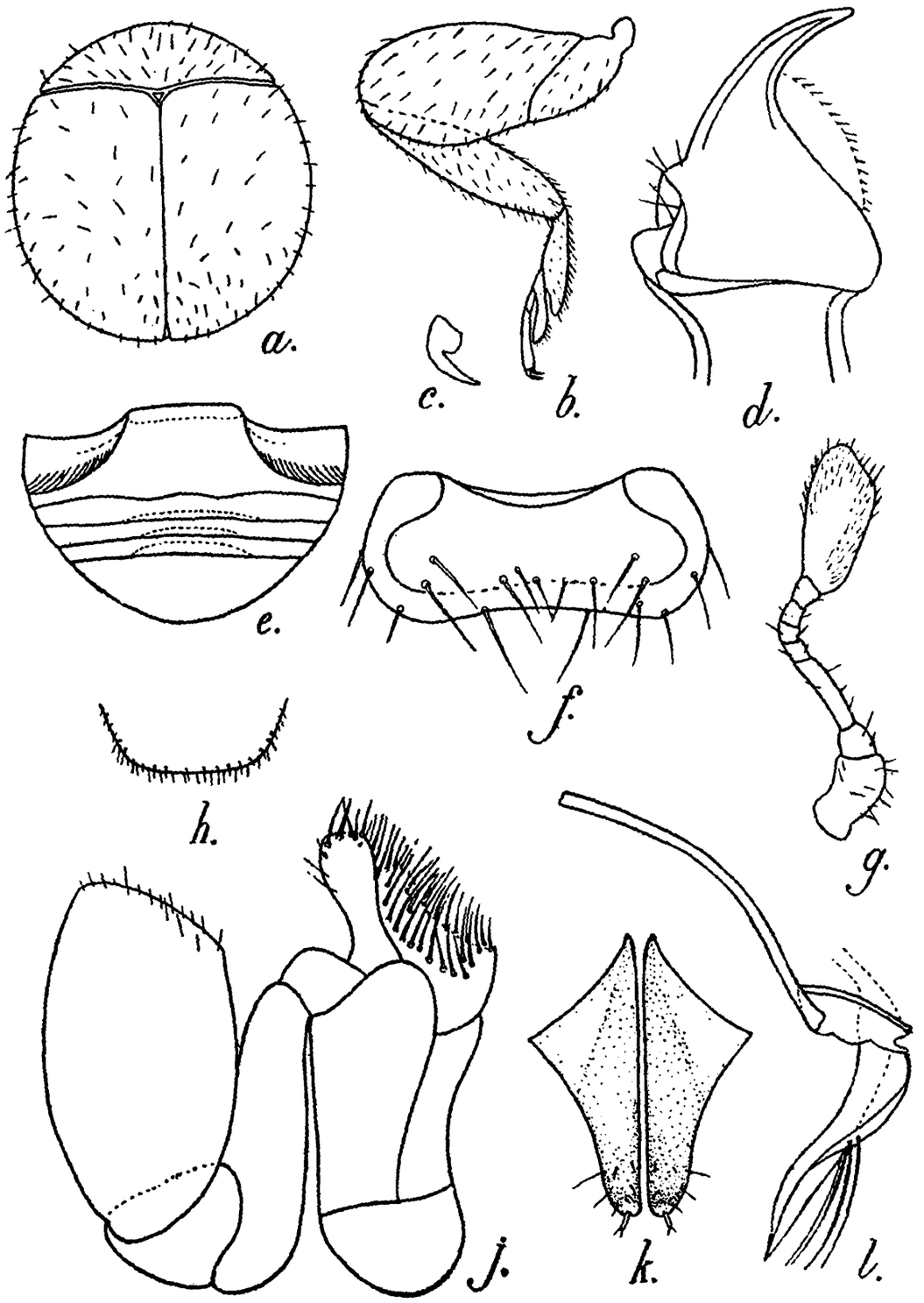
B. suturalis and *C. flavescens* were recorded from India and *Serangium* sp. from Japan. The material described below was found feeding on *D. citri* at Jeolikota, Nainital, Uttar Pradesh, by Mr. Z. A. Siddiqi. It belongs to the genus *Catana* Chapin (1940) of which the following three species are already known.

1. *Catana clauseni* Chapin is a native of the East Indies (Sumatra and Malaya) and has been introduced into Cuba in the West Indies. 2. *Catana parcesetosa* (Sicard) occurs in north and south India and feeds on Aleyrodidae. 3. *Catana spilota* (Weise) comes from the Philippines. A revised key to distinguish these three species and the newly described species is appended at the end.

Catana chapini, sp. nov.

Body sub-hemispherical, slightly longer than the greatest width (Text-fig. 1,*a*). Head brown to castaneous except for the greyish eyes. Pronotum variable in colour, being usually shining piceous but occasionally bright castaneous; on the whole slightly darker towards the base than near the anterior or lateral margins. Elytra shining, piceous to deep black. Pubescence on the upper surface greyish. Underside castaneous except in certain examples where the central portion comprising the median parts of metasternum and proximal abdominal sternites, is piceous.

Head slightly convex on the front, with minute and sparse punctation and thin, short, sparse and semierect pubescence. Eyes relatively coarsely facetted, slightly emarginate near the antennal socket which is



TEXT-FIG. 1.—*Catana chapini*, sp. n.; *a.*,—outline of the beetle showing sparse pubescence; *b.*,—leg of the third pair; *c.*,—claw (highly magnified) *d.*,—mandible; *e.*,—abdominal sternites (male); *f.*,—labrum; *g.*,—antenna; *h.*,—tenth tergite of female; *j.*,—maxilla; *k.*,—genital plates (ninth sternite; female); *l.*,—male genitalia (except sipho).

moderately large and distinctly margined. Antennae (*g*) eight segmented, first segment stout, second shorter and narrower, third elongate sub-

cylindrical and nearly as long as the fourth to seventh combined, fourth to seventh segments short and subequal, eighth spathulate, slightly longer than the second to fourth combined. Labrum (*f*) sub-quadrate rounded laterally and with prominent setae. Mandibles (*d*) narrowed, somewhat curved and strongly chitinized towards the apex which is pointed. Maxilla (*j*) with the galea and lacinia having many distinct setae, maxillary palpus with the last segment fairly large and not distinctly securiform. Labium sub-qudrate, labial palpus short with the third or apical segment narrow and sub-conical. Pronotum more coarsely punctured than the head, the punctures being also shallower ; pubescence on the pronotum rather sparse and a little longer than that on the head. Scutellum with three or four very minute punctures. Elytra with the punctation minute, rather shallow and very sparse except in the apical one-fourth where the punctures are relatively closer. A few very thin and moderately long nairs are present on the discal region of the elytra ; their number increases slightly towards the basal and external margins and towards the apical one-fourth of the elytron ; a row of rather short and suberect hairs runs near and parallel to the external margin of the elytron. Underside with rather minute and sparse punctures and thin, short, and sub-depressed and rather sparse pubescence except on the distal parts of the legs and the last visible abdominal sternite where the hairs may be more close. Hind legs (*b*) with the femora relatively broad and slightly produced on the inner margin ; tibiae slender ; claw (*c*) with a sub-quadrate basal tooth. The last or the fifth abdominal sternite long (like the first abdominal sternite) and apically subrounded in both the sexes (*e*). Male genitalia with the penis (*l*) narrowed and convex distally and pointed at the apex ; two bunches of hair, each containing two or three hair, arise from a little above the middle of the penis ; parameres apparently wanting ; trab and sipho (not figured) long and narrow. Female with the genital plates (ninth sternite) elongate, each with a small, narrow, papilliform process at the apex (*k*) ; the tenth tergite subtruncate distally (*h*) ; spermatheca relatively broad at the base, narrowed and strongly arched distally.

Length 1·75-2·00 mm. ; width 1·52-173 mm. ; altitude 0·09-1·00 mm.

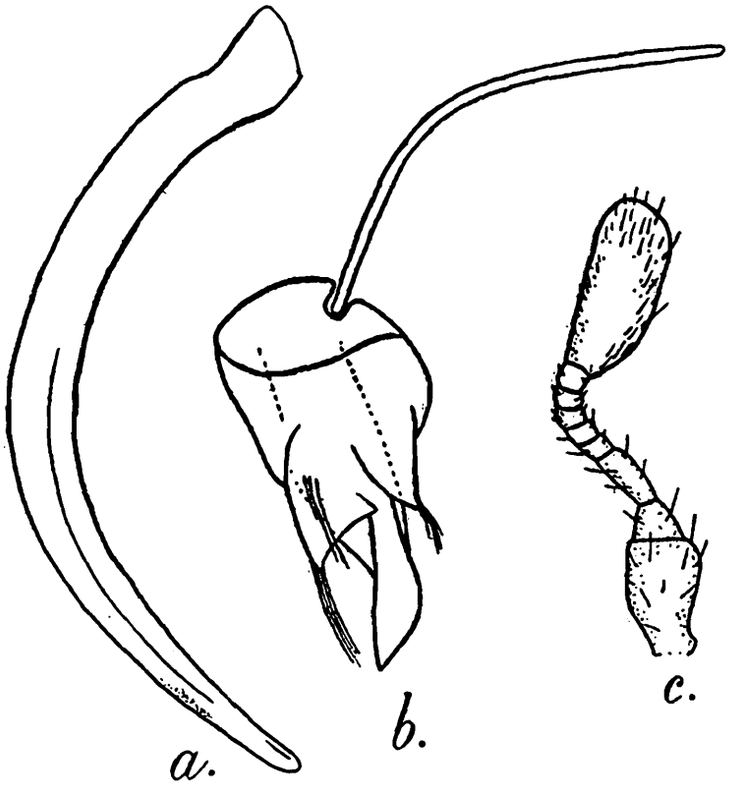
Holotype.—INDIA—Jeolikote, Nainital (Uttar Pradesh), predating upon citrus white-fly nymphs, 21.v.1952 (*Z. A. Siddiqi*). A male (genitalia dissected and mounted with the abdomen between two cover-slips and attached to the specimen), in the Zoological Survey of India (Z.S.I.), Indian Museum, Calcutta (Registered No. 9641/H4).

Allotype and 5 *Paratypes.*—All females with the same data as the holotype (on some specimens date of collection is 19 v.52 ; some with parts dissected) in Z.S.I. and the Indian Forest Research Institute. One paratype in Z.S.I. with entirely castaneous head and pronotum.

Remarks.—The species can be easily separated from the other species by colour differences as given in the following key, the structure of the

antennae, especially by the length of the fourth segment being subequal to the fifth, sixth or seventh segment; the eighth segment in other species is longer than the second to seventh combined while in the present species it is much shorter being equal to the second to fifth combined. It can be further distinguished by the structure of the male genitalia. In the only other Indian species, *C. parcesetosa*, the penis is asymmetrical and the parameres, which are present, are also unequally developed, one being much shorter than the other (Text-fig. 2, *b*); the sipho (*a*) in *C. parcesetosa* is more stout.

The antennae in *C. parcesetosa* may be nine segmented (*c*); this fact and the relatively smaller size of the species now described would



TEXT-FIG. 2.—*Catana parcesetosa* (Sicard);
a,—sipho, *b*,—male genitalia (except sipho); *c*,—antenna.

necessitate a more detailed study based on more extensive material of the genus *Catana* and other closely related genera.

KEY TO THE SPECIES OF *CATANA* CHAPIN.

The four species included in the genus may be distinguished by the following key which is based on Chapin's original key.

1. Uniformly pale, yellow-brown (India) . .	*parcesetosa* (Sic.)
Upper parts wholly or partly piceous .	2
2. Pronotum piceous or castaneous, elytra entirely piceous or black (India) . .	*chapini*, sp. n.
Pronotum deep piceous, elytron with a large castaneous spot	3
3. Pronotum rathe densely hairy at sides; spot on elytron elliptical (Philippines)	*spilota* (Ws.)
Pronotum sparsely but evenly hairy; spot on elytron reniform (Malaya, Sumatra)	*clauseni* Chapin

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CATALOGUE OF MAMMALS IN THE INDIAN MUSEUM (ZOOL. SURV.). III.[1] PRIMATES : COLOBIDAE.

PLATE V.

By H. Khajuria, *M.Sc. Hons., Zoological Survey of India, Indian Museum, Calcutta.*

There are one hundred and ninety two specimens representing forty three species and subspecies of Colobidae in the collection. The genera *Pygathrix, Rhinopithecus*, and *Simias* are unrepresented, and only one African subspecies is present. Several specimens are not provided with suitable labels making their proper identification difficult. Out of thirty one forms described in the *Fauna of British India* (Pocock, 1939), twenty one are present in the collection. The study has revealed some interesting individual and geographical variations and some cranial abnormalities.

I am grateful to Dr. S. L. Hora and Shri K. S. Pradhan for their suggestions.

Remarks on the Classification of Colobidae.

The reason for according Colobidae a family status *vis-a-vis* Cercopithecidae has already been given in an earlier report (Khajuria, 1955*a*). Briefly, there is a great difference between the two groups as regards the modifications of such important structures as the skull, generative organs, tail, etc. Except *Pygathrix*, all other genera recognized by Elliot (1913) are considered with consensus as valid. Pocock (1934) divided Elliot's *Pygathrix* into four genera, namely, *Semnopithecus, Presbytis, Trachypithcus*, and *Pygathrix*. Hill (1936) has further rightly separated *Kasi* from *Semnopithecus*, but almost all recent workers (Chasen, 1940 ; Simpson, 1945 ; Ellerman and Morrison-Scott, 1951) have unanimously agreed to group all these genera, except *Pygathrix*, under *Presbytis*. *Presbytis* thus constituted contains a long array of forms which are difficult to understand and classify. Leaving aside the question of convenience, it has been shown by Washburn (1944) on the basis of the proportions of the postcranial skeleton that the genera *Trachypithecus* and *Presbytis* as recognized by Pocock are very natural. An examination of the material in the collection under study also convinces me that Pocock's genera deserve at least subgeneric ranks.

Under the subgenus *Presbytis* as thus understood, Pocock (1934) included eight species, namely *femoralis, chrysomelas, melalophos, agyla, hosei, sabana, rubicunda* and *frontata* with a number of subspecies under *femoralis* and *melalophos*. Miller (1934), however, arrived at a different

[1] For reports Nos. I and II, see Khajuria (1953 and 1955*a*). Report No. I also includes some general remarks on the collection and the explanation of the abbreviations used in the measurements of skulls.

conclusion and merged Pocock's *femoralis* and *melalophos*, except the subspecies *siamensis* and *melalophos*, under one group, designated by him as ' femoralis group ' and gave all of them full specific rank. Chasen (1940) again reduced all of them to subspecies under *femoralis* which, as pointed out by Ellerman and Morrison-Scott (1951) should be replaced by *melalophos*. Besides this difference of opinion about the status of these forms, their affinities and even the diagnostic characters in some cases are not at all clear. The species *rubicunda* and *frontata* are very well defined and, as a matter of fact, they do not come under the definition of the subgenus *Presbytis* as given by Pocock (*op. cit.*) in some very important characters, such as the whiteness of the inner surface of the thigh, and the colour of the newly born young (at least where it is known). They appear to be very specialized off-shoots of the general stock. The rest of the forms may be treated as belonging to one group. Some of these forms appear to be higher in rank than a race or a subspecies, some good subspecies, while others seem hardly to have attained this status. This is apparently due to the peculiar geographical features of their homeland (Malaysian islands). The phenomenon gives a beautiful illustration of the mechanism of dynamics of evolution. It is not clear why Chasen (*op. cit.*) excluded *agyla* from this stock, and further considered *hosei*, *thomasi*, and *sabana* as subspecies of *agyla*.

The important works consulted during the study are Allen (1939), Chasen (1940), Ellerman and Morrison-Scott (1951), Pocock (1928, 1934, 1939), Schwarz (1929) and Simpson (1945).

The Catalogue.

Family Colobidae.

Subgenus Semnopithecus

Presbytis entellus ajax (Pocock).

1928. *Pithecus entellus ajax* Pocock, *J. Bombay nat. Hist. Soc.*, XXXII, p. 480, pl. 2, fig. 1 (Deolah in Chamba).

Material—

12135	Skin and skull	Rahla, Kulu Valley, 4-6-1929 H. W. Wells.
12136	Do.	Chatri, Chamba State, 1-12-1922. H. W. Wells.

Measurements.—Skull (No. 12135) : *l*, 124·0 ; *cb*, 100·8 ; *zw*, 94·1 ; *ow*, 59·5 ; *nw*, 32·2 ; c^1-m^3, 46·4 ; *ml*, 95·8.

Skin (No. 12135) : *hb*, 530 ; *tl*, 770 ; *hf*, 180 ; *e*, 40.

Remarks.—The specimens are typical.

Distribution.—Kashmir ?, Chamba and Kangra, at high altitudes.

Presbytis entellus schistaceus (Hodgson).

1840. *Semnopithecus schistaceus* Hodgson, *J. Asiat. Soc. Bengal*, IX, p. 1212 (Nepal Terai).

Material—

12232 .	Skull without lower jaw.	Mussooree, Uttar Pradesh. T. Hutton (1848).

Measurements of the skull.—1. 135·0 ; *cb*, 109·4 ; *zw*, 99·9 ; *iw*, 65·5 ; *mw*, 35·5 ; c^1-m^3, 48·2.

Remarks.—As the skin is not available, the identification is provisional.

Distribution.—Garhwal, Kumaon, Oudh and Nepal Terai.

Presbytis entellus achilles (Pocock).

1928. *Pithecus entellus achilles* Pocock, *J. Bombay nat. Hist. Soc.*, XXXII, p. 478, pl. 2, fig. 2, (Sathar Hills, Gorkha, Nepal, 12, 000′).

Material—

12157 (I. M. 11dd)	Adol.	Skin and skull	Sikkim, L. Mandelli (November, 1875).
12181 (I. M. 11cc)	Ad.	Skin (damaged) and skull.	Do.

Remarks.—The specimens were identified by Anderson (1881, p. 38) as *schistaceus* Hodgson, but they really appear to belong to the present form.

Distribution.—Kashmir ?, Sikkim and Nepal.

Presbytis entellus entellus (Dufresne).

1797. *Simia entellus* Dufresne, *Bull. Soc. Philom, Paris*, I, p. 49 (Bangal).

Material—

7444 S. ad.	♂	Skin and skull	N. L. Mukherjee (6-4-1896).
7445	♀	Do.	W. Rutledge (6-4-1896).
11431	♀	Do.	Ramkanali, 4 miles from Inspection Bungalow, Inanpur, Manbhum Dist. Bihar, 3-11-1948. Z. S. I. Party.
11829 (I. M. 112)	♂	Skull	Allahabad, J. Cockburn (12-1-1879)
11917 (I. M. 11j)	Young ♀	Skin and skull	W. Rutledge (9-2-1874).
11941	♂	Skull	Bunda Dist., Uttar Pradesh. J. Cockburn.
12147	♀	Do.	Talala, Junagarh State, 200′, 23-12-1912. C. A. Crump.
12148	♂	Do.	Midnapur, Bangal 200′, 4-9-1914. C. A. Crump.
12149 (I. M. 11n)	Young ♀	Skin	B. Collins (13-9-1874).
12150 (I. M. 11m)	Young ♂	Do.	Rajendar Mullick (7-12-1873).

12151 (I. M. 11k)	Young ♂	Skin . . .	Purchased (22-6-1872).
12152 (I. M. 11l)	♂	Skin and skull	Do. (6-8-1873).
12153	♂	Skin . . .	O. L. Fraser (1-11-1880).
12154	♂	Do. .	Purchased (6-11-1877).
12155 (I. M. 11i)	S. ad. ♂	Skin and skull .	A. S. B.
12158 (I. M. 11y)	♀?	Skull without lower jaw.	Botanical Gardens, Calcutta. Dr. J. Anderson, (1867).
12159 (I. M. 11r)	Adol. ♀	Skull . .	Do. (2-9-1865).
12216 (I. M. 11a)	♂	Skin (exhibited) .	E. Blyth (1842).

Measurements—

Skulls:

Z.S.I. Reg. Nos.	*l*	*cb*	*zw*	*ow*	*mw*	c^1-m^3	*ml*
11829 .	140·9	110·5	106·6	68·4	42·3	46·7	104·5
11841	135·6	111·0	103·4	66·9	40·1	47·4	..
11431 . .	120·0	93·2	90·4	59·8	31·2	42·4	90·8
12147 . .	104·0	82·8	81·9	58·6	29·3	38·6	80·5
12148 . .	119·4	97·6	94·6	60·6	36·0	45·5	90·5
12158 . .	110·2	89·8	83·5	58·7	30·0	38·2	..

Skins:

Z. S. I. Reg. Nos.	*hb*	*tl*	*hf*	*e*
11431	675	1025	186	46
12147	480	910	184	44
12148	615	995	195	45

Remarks.—One noticeable feature is the prominence of pale yellowish hue in many skins, especially on the ventral surface but spreading in some to the dorsal side as well. In No. 11431 the belly is orange. The young ♀ No. 11917 and young ♂ 12151 are pale yellowish all over. In No. 7445 the crown is defined from the rest of the dorsal surface by its paler tint. The measurements of the ♀ from Bihar are larger and those of the ♀ from Kathiawar smaller than those given by Pocock (1939, p. 118). No. 12216 is provisionally assigned to this race as the colour has much faded away due to exposure.

Distribution.—Northern peninsular India, South of the Ganges from Kathiawar to Bangal.

Presbytis entellus achates (Pocock).

1928. *Pithecus entellus achates* Pocock, *J. Bombay nat. Hist. Soc.* XXXII, p. 488 (Haunsbhavi, Dharwar, 2,000′).

Material—

12138	Young ♀	Skin and skull	Haunsbhavi, S. Dharwar, Bombay 23-2-1912. G. C. Shortridge.
12139	S. ad. ♀	Do.	Barchi, N. Kanara, Bombay, 1,500′, 30-1-1912. G. C. Shortridge.
12140	S. ad. ♂	Do.	Samasgi, Kanara Boundary, S. W. Dharwar, Bombay, 12-3-1912. G. C. Shortridge.
12141	Juv. ♂	Do.	Do. 22-3-1919. Do.

Remarks.—In the Juv. ♂ No. 12141, the white has started appearing on the chin and in the centre of hair radiation on the crown. In the young ♀ No. 12138 the colour of the crown imperceptibly passes into that of the back, and the arm below the elbow is darker and not much contrasted with the hand. The latter character is markedly pronounced in the s.ad. ♂ No. 12140.

Distribution.—Dharwar, Kanara, and Bellary.

Presbytis entellus priam (Blyth).

1844. *Semnopithecus priam* Blyth, *J. Asiat. Soc. Bengal*, XIII, p. 470 (Coromandel Coast).

Material—

11948 (I. M. 12a)	♂	Skin and skull	Coromandel Coast, Madras, W. Elliot (1847).
12137	♀	Do.	Dharampuri Range, N. Salem, Madras, 3-10-1930. N. A. Baptista.

Measurements—

Skulls :

Z.S.I. Reg. Nos.	*l*	*cb*	*zw*	*ow*	*mw*	c^1-m^3	*ml*
11948		..		58·1	28·5	38·1	78·7
12137	100·3	83·4	83·1	55·4	27·7	37·0	81·0

Skin (No. 12137) : *hb.* 600 ; *tl*, 900 ; *hf*, 173 ; *e*, 42.

Remarks.—The upstanding tuft of hair on the crown is present in both the skins. No. 11948 is probably the Type of the form.

Distribution.—Dharampuri, Palkonda, Shevaroy, and Nilgiri Hills, South India (range ill-defined).

Presbytis entellus aneas (Pocock).

1928. *Pithecus entellus aneas* Pocock, *J. Bombay nat. Hist. Soc.*, XXXII, p. 492 (Makut, S. Coorg, 250′).

Material—

2146	S. ad. ♂	Skull	S. Coorg. G. C. Shortridge.

Remarks.—The specimen was identified by the British Museum as belonging to this race ; but I am unable to confirm the opinion for want of the skin.

Distribution.—Southern Coorg, from Makut to Woottekolli.

Presbytis entellus hypoleucos (Blyth).

1841. *Semnopithecus hypoleucos* Blyth, *J. Asiat. Soc. Bengal, X*, p. 839 (Travancore).

Material—

11844 (I. M. 13a)	♂	Skin and skull	Travancore. W. Coles (1841).

Measurements of the skull.—1, 107·8 ; *zw*, 82· 6 ; *ow*, 55·0 ; *mw*, 31·7 ; c^1-m^3 37·0. *ml*, 77·4.

Remarks.—The specimen is apparently the Type of the form, and appears to be its sole representative. The skin is much damaged. The arms are missing and the posterior portion has separated off. The skull is also damaged.

Distribution.—Travancore, as at present known.

Presbytis entellus thersites (Blyth).

1841. *Presbytis thersites* Blyth, *J. Asiat. Soc. Bengal*, XVI, p. 1271 (Trincomalee).

Material—

6772	..	Skin and skull	Ceylon. Colombo Museum.
11832 (I. M. 12e)	♂	Skull . . .	Trincomalee, Ceylon. E. F. Kelaart.
11833 (I. M. 12b)	♂	Skin and skull	St. Pedro, Ceylon. E. L. Layard. (1848).
11857 (I. M. 12c)	♂	Skin (damaged) and skull.	Ceylon. W. Elliot (1845).
11947 (I. M. 12g)	S. ad. ♂	Skull (damaged)	Do. E. I. Layard.
11958 (I. M. 12h)	♀	Skull	Do.
12134	♀	Skin and skull	Cheddikulam, N. P., Ceylon, 29-11-1913. E. W. Mayor.
12142	Juv. ♀	Do. .	Ambawela, Ceylon, April, 1914. E. W. Mayor.
2143	♂	Do. . .	Cheddikulam, N. P., Ceylon, 22-11-1913. E. W. Mayor.
12144	♂	Do. . .	Ranna, S. P., Ceylon, 20-5-1913. E. W. Mayor.
12145	♀	Skin . . .	Mankeni, E. W. Ceylon, 1-9-1913. E. W. Mayor.

Measurements—

Skulls :

Z. S. I. Reg. Nos.	*l*	*cb*	*zw*	*ow*	*mw*	c^1-m^3	*ml*
11832	112·8	88·0		57·5	34·5	37·0	85·0
11833	114·2	..		57·7	37·1	43·4	38·0
11857	113·5	89·0	90·0	62·8	34·0	39·8	..
11958	97·0	74·3	70·6	40·1	25·1	34·6	70·8
12134	95·0	73·1	70·5	49·8	24·5	34·8	68·1
12143	107·6	86·4	79·9	54·0	30·0	38·0	78·0
12144	95·5	74·4	..	52·2	24·3	35·5	67·5
12145	97·5	75·1	75·3	52·3	26·9	38·5	72·0

Skins :

Z. S. I. Reg. Nos.	*hb*	*tl*	*hf*	*e*
12134	495	732	170	44
12143	550	785	186	44
12144	525	865	168	39
12145	525	724	165	39·5

Remarks.—In the Juv.♀ No. 12142, there is no whorl on the crown, and the cheeks are paler as in adults. In the same specimen and in No. 12134 the area just behind the eyebroys is not paler as in other specimens. Both the specimens from Cheddikulam are darker all over than other specimens. The female from this locality is exceptionally darker on the ventral side, cheeks, and the area behind the eyebrows ; while the male has an orange tint of variable intensity on the abdomen, the chin, the cheeks, and on the crown. In No. 6772, the feet are yellowish. No. 11857 is the Type of the form.

Distribution.—Ceylon and apparently Travancore.

Presbytis entellus (sub. sp.?)

Material—

11830 (I. M. 11w)	♂	Skulls .	..
11831 (I. M. 11v)	♂		
11843 (I. M. 11s)	Young ♀	Skull	Purchased (30-12-1868).
12156 (I. M. 11e)	Young ♀	Skin and skull .	E. Blyth (1842).
12160 (I. M. 11k)	S. ad.	Skull	Purchased (22-6-187?).

12161 (I. M. 11m)	♂	Skull without lower jaw.	R. Mullick (7-12-1873).
12162 (I. M. 11n)	Young ♀	Do.	B. Collins (13-8-1874).
12179	Young	Skin and skull	W. Rutledge ? (3-6-1903).
12180	Juv. ♂	In spirit	

Measurements of skulls—

Z. S. I. Reg. Nos.	*l*	*cb*	*zw*	*ow*	*mw*	c^1-m^3	*ml*
11830 . .	128·4	98·8	101·2	62·0	..	44·3	99·5
11831 .	129·4	102·3	104·1	65·4	37·8	45·6	99·0
12161 .	120·8	99·9	91·1	65·0	35·1	44·1	

Remarks.—In Nos. 12136 and 12179, the colour of the skins has faded away on account of long exposure, making the proper determination difficult. The other material is also inadequate for subspecific determination. The skull measurements appear to approximate to the nominate race.

Subgenus TRACHYPITHECUS

Presbytis pileatus pileatus (Blyth).

1843. *Semnopithecus pileatus* Blyth, *J. Asiat. Soc. Bengal*, XII, p. 174 (Sylhet).

Material—

10974	♀	Skin (exhibited) .	Kalanaga, Bareil Range, Manipur, Assam, Feb., 1936. Z. S. I. Party.
11422	♂	Skin and skull .	Manihar Basti, 8 miles east of Nongpoh, Khasi Hills, Assam, 2,500', 4-6-1949. Z. S. I. Party.
12171	..	Skin	Tura, Garo Hills, Assam, 8-3-1920. H. W. Wells.
12172 (I. M. 14h)	♂	Skin and skull	Khasi Hills, Assam. H. H. Godwin Austin (11-5-1870).
12173, 12174	Youngs	Do. . .	
12175	S. ad.	Skin	Zool. Gardens, Calcutta.
12220 (I. M. 14d)	♀	Skin (exhibited)	Barrackpore Managerie (1843).

Measurements.—Skull (No. 11432) : *l*, 105·6 ; *cb*, 82·2 ; *zw*, 78·0 ; *ow*, 58·5 ; *mw*, 28·6, c^1-m^3, 36·6 ; *ml*, 74·8.

Skin (No. 11432) : *hb*, 570 ; *tl*, 830 ; *hf*, 178 ; *e*, 30.

Remarks.—The colour of the dorsal surface varies from dark slaty grey to pale brown. The outerside of the leg below the knee is much paler in all the specimens. The colour of the underside varies from white to light orange. The top of the head just behind the eyebrow and the

tip of the tail are the darkest, and the loins the palest parts of the body. The skulls, at least the adult ones, are all characterized by the great breadth of the bridge of the nose.

Distribution.—The Garo, the Khasi, the Jaintia, and the Naga Hills in Assam.

Presbytis pileatus durga (Wroughton).

1916. *Presbytis durga* Wroughton, *J. Bombay nat. Hist. Soc.*, XXIV, p. 685 (Cachar ?).

Material—

12165 (I. M. 14m)	♂	Skins	Samaguting, Assam.	J. Butler (4-10-1872).
12166 (I. M. 14j)	♀			
12167 (I. M. 14k)	♀	Skins and skulls	Do.	
12168 (I. M. 14l)	♀			
12169 (I. M. 14i)	Adol. ♀	Skin	Sibsagar, Assam.	S. E. Peal (Jul 1870).
12170 (I. M. 14a)	♀	Do.	Chittagong Hills, Assam.	J. Barbe.
12176 (I. M. 14n)	Young ♂	Do.	Arakan Hill tracts.	Zool. Gardens, Calcutta (23-1-1878).
12178	Adol. ♀	Skin and skull	Chittagong, East Pakistan.	W. Rutledge (20-12-1870).
12221	Adol. ♂	Skin (exhibited)	Tippera Hills, East Pakistan.	F. Skipwith (1846).

Measurements of skull (No. 12168).—*l*, 110·5 ; *cb*, 93·2 ; *zw*, 83·0 ; *ow*, 59·7 ; *mw*, 32·7 ; c^1-m^3, 34·6 ; *ml*. 80·0.

Remarks.—The specimens from Samaguting have more red on the ventral surface and on the cheeks than other specimens. In the same specimens the fingers and the toes are also more clearly marked off from the hands and the feet respectively by their paler hue. In a female (No. 12170) from Chittagong, the hands and the feet are much darker and are also not contrasted with fingers and toes respectively ; but another specimen of the same sex from the same locality has typical colouration. Nos. 12176 and 12178 are approaching the typical race.

Distribution.—Upper Chindwin, from Lakhmipur to Naga Hills, Cachar, Tippera, and Chittagong.

Presbytis pileatus shortridgei (Wroughton).

1915. *Presbytis shortridgei* Wroughton, *J. Bombay nat. Hist. Soc.*, XXIV, p. 56 (Homalin, Upper Burma).

Material—

10590	Young ♀	Skin and skull	. Kamaing, Burma, 23-12-1926. Z. S. I. Party.
12164	♂	Do.	. H. Kampti, Upper Chindwin, Burma, 500′, 27-7-1914. G. C. Shortridge.

Measurements:—

Skin No. 12164 : *hb*, 670 ; *tl*. 1,100 ; *hf*, 203 ; *e*, 38.

Skull No. 12164 : *l*, 109·0,; *cb*, 86 ; *zw*, ; *ow*, 69·0 ; *mw* 35·0 ; c^1-m^3, 37·5 ; *ml*, 79·5.

Remarks.—A character which does not appear to be recorded is a low crest formed between the angle of the mouth and the lower border of the ear by the meeting of outwardly and upwardly directed hairs of the throat and downwardly and outwardly directed hairs of the cheeks. The tail tip in the young female has longer hairs (*cf.* Pocock, 1939, p. 129). The cheeks in this specimen are also noticeably paler.

The measurements of the skull as recorded here are noticeably shorter than those given by pocock (1939) for this form.

Distribution.—Eastern side of Upper Chindwin, Upper Burma.

Presbytis pileatus (sub.-sp.?).

Material—

11937	Young ♂	Skin and skull	. W. Rutledge (1884).
11983 (I. M. 14o)	♂	Skull (damaged)	. Assam. Museum Collector (1874).
12177 (I. M. 14g)	Juv.	Skin and skull	. ....
12202	Young ♂	In spirit .	. J. A. Sinton.
12203	♂	Do.	. Director, Central Malaria Survey, Kasauli, Punjab (I).

Measurements of the skull (No. 11983).—*l*, 118·5 ; *zw*, 89·5 ; *ow*, 65·9 ; *mw*, 32·2 ; c^1-m^3, 35·8 ; *ml*, 84·5.

Remarks.—In the juvenile the colour on the dorsal surface is pale orange-yellow with brownish tinge, and the ventral surface is distinctly paler. There is a transverse band of dark-tipped hairs on the nape, and the crown has become quite darker. The hairs on the tip of the tail are much longer and brighter than on the rest of this part of the body. No. 11937 is intermediate between *durga* and the nominate race. The colour of the spirit preserved specimens is too faded away to allow sub-specific determination.

Presbytis cristatus rutledgei (Anderson).

1878. *Semnopitheous rutledgei* Anderson, *Anat. zool. Resch.*, I, p. 38 (no locality).

Material—

12231 M. 22b)	Adol.	Skin and skull without lower jaw.	W. Rutledge (18-9-1871).

Remarks.—The specimen is the type of the form. In absence of the type locality, the name has provisionally been revived to replaced *ultima* Elliot (*vide*, Khajuria 1955*b*). When the paper just mentioned was sent to press, the skull of the specimen under report was not available ; but it has now been found out. As it has not been figured before the photographs are now being published (Plate v, figs. 3 & 4).

Distribution.—Malaya States, Borneo and Sumatra (part).

Presbytis cristatus pyrrhus (Horsfield).

1823. *Semnopithecus pyrrhus* Horsfield, *Zool. Resch. Java.*, pt. 7 (unpaged) pl. 3 (Java).

Material—

12189 (I. M. 18l).	♀	Skin (damaged) and skull.	Java. Indian Museum, through the Trustees British Museum, London (13-1-1880).

Remarks.—The specimen is a red mutant and agrees well with the description of co-types given by Pocock (1934, p. 929). The cheeks, the arms below the elbows and the legs below the knees are much paler.

Distribution.—Java (parts).

Presbytis cristatus sondaicus (Robinson & Kloss).

1919. *Pithecus pyrrhus sondaicus* Robinson and Kloss, *Ann. Mag. nat. Hist.* (9) IV, p. 374 (Tjibodas, Preanger Regencies, West Java, 4,500').

Material—

11960 (I. M. 18b)	Adol. ♀	Skin (damaged) and skull.	Purchased (1846).
11962 (I. M. 18h)	Young ♀	Skin and skull	W. Rutledge (1-10-1880).
12190, 12191, 12192		Skins (damaged)	
12118 (I. M. 18c)	Adol. ♀	Skin (exhibited)	Ammoo Island ?. W. Rutledge (Aug. 1869).
12228 (I. M. 18b)	Young ♀	Skin	W. Rutledge (18-1-1877).
12229 (I. M. 18d)	Adol. ♀	Do.	Pandang ?, Sumatra. W. Rutledge (9th May 1873).

Remarks.—Except in No. 12118 which is provisionally assigned to this race, the grey-tipped hairs on the back of the thighs are present in varying quantity. In No. 12118 (Pl. v, fig. 1) the colour is black throughout with bases of hairs paler and with reddish tinge. In this specimen the hairs growing downward in front, below, and behind the ears are especially long and form a high crest below the ear by meeting the hairs from the side of the throat which are directed backward and upward. Most of the hairs of this crest are with slightly paler tips. Anderson (1881) did not assign any locality to this specimen but its label carries, 'Amoo'

Island, which I have not been able to find out on the map. The specimen possibly belongs to an undescribed race. In No. 12229, the locality is probably wrong.

Distribution.—Java (part).

Presbytis cristatus pyrrhus and P. c. sondaicus.

Material—

5237	Juv. ♀	Skulls	....
11959 (I. M. 18i)	Adol. ♀		
11961 (I. M. 18a)	Adol. ♂	Do.	Purchased.

Remarks.—As the skins are not available, the specimens are provisionally determined.

Presbytis cristatus cristatus (Raffles).

1821. *Simia cristata* Raffles, *Trans. Linn. Soc. London*, XIII, p. 244 (Benkalen[1] Sumatra).

Material—

4285 (I. M. 22a)	♂	Skin	Sumatra. S. Raffles, presented by India Museum, London, through Trustees, British Museum, London (13-4-1880).
11938	..	Skull	Zool. Gardens, Calcutta.
11950	Juv.	Do.	
12193 (I. M. 22c)	Young ♀	Skin and skull	W. Rutledge (14-12-1874).

Measurements of the skull No. 11938.—*l*, 87·4 ; *cb*, 70·0 ; *zw*, 72·3 ; *ow*, 50·9 ; *mw*, 24·8) c^1-m^3, 28·8 ; *ml*, 66·6.

Remarks.—No. 4285 has been described by Elliot (1913, pp. 79-80), but it is not so extensively silvered as may appear from his description and appears to me to be quite a typical representative of the race. Nos. 11938 and 11950 are provisionally included under this form as the skins are not available.

Distribution.—Sumatra (part.), Rhio and Lingga Archipelagos, Bangka[2] and Bilitong[3] Islands.

Presbytis cristatus germani (Milne Edwards).

1876. *Semnopithecus germani* (misprint for *germaini*) Milne Edwards, *Bull. Soc. Philom. Paris*, (6)XX, p. 8 (Cochin China).

Material—

12194	♀	Skin	W. Rutledge (1-10-1880).

Remarks.—The specimen agrees with the description given by Pocock (1934, p. 936) except that the lower arm is not darker.

Distribution.—Indochina and Siam.

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[1], [2], [3] Chasen (1940) gives the spelling as Bencoolen, Banka, and Billiton respectively.

Presbytis cristatus barbei Blyth.

1847. *Presbytis barbei* Blyth, *J. Asiat. Soc. Bangal*, XVI, p. 734 (Tippera Hills).

Material—

11837 (I. M. 19a)	♂	Skin and skull	Tippera Hills, East Pakistan. J. Barbe (1845).
11838 (I. M. 19c)	♂	Skull	Second defile of the Irrawady, Upper Burma. J. Anderson (1875).
11876 (I. M. 19b)	♀	Skin and lower jaw.	Tippera Hills, East Pakistan. J. Barbe (1845).
12195 (I. M. 19d)	♂	Skin	Mulaiyit Range, Tanasserim. O. Limborg (Jan. 1877).
12204	♂	In spirit	W. Rutledge (14-11-1880).

Measurements of skulls—

Z. S. I. Reg. Nos.	*l*	*cb*	*zw*	*ow*	*mw*	c^1-m^3	*ml*
11837	98·2		73·0	50·7	29·8	33·7	70·
11838	97·0	78·5		52·1	29·2	31·3	67·

Remarks.—For the revival of *barbei* see Khajuria (1955*b*). Nos. 11838 and 12204 are provisionally determined. In No. 12204 true nature of the colour can not be made out on account of its being preserved in spirit for a long time. Nos. 11837 and 11876 are the syntypes of the form.

Distribution.—From Tippera Hills, East Pakistan to Tennasserim and adjoining parts of Siam.

Presbytis cristatus (sub-sp.?).

Material—

11346 (I. M. 22d)	Adol. ♀	Skull	W. Rutledge (18-9-1861).
11886 (I. M. 22d)	♀	In spirit	W. Rutledge (21-2-1879).
12208	♂	Do.	Zool. Gardens, Calcutta (15-8-1882).

Remarks.—As Nos. 11886 and 12208 are spirit preserved specimens, nothing can be said with certainty regarding the character of their colouration, and as such the identification is provisional.

Presbytis phayrei phayrei (Blyth).

1847. *Presbytis phayrei* Blyth, *J. Asiat. Soc. Bengal*, XVI, p. 733 (Arakan).

Material—

11845 (I. M. 20a)	♂	Skin and skull	Arakan. A. P. Phayre (1844).
11934 (I. M. 20b)	Juv. ♂	Do.	Do. Major Abbot (1844).
11935 (I. M. 20c)	Juv. ♀		
12187	Young ♀	Skull	Prome, Burma. J. M. D. Mackenzie.
12188	♂	Do.	Mount Popa, Burma. G. C. Shortridge.
12205 (I. M. 20d)	Young ♂	In spirit	Akyab Hill tracts, Burma. Zool. Gardens, Calcutta (8-7-1877).
12206 (I. M. 20c).	Young ♀	Do.	Do. (9-8-1877).

Measurements of skulls—

Z. S. I. Reg. Nos.	*l*	*cb*	*zw*	*ow*	*mw*	c^1-m^3	*ml.*
11845	97·5	78·5		51·5	30·0	31·5	70·5
12188		..	73·5	51·4	28·4	32·0	69·8

Remarks.—No. 11845 is the type of the form. All the skins have a crest on the crown. In none of them the cheeks and the forehead are appreciably darker (*cf.* Pocock, 1939). In No. 12205, the colour of the eyelids and lips have been obscured by the action of the preservative. The skulls are smaller than those measured by Pocock (*op. cit.*).

Distribution.—Burma, as far north as Bhamo to Pegu.

Presbytis phayrei shanicus (Wroughton).

1917. *Presbytis shanicus* Wroughton, *J. Bombay nat. Hist. Soc*, XXV, p. 47 (Seén, Hsipaw State).

Material—

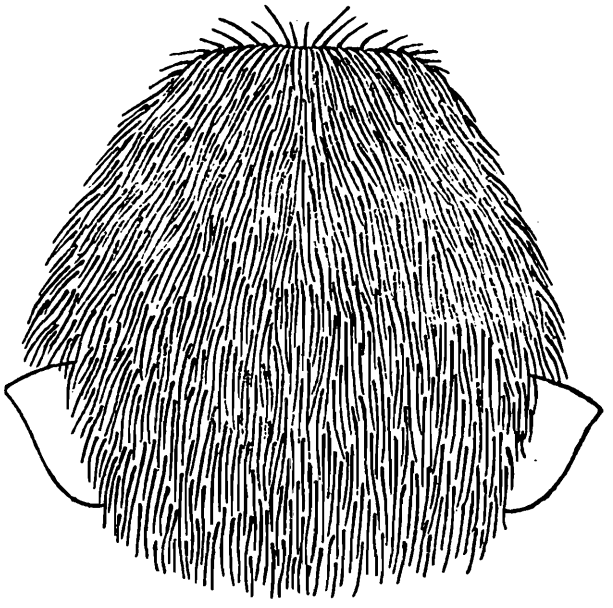
12184	Young ♂	Skin and skull	Gokteik, N. Shan States, Burma, 24-4-1913. G. C. Shortridge.
12185	♀	Do.	Seén, Hsipaw State, N. Shan States, 26-5-1913. G. C. Shortridge.
12186	Juv. ♂	Do.	Gokteik, N. Shan States, Burma, 24-4-1913. G. C. Shortridge.

Measurements of the skulls No. 12185.—*l*, 94·0 ; *cb*, 74·9 ; *zw*, 69·8 ; *ow*, 50·6 ; *mw*, 25·5; c^1-m^3, 31·2 ; *ml*, 66·2.

Remarks.—The juvenile has only its first milk premolar erupted. The specimen appears to be somewhat difficult for determination. The tail and the hinder parts of the legs are much brighter, and as such the specimen can be referred to *P. obscurus* (Reid), but for the absence of the pale cap on the crown. Again, there is no whorl or parting

on the crown which is characteristic of this race (Text-fig. 1). According to Pocock, (1939), this character is well defined even in the immature specimens.[1] The character, if taken as present in this specimen, is only indicated to some extent by the direction of hair growth on the forehead which, however, can not be called as a whorl or parting. Thus, it appears that, if this specimen is included in this race, the presence of a whorl or a parting on the forehead may not be a good diagnostic character. The reasons which make me assign the specimen to the race under report are : (1) its locality ; (2) its collection along with the typical specimens; and (3) the fact that the specimen is in the course of changing its juvenile golden colour into the adult colouration. The brighter colour of the tail and the hinder parts of the legs may be reminiscent of its juvenile hue.

Distribution.—Northern Shan States and their neighbourhood to the east of the Irrawady in the dry zone of Burma.



TEXT FIG. 1.—Upper View of the head of the juvenile ♀ of *Presbytis phayrei shanicus* from North Shan States showing the directions of hair growth.

Presbytis phayrei (sub-sp.?).

Material.—

12217	Young ♀	Skin (exhibited)	Purchased (1866).
12230 (I. M. 21a)	♂	Skull	W. Rutledge (29-10-1872).

Measurements of the skull.—*l*, 100·5 ; *cb*, 8·07 ; *zw*, 73·7 ; *iw*, 55·3 ; *mw*, 30·5 ; c^1-m^3, 35·3 ; *ml*, 74·5.

Remarks.—No. 12228 is the type of *Semnopithecus holotephreus* Anderson. For reasons as to the assignment of the specimen to the present species see Khajuria (1954*a*). The other specimen is inadequately labelled and its colour is too faded away to allow sub-specific identification.

[1] This statement needs some clarification since the present specimen was in the British Museum at the time when Pocock wrote and was considered as *shanicus* by the Museum experts.

Presbytis obscurus flavicauda (Elliot).

1910. *Presbytis flavicauda* Elliot, *Proc. U. S. natl. Mus.*, XXXVIII, p. 352 (Trang, Peninsular Siam).

Material—

5234	Adol. ♀	Skin and skull	Mergui 27-12-1881. J. Anderson.
5235	♀	Skin	Do. 12-12-1891. Do.
5236	♂	Do.	Blair Isle, 14-3-1882. Do.
5305	Juv. ♀	In spirit	Mergui. J. Anderson.
12198	Juv.	Skin	Mergui. M. Berdmore (1854).
12199	♀	Skin and skull	Bankachon, S. Tenasserim, 28-12-1913. G. C. Shortridge.
12200	♀	Skin	Do. 10-12-1913 Do.
12201	Young ♂	Do.	Mergui, 13-12-1881. J. Anderson.

Measurements.—Skull No. 12199 : *l*, 91·2 ; *cb*, 71·8 ; *zw*, 62·7 ; *ow*, 48·4 ; *mw*, 23·2 ; c^1-m^3, 30·2 ; *ml*, 65·5.

Skins : 2♀ from Bankachon.—*hb*, 538-545 ; *tl*, 675-785 ; *hf*, 108?-146 ; *e*, 29-31.

Remarks.—Skins from Mergui bear out Pocock's (1939, p. 140) views that the race *corax* Pocock should be considered as a synonym of the present form. No. 12198 is in the process of changing its juvenile colour into the characteristic hue of the adult. No. 5236 is more silvery on the shoulders than other specimens. In the skull No. 12199 the right upper outer incisor is abnormally underdeveloped. In No. 5305 there is a parting on the crown.

Distribution.—Mergui Archipelago,[1] Tavoy in Tenasserim downward to northern part of Malaya Peninsula, and Pechburi District of S. W. Siam.

Presbytis obscurus obscurus (Reid).

1837. *Somnopithecus obscurus* Reid, *Proc. zool. Soc. London*, p. 14 (Malaya Peninsula, restricted to Malacca).

Material—

10532		Skin	....
11868 (I. M. 17a)	♂	Skull	Malaya Peninsula. F. W. Lindstedt. (1846).
11971	♀	Skin and skull	W. Rutledge (1883).
12187 (I. M. 17e)	Young ♀	Do.	Malaya Peninsula. F. W. Lindstedt.

Measurements of skulls.—

Z.S.I. Reg. Nos.	*l*	*cb*	*zw*	*ow*	*mw*	c^1-m^3	*ml*
11868			76·8	54·6	29·1	33·9	76·3
11971	89·2	72·5	67·6	48·2	23·6	29·4	66·4

[1] Not included in the distribution of this race by Pocock (1939).

Remarks.—As no precise locality is known, the determination of the specimens is provisional. In the young female No. 12187 the tail is much paler than in other specimens, but this may possibly be a juvenile character. In No. 11971 the paleness of the rump extends as a median band on the back for some distance.

Distribution.—Malaya States.

Presbytis obscurus (sub-sp. ?).

Material—

8032	Juv. ♂	Skin . . .	J. G. Scott.
11949 (I. M. 17b)	♀	Skull (damaged)	E. W. G. Frith (1846).
12196	Young ♀	Do. .	W. Rutledge (18-6-1881).
12207	♂	In spirit	Do. (21-2-1880).

Measurements of the skull No. 11949.—*ow*, 40·0 ; c^1-m^3, 30·4 ; *ml*, 68·0.

Remarks.—For want of proper data the specimens cannot be sub-specifically determined. In No. 8032, the white cap on the crown is only faintly visible. The general colour of this specimen including the shoulder and the forearm is slaty grey. In No. 12196, the general colour is reddish brown. In both the skins the ventral side is much contrasted with the general hue of the body. No. 12207 is provisionally assigned to this species as its colour has much faded away due to the action of the preservative. The tail appears to be quite darker than the legs.

Subgenus KASI

Presbytis johni (Fischer).

1829. *Cercopithecus johni*, Fischer, *Syn. Mammal.*, p. 25 (Tellicherry).

Material—

11981 (I. M. 16c)	♀	Skull .	Purchased (15-11-1867).
12061 (I. M. 16a)	♂	Skin and skull (exhibited).	Barrackpore Managerie (1844).
12099	♀	Skin and skull	Kukhal Shola, Palni Hills, Madura, Madras, 6,100, 4-6-1922. C. McCann.
12100	Young ♂	Do.	Cotegadar Estate, Cochin, S. India, 5-4-1921. J. Ryley O'Brien
12110 (I. M. 16b)	♀	Skin and skull (exhibited).	Nilgiris. J. C. Jerdon (1843).

Measurements—
Skulls—

Z. S. I. Reg. Nos.	*l*	*cb*	*zw*	*ow*	*mw*	c^1-m^3	*ml*
11981 .	100·6	82·4	72·4	51·3	28·5	38·0	74·0
12099	107·0	86·0	83·0	53·0	..	37 0	77·7

Skin No. 12099 : *hb*, 600 ; *tl*, 800 ; *hb*, 171 ; *e*, 37.

Remarks.—In all the adults the grizzled patch on the loins and at the roots of the tail is well-developed but is absent in the young male No. 12100. In the female from the Nilgiris the coat is noticeably more luxuriant than in other specimens. In all the skulls the posterior border of the post-dental part of the mandible is convex in its lower portion.

Distribution.—Coorg, the Nilgiris, the Anamalai, the Brahmagiri, and the Palni Hills in South India.

Presbytis senex vetulus (Erxleben).

1777. *Cercopithecus vetulus* Erxleben, *Regn. Anim.*, XXIV, p. 25 (Ceylon).

Material—

11834	♂	Skin and skull (exhibited).	Barrackpore Managerie (1872).
12101	♂	Skin and skull	Anasigalla, Matugama, Ceylon, 2-4-1921. W. W. A. Phillips.
12103 (I. M. 15i)	Juv. ♀	Skin	W. Rutledge (1877).
12104 (I. M. 15f?)	♀	Do.	Ceylon. Colombo Museum.
12105 (I. M. 15*l*).	Young ♂	In spirit	W. Rutledge (1879).
12108 (I. M. 15a)	Adol. ♀	Skin and skull	Purchased (1845).

Measurements—

Skulls—

Z. S. I. Reg. Nos.	*l*	*cb*	*zw*	*ow*	*mw*	c^1-m^3	*ml*
11834	105·0	86·9	76·8	54·1	30·7	35·3	75·8
12101	102·9	85·5	73·0	49·3	..	33·3	..

Skin No. 12101 : *hb*, 525 ; *tl*, 775 ; *hf*, 169 ; *e*, 33.

Remarks.—The colour of the croup patch is yellowish in all the skins except No. 12101 where it is silvery. The whiskers in all the skins are brownish distally. The crown patch in Nos. 12103, 12104, and 12105 is pale brown. The tail is white to yellowish white, or dirty white terminally, but not reddish brown as recorded by Phillips (1935, p. 14). The young one No. 12103 has acquired all the characters of the adult except the back which is somewhat paler. The measurements of the skulls are larger than those recorded by Pocock (1939, p. 157).

Distribution.—The wettest parts of the lowlands of west and south-west Ceylon.

Presbytis senex nester (Bennet).

1833. *Semnopithecus nester* Bennet, *Proc. zool. Soc. London*, p. 67 [Ceylon, probably Rayigam (Phillips)].

Material—

7580	♀	Skin and skull	W. Rutledge (20-3-1897).
12106 (I. M. 15u)	♂	Do.	Ceylon, Colombo Museum (1885).

Remarks.—The crown and the nape are not appreciably contrasted with the colour of the back perhaps due to foxing. However, a patch of paler hair on the crown is present.

Distribution.—The low country wet zone of the Western Province in Ceylon.

Presbytis senex senex (Erxleben).

1777. *Cercopithecus senex*, Erxleben, *Regn. Anim.*, p. 24 (Hills of southern Ceylon).

Material—

12107 (I. M. 15s)	Young ♀	Skin and skull	Ceylon. E. F. Kelaart (1851).

Remarks.—The specimen is an albino. The general colour is pale yellowish white but the head is faintly marked with brownish. As some other races of this species are also liable to albinism, the identity of this specimen is questionable.

Distribution.—The Hills east of Matale and Madulkelle upto 5,000′ also low country dry zone of N. C. P., N. W. P. and C. P., Ceylon.

Presbytis senex monticola (Kelaart).

1850. *Presbytis cephalopterus var. monticola* Kelaart, J. Ceylon *Brit. Asiat. Soc.* II, p. 207 (Nuwara Eliya, Ceylon).

Material—

11836 (I. M. 15n)	Young ♂	Skin and skull	Ceylon. T. C. Jerdon (1843).
11891 (I. M. 15p)	♀	Do.	Nuwara Eliya, Ceylon. E. F. Kelaar (1847).
12109 (I. M. 15q)	Young ♂	Do.	Do. (1846).

Measurements of the skull No. 11891.—*l*, 100·0 ; *cb*, 82·0 ; *zw*, 80·0 ; *ow*, 53·3 ; *mw*, 31·3 ; c^1-m^3, 34·4 ; *ml*, 73·7.

Remarks.—Nos. 11891 and 12109 are the cotypes. The cap in No. 12109 is well differentiated but the rump patch is absent. The colour of the hands and the feet is much darker than the rest of the body. In No. 11836 both the cap and the rump patch are well differentiated but the hands and the feet are much lighter than in the other two specimens. The measurements of the skull are smaller than those given by Pocock (1939, p. 157) for the male he measured.

Distribution.—The central hill ranges (above 4,000′) of Ceylon.

Presbytis senex (sub sp. ?).

Material—

11835 (I. M. 15g)	Adol. ♀	Skull .	..
11877 (I. M. 15j)	♀	Skull and some bones	W. Rutledge (7-11-1878).
11879 (I. M. 15e)	♂	Incomplete skeleton	Barrackpore Managerie (1872).

11969 (I. M. 15m)	♀	Skull . . .	Ceylon. R. Templeton (1848).
11970 (I. M. 15i?)	Young	Do. . .	....

Measurements of skulls—

Z. S. I. Reg. Nos.	*l*	*cb*	*zw*	*ow*	*mw*	c^1—m^3	*ml*
11877 .	93·0	73·0	68·0	48·7	23·5	31·1	68·4
11969 . .	92·8	74·0	68·8	49·6	23·6	32·2	66·3
11970 . .	88·7	..	66·5	47·1	23·0	31·8	65·2

Remarks.—The material is too inadequate for subspecific determination. The skull No. 11970 is peculiar in having only four teeth between the two lower premolars instead of six (Pl. v, fig. 2). As these teeth have fallen off, it cannot be said with certainty from the characters of the sockets which of them have failed to develop.

Subgenus PRESBYTIS.

Presbytis melalophos fuscomurinus (Elliot).

1906. *Presbytis fuscomurinus* Elliot, *Proc. biol. Soc. Washington*, XIX, p. 49 (Telok, Betong, Lampongs, South Sumatra).

Material—

7390	♀	Skins and skulls	W. Rutledge (8-5-1895).
7391	Adol. ♀		
7560	Young ♂	Do. . .	Do. (6-5-1897).
11841 (I. M. 25k).	Young ♀	Do. . . .	Do. (17-10-1876).
11951 (I. M. 25d)	♀	Do. . .	Do. (6-11-1874).
12120 (I. M. 25j)	♀	Skin .	Do. (20-10-1876).
12121 (I. M. 25g)	Adol. ♀	Do. . . .	Do. (6-6-1876).
12122 (I.M. 25e)	Adol. ♀	Do.	Do. (18-8-1875).
12123 (I. M. 25f)	♂	Do. . . .	Do. (6-11-1875).

Measurements of skulls—

Z. S. I. Reg. Nos.	*l*	*cb*	*zw*	*ow*	*mw*	c^1—m^3	*ml*
7390 .	88·0	67·5	64·5	50·0	22·9	29·6	61·5
11951 . .	99·3	74·0	71·0	53·4	26·0	31·2	70·0

Remarks.—In none of the skins there is a narrow dark line running on the sides of the head above the ears as described by Elliot (1913). The character, however, is not recorded by Pocock (1934) and Chasen (1940) as occurring in this race. In some skins there is an orange wash over the loins, the tail, the hands, and the feet. In No. 11841 the colour on the loins is almost orange red. A very light orange tint is also visible on the back in some skins. Ill-defined whorls very close to the brow are present in most of the skins. In some an almost bald area is present in their position.

Distribution.—Sumatra (part).

Presbytis melalophos nobilis (Grey).

1842. *Semnopithecus nobilis* Gray, *Ann. Mag. nat. Hist.*, (1) X, p. 256 (Indrapur, Sumatra).

Material—

12118	♂	Skin	Zool. Gardens, Calcutta (16-7-1881).

Remarks.—The general colour on the upper parts is deep red but the tips of the hairs are lightly coloured to a greater or a less extent. The lower arms, the lower leg and the lower side of the tail are paler. The ventral surface is pale red but is redder on the chest.

Distribution.—Sumatra (part).

Presbytis melalophos thomasi (Collett).

1892. *Semnopithecus thomasi* Collett, *Proc. zool. Soc. London*, p. 613 (Langkat, N. E. Sumatra).

Material—

11936	Young♀	Damaged skin and skull.	W. Rutledge (17-5-1882).

Remarks.—This form probably deserves a full specific rank, and is being considered a race of *melalophos* more for the sake of convenience than for any thing else.

Distribution.—Sumatra (part).

Presbytis melalophos melalophos (Raffles).

1821. *Simla melalophos* Raffles, *Trans. Linn. Soc.*, XIII, p. 245 (Benekulen, West Sumatra).

Material—

12112	♂	Skin	Zoological Gardens, Calcutta (27-9-1920).

Remarks.—The back, the outerside of the limbs, and the tail are tinted with red, the individual hairs being whitish towards the base and reddish towards the tip. The head for the most part is white, but the hairs of the crest are tipped with blackish. There is a band of darker hairs separating the white cheeks from the forehead, but it is confined to the right side only (*cf.* Pocock, 1934, p. 919). There is some red on the hands, but the feet are yellowish white.

Distribution.—Sumatra (part).

Presbytis melalophos femoralis (Martin).

1838. *Semnopithecus femoralis* Martin, *Charleswarth's Mag. nat. Hist.*, II, p. 4363 (Singapore).

Material—

11840 (I. M. 24b)	♀	Skull (damaged)	W. Rutledge (6-7-1869).
11968 (I. M. 24c)	Young ♀	Skin and skull	Do. (10-4-1876).
12112 (I. M. 24a)	Adol. ♀	Skin (exhibited)	Purchased (11-12-1867).
12117	..	Skin	Zool. Gardens, Calcutta (6-7-1869).

Remarks.—In No. 12112 the general colour above is blackish brown with reddish tint. The under parts in this specimen were described by Anderson (1891, p. 53) as yellowish white, but they now appear brownish especially on the anterior part of the chest. The white line on the chest is only faintly visible. There are two whorls on the crown very close together and in the process of coalescing. In No. 11968 the white streak on the chest is well marked. In the skull No. 11840, the frontals just behind the orbits are flattened.

Distribution.—Singapore Island.

Presbytis melalophos siamensis (Müller and Schleger).

1841. *Semnopithecus siamensis* Müller and Schleger, *In Temm. Verh. nat. ges. ned. overz. bezitt. Zool.* (*Mamm.*), p. 60 (Malacca=Malaya States).

Material—

7835	Young ♀	Skin and skull	W. Rutledge.
11839 (I. M. 23b)	♀	Skull	Malacca. F. W. Lindstedt (1846).
11973 (I. M. 23a)	♂	Skin (exhibited) and skull.	Malacca. R. W. G. Frith (1846).
12113 (I. M. 23e)	♂	Skin	W. Rutledge (1878).
12114 (I. M. 23d)	Young ♀	Skin (exhibited)	Malacca. F. W. Lindstedt (1846).
12116 (I. M. 23c)	♀	Skin and skull	Do. R. W. G. Frith (1846).

Measurements of skulls—

Z. S. I. Reg. Nos.	*l*	*cb*	*zw*	*ow*	*mw*	c^1—m^3	*ml*
11839 . .	..	..	..	52·0	21·9	26·1	63·0
11973 . .	..	..	..	54·8	25·9	29·1	65·1

Remarks.—In No. 12113 the coat is long and full and the colour of the upper parts is much darker than in other skins. The whorls and the crest on the crown are indistinct. The tail in this specimen gradually darkens towards the tip. In No. 7835, though the coat is in similar condition, the colour is much paler. The last lower molar in No. 11973 is provided with five cusps.

Distribution.—Malaya States (part).

Presbytis melalophos (sub sp. ?).

Material—

11862 (I. M. 25h)	♂	Skeleton without skull.	W. Rutledge (6-6-1876).
11867 (I. M. 25k)	Young ♀	Incomplete skeleton without skull.	Do. (17 10-1876).
11940 (I. M. 25b)	Young ♀,	Skulls	Do. (11-5-1875).
11952 (I. M. 25c)	Adol. ♀		
12209 (I. M. 25l?)	♂	In spirit	Do. (10-6-1879).

Remarks.—In No. 12209 the colour has been bleached due to the action of the preservative. In other specimens also the material is too inadequate to allow proper identification. The specimens are being referred to the present species mainly on the authority of Anderson (1881).

Distribution.—?

Presbytis rubicundus (Müller).

1838. *Semnopithecus rubicundus* Müller, *Tjidsch. Nat. gesch. Physicl.*, V , p. 13 (South Borneo).

Material—

7227	Juv. ♂	Skin and skull	W. Rutledge (6-3-1891).
10357	♀	Skin	West Borneo, Oct., 1917. C. B. Kloss.
10524	♂	Do. . .	D. Ezra (12th July 1918).

Remarks.—Pocock (1934, p. 923) after analysing the characters of various supposed races of this monkey was not in favour of any subspecific spiltting ; but Chasen (1940, pp. 80-81) recognized four races with the remarks that ' no useful study of the variations in this species can be based on the quite inadequate material in the British Museum'. As far as the published data are concerned, it appears difficult to diagnose the races recognized by Chasen. I, therefore, follow Pocock in not dividing the species any further.

The hands and the feet in No. 10524 are much lighter than in other skins, and the locality given on the lavel is Java ; but, since Mr. Ezra who presented the specimen used to purchase specimens from dealers, sources of his information were not reliable. In the young one, the second premolar has only incompletely erupted, but it has acquired the characteristic colour of the adult. In this specimen, there is a small dark patch on the crown just behind the centre of hair radiation, and the colour of the innerside of the thigh is paler.

Distribution.—Borneo and Karimata Island.

Nasalis larvatus (Wurmb).

1781. *Cercopithecus larvatus* Wurmb, *verhand, Betav. Genootsh,* 1st ed., III, p. 353 (Pontianak, West Borneo).

Material—

7319 7320	Adol ♀ ♀	Skulls . .	Borneo, W. Rutledge (8-3-1893).
8418	Young ♂	Skin (exhibited) .	Borneo. Zool. Gardens, Calcutta (18-2-1907).
11939 (I. M. 26d)	Young ♀	Skin (damaged) and skull.	W. Rutledge (8-7-1880).
11943	Juv.♀	Damaged skin and skull.	Zool. Gardens, Calcutta (14-11-1881).
11944 (I. M. 26b)	♀	Imperfect skin, skull and model of head.	O. L. Fraser (19-11-1878).
11945 (I. M. 26c)	Adol ♂	Damaged skin and skull.	W. Rutledge (4-7-1879).
11946	Young ♂	Skull . . .	Zool. Gardens, Calcutta (3-7-1881).
11972	♂	Skin and skull .	Do. (July, 1882).

Measurements of skulls—

Z. S. I. Reg. Nos.	*l*	*cb*	*zw*	*ow*	*mw*	c^1—m^3	*ml*
7320 . .	112·7	88·0	74·6	52·7	29·3	36·0	81·5
11944 . .	110·0	87·0	78·4	52·4	33·0	35·3	78·3
11972 .	131·3	106·4	84·3	60·6	36·9	43·1	92·0

Remarks.—Chasen (1940, p. 83) recognized two races of this species on the grounds that the adults from north-east Borneo differs from those from west Borneo in having the cap and the nuchal stripe much less defined, in the upper parts being much paler and more uniform, and in the under parts being more deep and uniformly ferruginous. I find it difficult to identify the specimens before me on the basis of these characters.

In the juvenile No. 11943, the crown is dark ferruginous or liver-brown and is sharply contrasted with much paler (approaching on certain parts to apricot buff on the other to cinnamon rufous) of the upper neck and the back. The part of the posterior portion of the back bordering the characteristic grey rump area is cinnamon rufous. There is a slight wash of ferruginous on the throat. In Nos. 11939 (♀) and 11945 (♂), the crown is much darker but there is no nuchal stripe. The colour towards the foreback is redder ; and the throat is contrasted with the breast as given by Chasen (*op. cit.*) in the case of the nominate race. The adult male No. 11972 agrees more or less with the Chasen's description of the nominate race except that the throat is not so well-contrasted as stated by him and that the ' lower back ' is represented by a much smaller area. There is no black tip to the tail as stated by Elliot (1913, p. 112). The skull is notable for the absence of ridges, flattening of nasals, low nose bridge, wide nasal aperture, and broad muzzle. The forehead in the young is much convex but gradually gets flattened as the age advances.

Distribution.—Borneo.

Colobus polykomas abyssinicus (Oken).

1816. *Lemur abyssinicus* Oken, *Lehrb. d. Naturgesch*, pt. 3, Sect. 2, p. 1182 (Abyssinea).

Material—

11954		Skull	....
12080	♂	Skin	Shea, Abyssinea, 1-3-1880, W. Ganslandt.

Measurements of the skull.—l, 113·6 ; *ow*, 51·1 ; *mw*, 30·1 ; cl m^3, 2.83; *ml*, 76·1.

Remarks.—No. 12080 is a fine specimen answering well the description given by Schwarz (1929, p. 593). The tail has three types of hairs : white, black, and speckled with black and white. The black is pronounced towards the tip and the white towards the root of the tail. The skull is provisionally assigned to this form as the distinguishing skull characters, except the measurements, are unknown. It was labelled as '*Colobus guereza*' which is considered to be the synonym of this form (Elliot, 1913, p. 143). The skull of this race measured by Elliot (*op. cit.*, p. 144) is, somewhat larger than the one in the collection under study.

Distribution.—Forested mountains of Abyssinia west of the Hawash River.

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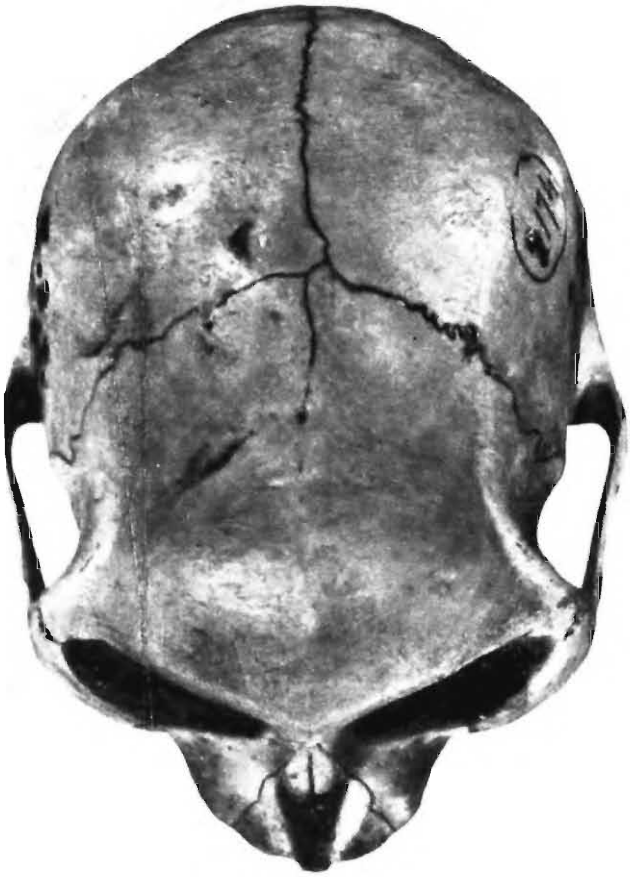
EXPLANATION OF PLATE V.

FIG. 1.—*Presbytis cristatus ? sondaicus* from ' Amoo ' island showing a ruff of longer hairs around the head.

FIG. 2.—Upper view of the lower jaw of *Presbytis senex* showing abnormal number of teeth.

FIGS. 3 & 4.—Dorsal and lateral views of the skull of the type of *Presbytis cristatus rutledgei* (Anderson).

1



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2

4

Presbytis cristatus? sondaicus and skull of some Colobidae

STUDIES ON PARASITES OF INDIAN FISHES.

III. PROTOZOA 2 (MASTIGOPHORA AND CILIOPHORA) [1]

By YOGENDRA R. TRIPATHI,

Central Inland Fisheries Reserach Station, Calcutta.

Only two species, one each of the classes Mastigophora and Ciliophora, *viz.*, *Trypanosoma clariæ* Montel (1905), *var. tabrachi* de Mello and Vales 1936 and *Zoothamnium horai* Khajuria and Pillay 1952 from Indian fishes, have been fully described. Lingard (1904) recorded unnamed species of *Trypanosoma* from *Barbus carnaticus, Gobius giurir, Macrone seenghala, Ophicephalus striatus,* and *Trichogaster fasciatus.* Jones and Job (1938) have also recorded *Zoothamnium* sp. from the mouth of *Acentrogobius neilli* from Madras.

During the course of my studies on the parasites of Indian freshwater food fishes, a new species belonging to the class Mastigophora and three new species of the class Ciliophora were found, and are described below.

The parasites were first studied in the living condition after staining with the vital stains, methylene blue and neutral red, and then fixed in osmic vapour or aqueous Bouin's fluid and stained with Ehrlich's hæmatoxylin and eosine.

Class MASTIGOPHORA

Order PROTOMANADINA Blochmann.

Family BODONIDAE Butschli.

Genus **Bodomonas** Davis, 1947.

Bodomonas rebae, sp. nov.

(Text-fig. 1, *a-c*)

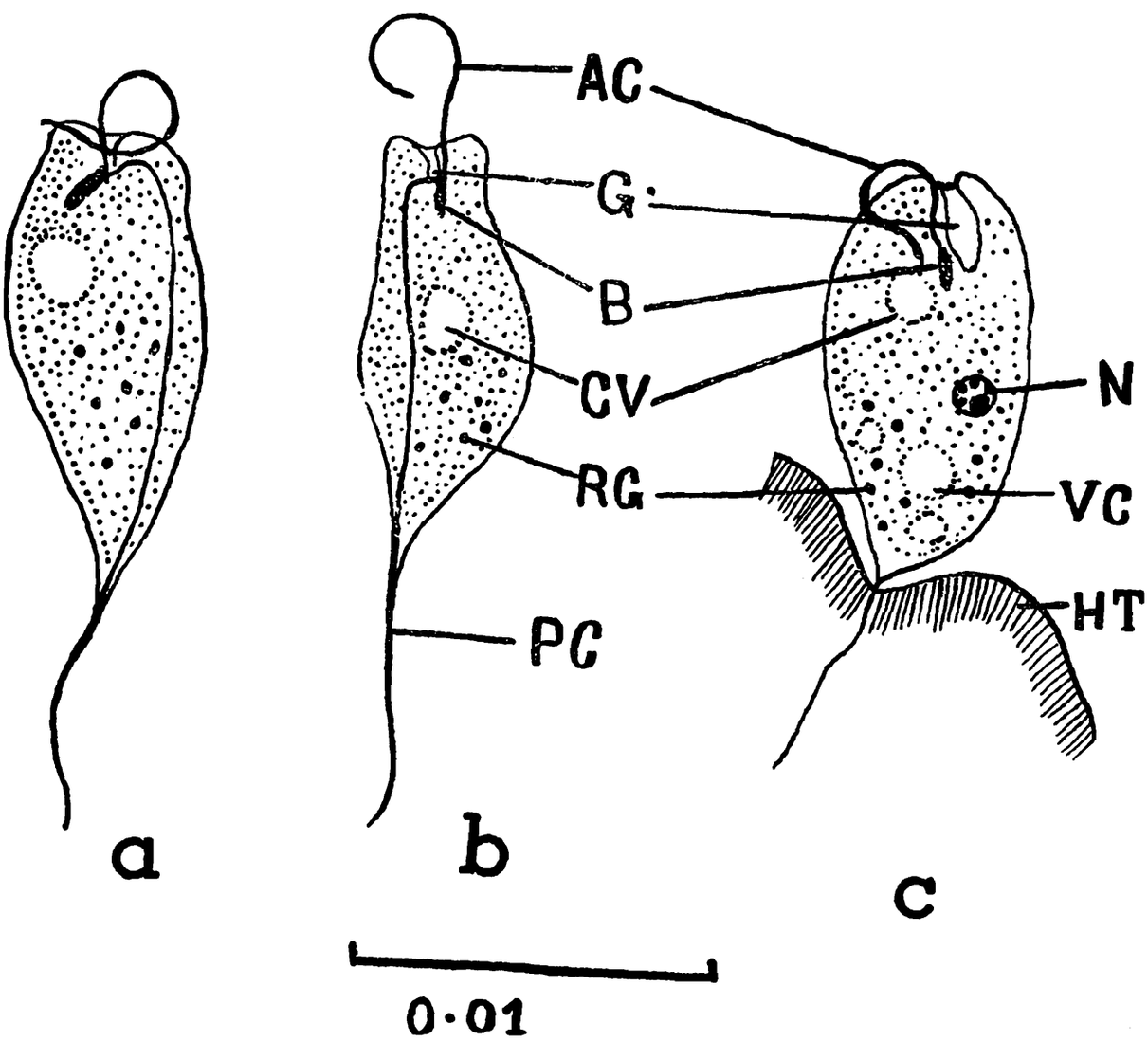
This flagellate parasite was found on the gills of the fry of *Cirrhina reba, C. mrigala, Labeo rohita* and *Catla catla* (1·8-2·5 cms. long) during August 1953. The parasite is so small that it is apt to be missed unless examined under a high power objective with ×20 or ×12 eye-piece. 59 per cent of the 200 fry examined from two consignments were found infected with this parasite. The following table shows the incidence of infection in individual species.

Species.	No. examined.	No. infected.	Per cent infection.
Labeo rohita	50	38	76
Cirrhina reba	50	45	90
C. mrigala	50	25	50
Catla catla	50	10	20

[1] Published with the permission of the Chief Research Officer, Central Inland Fisheries Research Station, Calcutta.

The parasite is attached by its posterior flagellum to the end of the gill filaments.

Body long, tapering posteriorly, anterior end broad and flattenedt Middle part of the body broadest. Protoplasm granular with refringena granules especially in the posterior half of the body. Contractile vacuole spherical, posterior to the elliptical blepheroplast. Cytopharynx, small depression at the anterior end. Nucleus spherical containing granules of chromatin which stain deeply with methylene blue. Two flagella, the anterior small and curved, the posterior long and trailing behind the body, serving as an anchor.

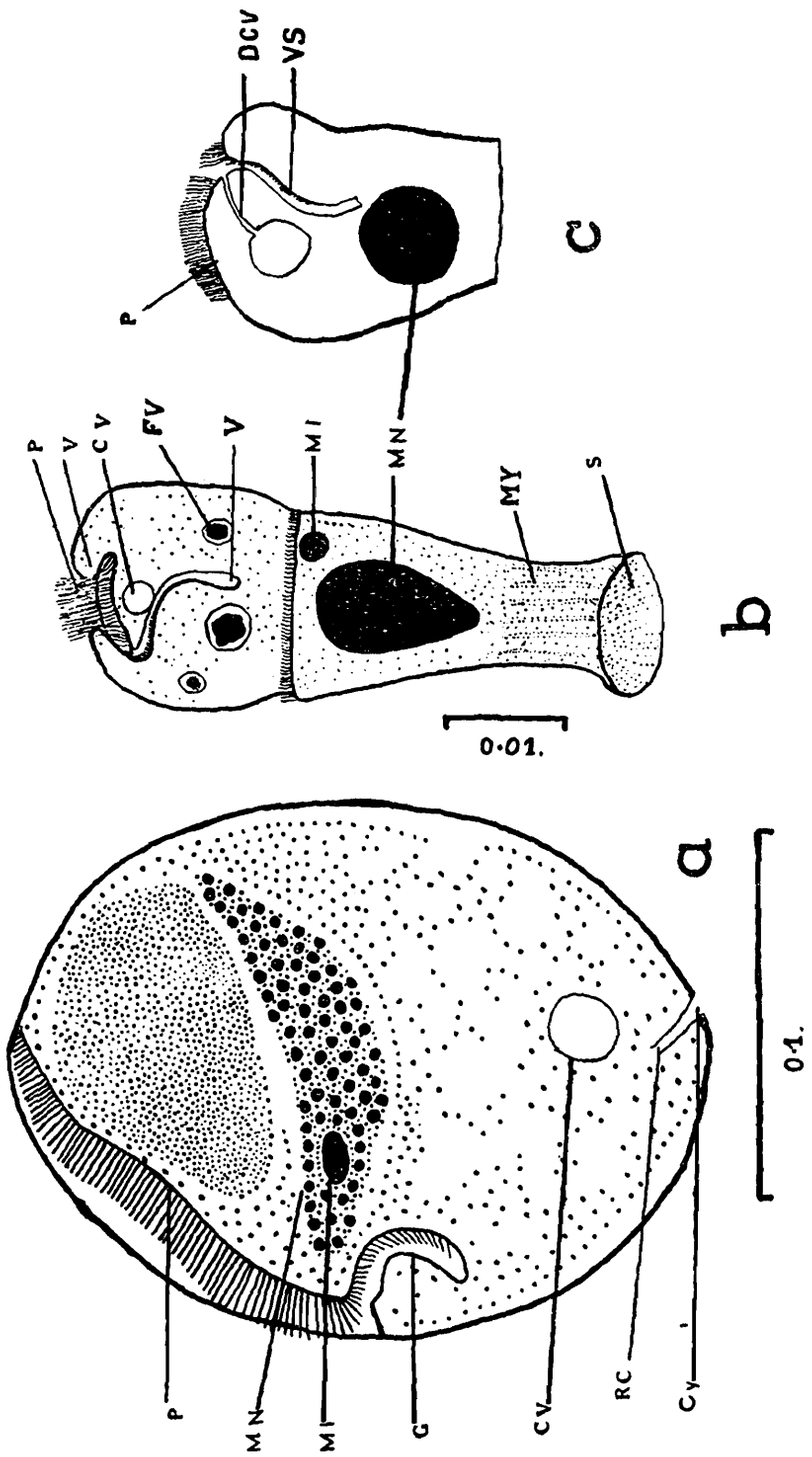


TEXT-FIG. 1.—*Bodomonas rebæ*, sp. nov. (*a*) & (*b*) Stained with neutral red in living condition. (*c*) Stained with methylene blue showing nucleus, in living condition. *AC*, Anterior flagellum ; *B*, Blepheroplast ; *CV*, Contractile vacuole ; *G*, Cytopharynx ; *HT*, Host-tissue ; *N*, Nucleus ; *PC*, Posterior flagellum ; *RG*, Refringent granule ; *VC*, Vacuole.

The anterior part of the body wriggles vigorously when attached to the host tissue, gyrating with the anterior end forward.

The effect of this parasite is masked as it is always in association with *Trichodina indica*, sp. nov. or *Scyphidia pyriformis*, sp. nov. (see page 223).

Reproductive stages were not observed.



TEXT-FIG. 2(*a*).—*Nyctotherus pangasi*, sp. nov. (*b*) & (*c*) *Scyphidia pyriformis*, sp. nov. *CV*, Contractile vacuole; *CY*, Cytopyge; *DVC*, Duct of contractile vacuole; *FV*, Food vacuole; *G*, Cytopharynx; *MI*, Micronucleus; *MN*, Macronucleus; *MY*, Myonemes; *P*, Peristome; *RC*, Rectum; *S*, Scopula; *V*, Velum; *VC*, Vacuole *VS*, Vestibule.

*Measurements.**—Length (including the posterior flagellum) 15·0-18·0. breadth, 4·5-6·0; anterior flagellum, 5·0-6·0; contractile vacuole, 1-5-2·

* All measurements are in microns.

Remarks.—The only other species of the genus is *B. concava* Davis, 1947, found on the gills of *Pomoxis annularis*, *P. sparoides*, and *Lepomis macrochirus* in the U. S. A. These two species differ in the shape and size of the blepharoplast which in *B. rebæ* is elliptical and smaller than in *B. concava*.

Class CILIOPHORA

Order SPIROTRICHA Butschli.

Family SPIROSTOMIDAE Khal.

Genus **Nyctotherus** Leidy.

Nyctotherus pangasia, sp. nov.

(Tex-fig. 2*a*)

This ciliate parasite was found in the intestine of *Pangasius pangasius* from the river Ganga at Buxar in January 1953 and from the river Cauvery at Mettur Dam in June 1953. The infected fishes were 41·3—60·9 cms. long. Smaller specimens 16·8-30·5 cms. long bought from the local fish market were free from the infection. Although infection was heavy no pathological effects were observed on the intestinal wall.

Body oval to round, Peristome reaching to middle of body, its outer margin lined with long stiff cilia. Cytopharynx arched, nearly one-fifth as long as body and extending posteriorly beyond the middle of body. A long thin cytogut visible in some specimens between the cytopharynx and the rectum. Cytopyge at the posterior end of the body. Spherical contractile vacuole lateral to rectum. Protoplasm granular. Prenuclear part of body dark brown due to glycogen granules. Macronucleus elliptical to oval, granular in texture. Micronulceus embedded in or just posterior to the macronucleus.

Measurements.—Length, 150·8-262·2; breadth, 114-197·6; length of cytopharynx, 38·0.

Remarks.—Bhatia (1936) has given a key to nine species of *Nyctotherus* from Anuran and invertebrate hosts from India. The present species is the first record of *Nyctotherus* from an Indian fish. It is characterised by the ovoid body, the cytopharynx reaching beyond the middle of the body, and nearly a quarter of the body width in length. In these characters it resembles *N kempi* Ghose, and *N. cordiformis* (Ehrb.) but all the three species differ from one another in the shape of the nucleus and the curvature of the cytopharynx.

Recently Sandon (1950) has recorded without description some Opalinids, *Balantidium* and *Nyctotherus* from the Nile fishes belonging to the families Siluridæ, Mochocidæ and Citharinidæ. He did not find any relation between the feeding habit and the infection in these fishes. *Pangasius pangasius* feeds on Lamellibranch and Gastropod molluscus from the bottom of the river. Other Siluroids and Carps examined from these sources were free from the infection, therefore it is not possible to make any general comment on the relationships between the food and feeding habits and parasitisation of these fishes. However, it may be noted that only large-sized *P. pangasius* are infected.

Order PERITRICHA Stein.

Family URCEOLARIDAE Stein.

Genus **Trichodina** Ehrenberg.

Trichodina indica, sp. nov.

(Tex-fig. 3, *a-c*)

This is the commonest Ciliate parasite infecting the pond fishes and their fry and fingerlings. The following table gives the incidence of infection.

Species.	No. examined.	No. infected.	Per cent infection.
1. *Labeo rohita*	2,000	1,828	91·4
2. *Labeo calbasu*	40	5	12·5
3. *Cirrhina mrigala*	2,000	1,453	76·5
4. *Cirrhina reba*	1,500	840	56·0
5. *Catla catla*	2,000	937	46·85
6. *Amblypharyngodon mola*	20	4	20·0
7. *Chela bacaila*	10	1	10·0
8. *Ophicephalus gachua*	9	2	22·22
9. *O. punctatus*	15	6	40·0
10. *Ambassis nama*	10	3	33·33
11. *A. ranga*	10	4	40·0

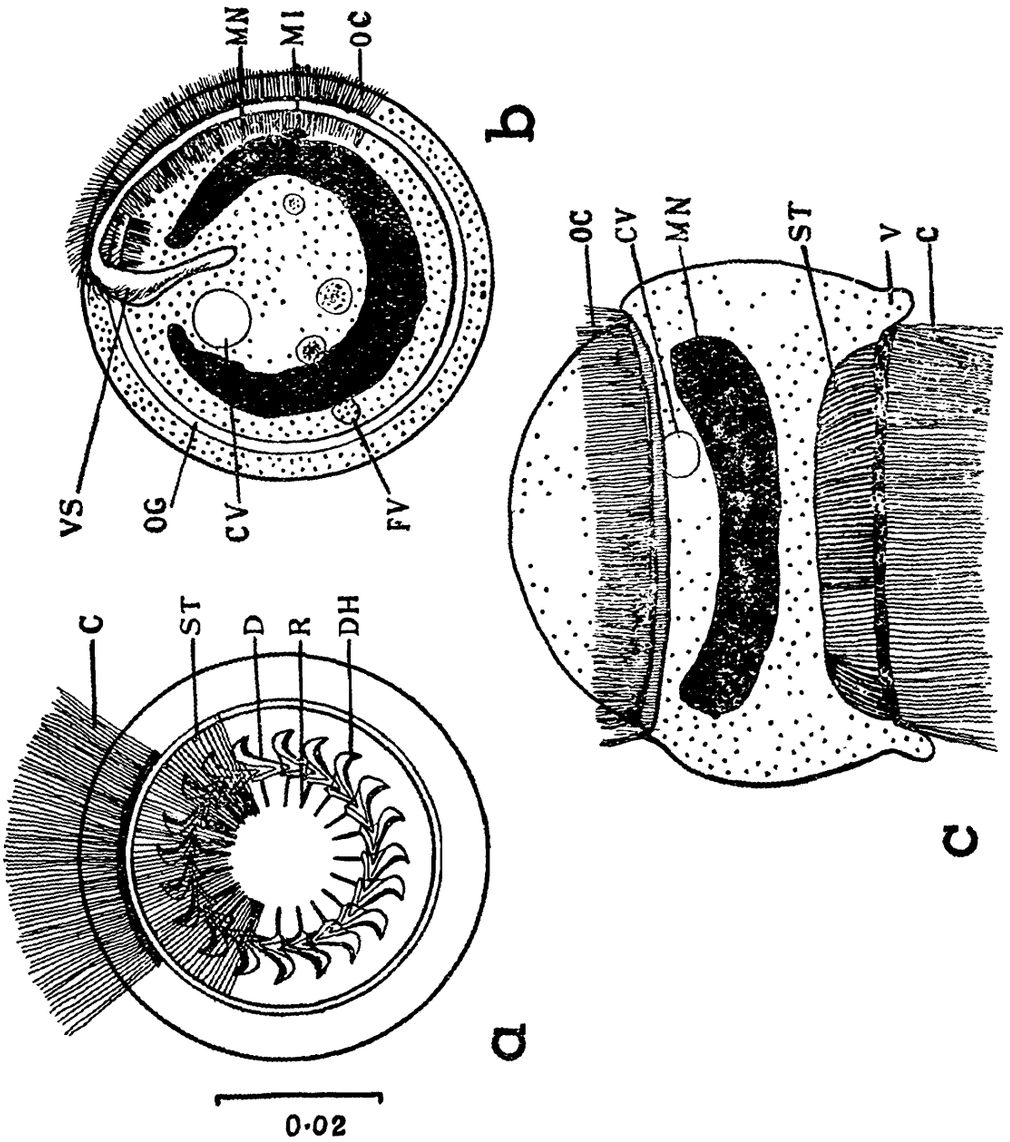
The percentage of infection in the last six species (nos. 6-11), though low and erratic, varies between 10-40. Amongst the carp fry and fingerlings the intensity of infection was generally high, being highest in *L. rohita*.

Body semicircular or sub-spherical in side view and circular in anterior view. Anterior end arched, surrounded by the oral ciliary groove which makes one anti-clockwise turn and then descends obliquely to form the vestibulum. Inner and outer margins of groove lined with cilia. Outer ciliary ring continued into the vestibule, posterior part of which is non-ciliated and forms the gut. Food vacuoles arise first near the gut and then move away towards the periphery. Contractile vacuole in anterior half of the body opening in the vestibule by a small duct. It pulsates every 4 or 5 seconds.

Aboral end with skeletal ring consisting of an outer striated ring and an inner denticulate ring, the latter consisting of 20-22 cone-shaped denticles, fitting into one another to form an interlocking ring. Each denticle with an outer winged hook and an inner ray. Striated ring formed by striæ sligtly thicker at the outer end and 7-9 striæ to each denticle.

Aboral ciliary ring outer to the skeletal ring, formed by long cilia fused at their base to form a small membranelle velum, a thin protoplasmic pellicle variable in shape, outer to the aboral ciliary ring.

Macronucleous horse-shoe shaped, thicker in the centre and slightly tapering at the open ends. Micronucleus elliptical and outer to macronucleus.



TEXT-FIG. 3.—*Trichodina indica*, sp. nov. (*a*) Aboral side. (*b*) Oral side. (*c*) Side view; *C*, Aboral cilia; *CV*, Contractile vacuole; *D*, Denticle; *DH*, Denticle-hook; *FV*, Food-vacuole; *MI*, Micronucleus; *MN*, Macronucleus; *OC*, Oral cilia; *OG*, Oral groove; *R*, Denticle ray; *ST*, Striated ring; *V*, Velum; *VS*, Vestibule.

Reproduction by binary fission as in other species of the genus. Fission is more frequent during July to September (temp. 25-32°C.), decreasing during winter when the temperature falls below 20°C. Examination of individuals on two occasions during July and August 1952 showed that 30 per cent and 27 per cent of the population consisted of daughter individuals.

The parasite attatches itself to the tissue of the host by the aboral end. By an upward movement of the skeletal ring a slight vacuum is created between its body and the host tissue, thus ensuring firm fixation,

The parasite moves freely now and then on the body of the host or is sometimes found swimming about in the water as part of the plankton. When the host dies the parasite attaches itself to another host. It feeds on the desquamated epithelial cells and bacteria.

Measurements.—Total diameter, 21·9-28·4 ; height, 18·25-20·07 ; diameter of striated ring, 18·25-20·07 ; diameter of denticulate ring, 7·3-11·9.

Remarks.—There are 39 species of *Trichodina* including the present, eight of which belong to the sub-genus *Cyclochæta*. The present new species belongs to the sub-genus *Trichodina* and differs from all the other species of this sub-genus in the size of the body and the number of its denticles.

Family SCYPHIDIDAE Khal.

Genus **Scyphidia** Dujardin.

Scyphidia pyriformis, sp. nov.

(Text-fig. 2, *b* & *c*)

This parasite was first observed infecting the fry of *L. rohita* (2·5-3·8 cms. long) on 26-viii-1952 in a nursery pond at Serampore (W. Bengal). The fry of other carps, *i.e., C. catla, Cirrhina mrigala* and *C. reba* were not infected in this lot. The parasite was usually present on the skin, but sometimes more were present on the fins than on the gills. The infected fishes were weak and sluggish. These fry were kept in tap water for eight hours and then despatched by air, in sealed oxygen tin carriers to Jorhat (Assam) where, on arrival, the mortality was only two per cent. Subsequently this parasite has been found on fry and fingerlings of *catla, mrigala* and *bata* (local name for *C. reba.*). The following table gives the incidence of infection on carp fry for the year 1952-53.

Species.	No. examined.	No. infected.	Per cent infection.
Labeo rohita	1,200	743	61·91
Cirrhina mrigala	756	339	43·51
C. reba	946	10	1·05
Catla catla	800	3	0·375

Body urn-shaped or conical, anterior end round, posterior end elongate and truncate with broad frill-like ' scopula ' for attatchment. Single row of cilia girdling the middle of body. Peristome arched, with ciliated circular oral groove which descends obliquely to form vestibule. Velum covers the peristome completely in contracted forms. Contractile vacuole in the anterior part of body, pulsates every 3 or 4 seconds and is connected with vestibule by a small duct. Vestibule sigmoid, reaching to near the macronucleus. Food vacuoles contain desquamated epithelial cells from epidermis of the host. Macronucleus pyriform, pointing posteriorly. Micronucleus spherical, anterior to macronucleus. Protoplasm granular. Posterior part of body contractile due to presence of myonemes in protoplasm.

Reproduction by binary fission as in other peritrichous ciliates. In one specimen in a stage prior to fission, the macronucleus was divided into two, and the micronucleus into four.

The parasite attaches itself by the scopula to the host-tissue, but does not move as freely in the water as species of *Trichodina*.

Measurements.—Length, 38·5-46·9 ; breadth, 18·0-20·36 ; oral cilia, 7·8 long ; contractile vacuole, 5·0-6·0 in diameter ; macronucleus length, 8·9 ; scopula breadth, 6·0-9·0.

Remarks.—The posterior elongation of the body puts the species in the sub-genus *Scyphidia*. The pyriform nucleus, the two rings of cilia on the body and the arched peristome are the characteristic features of this species. In the shape of the nucleus it resembles *S. micropteri* Surber, but the latter species lacks the middle ring of cilia. *S. pyriformis* differs from the other two Indian species *S*(*S*). *indica* Bhatia and *S.* (*Gerda*) *purniensis* Ghose, in the shape of the nucleus and the peristome. Hirshfield (1949) has given the size and other characters of 23 species of *Scyphidia*. The present is the twenty-fourth species known, and the third to be described from India.

Discussion.

From the foregoing, it would seem clear that the fry of major carps are more susceptible to infection by *T indica* than by *S. pyriformis* or *B. rebæ*. The incidence and intensity of infection is higher in *L. rohita* than in other carps. This may be due to the biochemical properties of its mucus which forms the microhabitat for the parasite. The gills of fry below 1·8 cms. in length are not infected with any of the above parasites, though they may be present on the body surface. The density of population of the parasites specially of *T indica* is higher between July and August (temp. 25°-32°C.) when the rate of its binary fission is also higher. Nigrelli and Atz (1943) also report higher rate of reproduction in *Trichodina* sp. from *Spheroides maculatus* between July to September when the temperature was 70°F. (23·75°C.).

As transmission of parasites from one fish to another is due to proximity, the chances of infection are greater in crowded ponds. The higher incidence of *Trichodina* infection is probably due to its freer movement in the water which enables the species to infect a larger number of fishes. The intensity of parasitisation on fry obtained from the river is less than on those from the ponds. A similar observation was made by the present author for those obtained from the river Ganga at Futwah (Bihar) in July 1951.

The presence of these parasites on the body and the gills, causes irritation, resulting in hyper-secretion of the mucus. In the case of gills, the effective respiratory area is decreased and the fish cannot breathe properly. It has been observed that in the ponds where mortality of fish is due to deficiency of oxygen, such infected fishes are the first to succumb. In the case of the heavy infection on the body, the free movements of the fins are hampered by the excess of mucous secretion,

and the fish consequently become sluggish and emaciated. Up to now, no case of mass mortality of fish in ponds, due to excessive infection by these parasites, has been recorded. But when such fishes are kept in the aquaria or in small earthen vessels (*handis*) some mortality has been observed. Nigrelli (1943) reports that *T. spheroides* and *T. halli* were responsible for 10 per cent, 4 per cent, and 12 per cent of death of fish in New York aquarium during 1939, 1940 and 1941 respectively. The focus of infection in the above cases was *Spheroides maculatus* and he suggests that fishes should not be haphazardly introduced in the aquaria. It is a well known fact that fishes and their parasites in a state of nature establish a physiological balance which is normal to them. Parasites introduced into new areas may infect new hosts with greater intensity, resulting in greater harm to them than to the accustomed hosts. It is therefore advisable to exercise due care to introduce only parasite-free fishes from one part of India to another. The introduction of exotic fishes into India is fraught with even more danger of new infection by parasites from other countries.

CONTROL.

The three species of ectoparasites are killed in 5 to 10 minutes in 2-3 per cent salt solution. The time and concentration may be varied depending on the physical condition of the fish and the intensity of infection. In some cases, more than one treatment in a saline bath may be necessary. Davis (1947) has suggested the use of 3 per cent salt solution or 1 : 500 acetic acid solution, or 1 : 4000 formalin (40 per cent) solution. The two latter chemicals have been tried with success in the laboratory in proportions as follow : 1 : 1000 acetic acid solution, and 1 : 5000 to 1 : 6000 formalin solution. A salt bath is usually preferred and recommended for field use under Indian conditions on account of its low cost and ease of application, particularly when handling sick fry.

SUMMARY.

Nyctotherus pungasi, sp. nov. is described from the intestine of *Pangasius pangasius*. *Trichodina indica*, sp. nov., *Scyphidia pyriformis*, sp. nov., and *Bodomonas rebæ*, sp. nov., are described from the gills and skin of fry and fingerlings of Indian major carps. Their pathological effects and methods of control are also given.

ACKNOWLEDGMENTS.

My sincere thanks are due to Dr. H. S. Rao, Chief Research Officer, for critically going through the manuscript and suggesting improvements, and for the interest he has shown in the work.

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STUDIES ON THE PARASITES OF INDIAN FISHES.*

IV. Trematoda: Monogenea, Microcotylidae.

By Yogendra R. Tripathi, *Central Inland Fisheries Research Station, Calcutta.*

Contents.

Introduction.

In the course of the examination of Indian marine and estuarine food fishes for parasites, the following species of Monogenea of the family Microcotylidae were collected from the gills, and are described in this paper. The incidence of infection is given in Table I.

Table I.

Host.	No. examined.	No. infected.	Parasite.	Place.
Chirocentrus dorab	6	4	*Megamicrocotyle chirocentrus*, Gen. *et* sp. nov.	Puri.
Chorinemus tala	1	1	*Diplasiocotyle chorinemi*, sp. nov.	Mahanadi estuary.
Cybium guttatum	4	2	*Thoracocotyle ovale*, sp. nov.	Puri.
„ „	4	3	*Lithidiocotyle secundus*, sp. nov.	Puri.
Pama pama	48	30	*Microcotyle pamae*, sp. nov.	Chilka lake and Hoogly.
Polynemus indicus	6	3	*Microcotyle polynemi* MacCallum 1917.	Chilka lake, Hoogly and Mahanadi.
P. tetradactylum	30	9	„ „ „	
Stromateus cinereus	6	3	*Bicotyle stromatea*, Gen. *et* sp. nov.	Puri.

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The parasites were fixed in Bouin's fluid or Bouin-Duboscq fluid under pressure of cover slip and stained with Ehrlich's haematoxylin, which gave satisfactory results. Those on the gills of *Chorinemus tala* were picked from specimens of fish preserved in 5 per cent formalin in the field and examined in the laboratory after washing and staining as above, but the fixation was not satisfactory.

Systematic Account of the Species.

Sub-family *Microcotylinae* Monticelli, 1892.

Genus **Microcotyle** van Beneden & Hesse, 1863.

Microcotyle pamae, sp. nov.

(Text-Fig. 1, a-f.)

Body long, anterior end truncate, maximum breadth in the ovarian region (text-fig. 1*a*). Haptor long and tapering posteriorly. Clamps unequal in number on the two sides, 28-54 on one side and 34-64 on the other. Two larval specimens with two pairs of anchors have 7 and 22 pairs of clamps respectively. Ventral surface of the clamp capsule with 6-7 thin striae on either side of the middle piece.

Anterior suckers septate and oval. Pharynx spherical. Oesophagus long and thin, bifurcating into intestinal crura in front of the genital pore. In some specimens the oesophagus was red, presumably due to the blood of the host on which the parasite had fed.

Testes 8-11, globular to oval in shape. Vas deferens long, stout and sinuous, and opening into the spiny genital atrium. Spines long and curved forming a coronet with another circlet of 15-20 smaller spines at their base. Ovary convoluted. Germiduct starts at its posterior end where vitelline duct also joins it. Genito-intestinal canal present. Uterus long with one oval egg, having a spathulate appendage at its posterior end. Vagina opening midway between the ovary and the anterior end of body, armed with a circlet of recurved spines surrounded by muscle fibres. Vitellaria follicular and lateral; they extend, from the genital pore to the middle of the haptor.

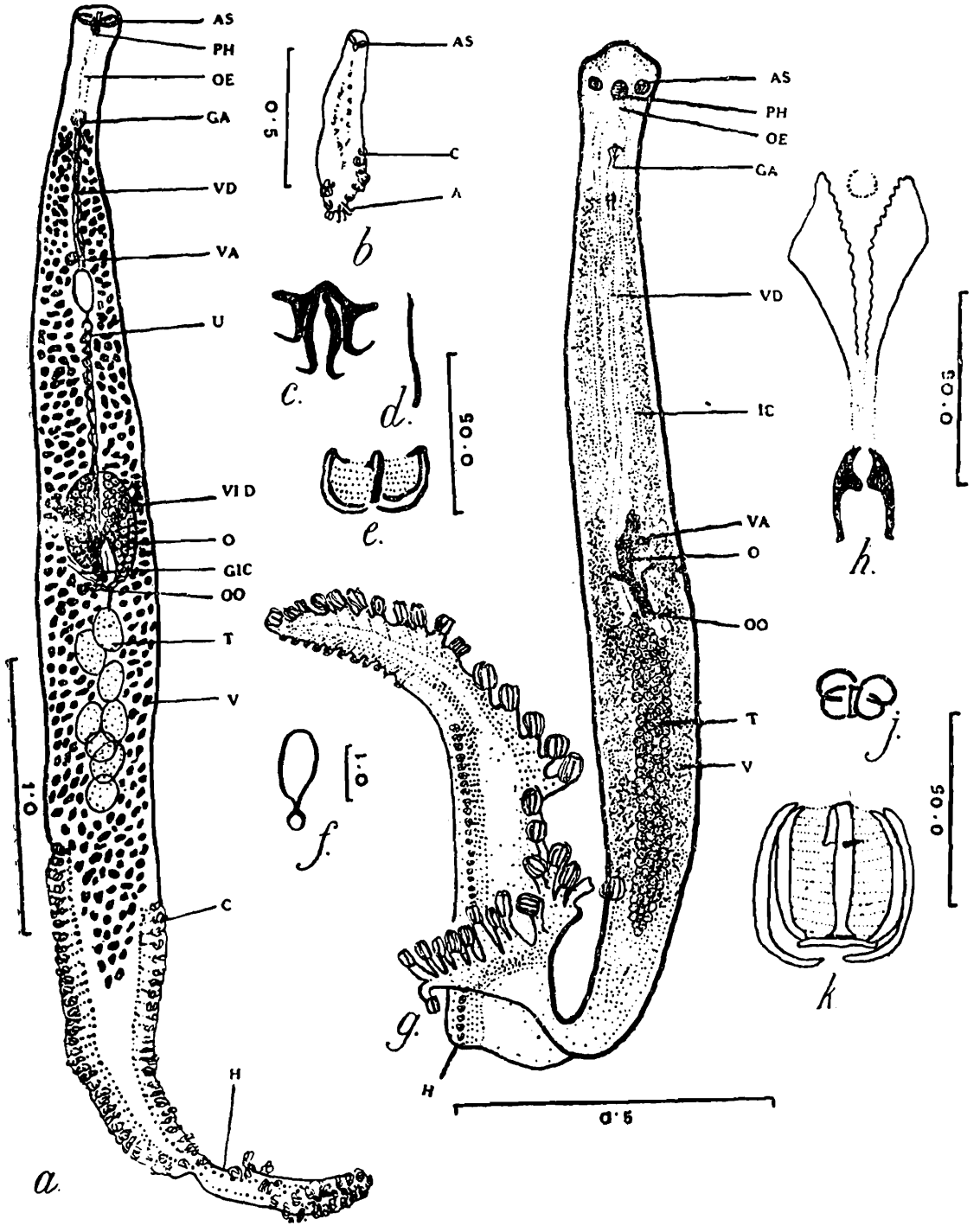
*Measurements.**—Total length, 2·17-5·06 ; breadth, 0·116-0·40, haptor, length 0·26-1·9 ; clamp, width 0·038-0·041 ; anchors, length inner pair 0·045-0·053, outer pair, 0·041 ; anterior sucker, 0·038-0·041 × 0·038-0·066 ; pharynx, 0·03-0·034 × 0·038-0·045 ; cirrus-spine, length 0·038 and 0·015 ; genital atrium diameter, 0·054-0·06 ; vagina diameter 0·038-0·044 ; testis, 0·05×0·07 ; egg, 0·087-0·1×0·152-0·18, egg filament, length 0·07.

Remarks.—This species differs from *M. archosargi*, *M. canthari* *M. labracis*, and *M. polymemi* in having an unequal number of clamps on the two sides of the haptor. All these species belong to the sub-genus *Bispina* (see page 242).

*All measurements in this paper are in millimeters.

Microcotyle polynemi MacCallum, 1917.

This species was obtained from the gills of *Polynemus indicus* and *P. tetradactylum,* obtained from the estuaries of the Matla, Hoogly and Mahanadi rivers, and Chilka lake; but not in specimens of these fish from the sea at Puri. Not more than five specimens were obtained from a single fish, which showed very low frequency of infection as seen in Table I. MacCallum (1917) first described this species from the gills of

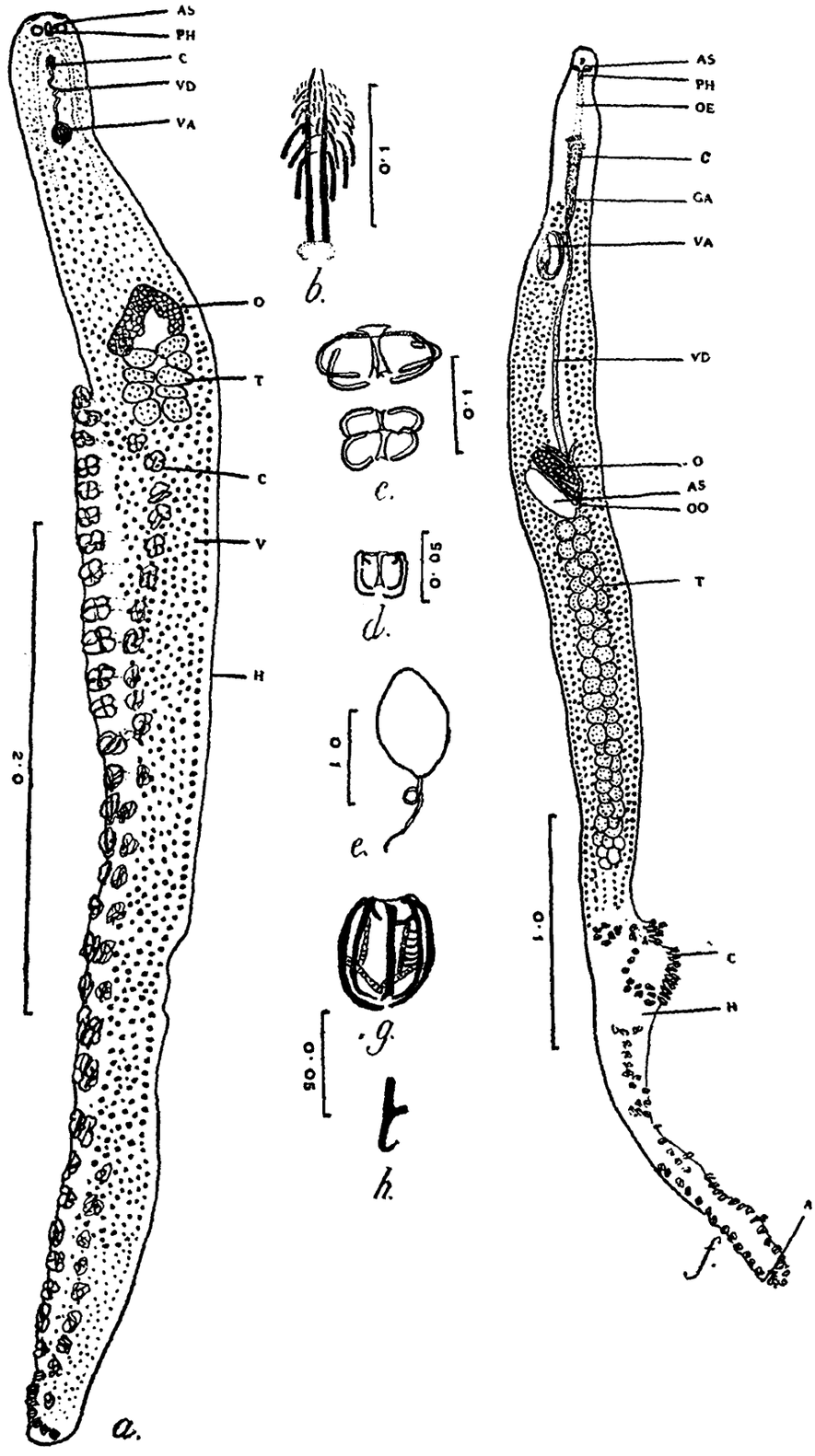


Text-fig. 1.—*Microcotyle pamae,* sp, nov.
(*a*) Complete worm, (*b*) Larval form, (*c*) Anchors of the larva, (*d*) Cirrus spine, (*e*) Clamp, (*f*) Egg.

Text-fig. 1.—*Megamicrocotyle chirocentrus,* gen. *et.* sp. nov.
(*g*) Complete worm, (*h*) Cirrus, (*j*) Smaller clamp, (*k*) Larger clamp.

Polynemus auratus from Batavia.—The present record shows a new host species of the same genus for this parastite, and also extends its geographical distribution.

Measurements of the specimens are given below. MacCallum's data are given in parenthesis.



Text-fig. 2.—*Diplasiocotyle chorinemi*, sp. nov.

(*a*) Complete worm, (*b*) Cirrus spines, (*c*) Larger clamps, (*d*) Smaller clamp, (*e*) Egg.

Text-fig. 2.—*Lithidiocotyle secundus*, sp. nov.

(*f*) Complete worm, (*g*) Clamp, (*h*) Anchor.

Length, 4·9-6·6 (10·0) ; breadth, 0·43-0·45 (1·0) ; haptor length 1·5-2·8 ; clamp, 0·045 × 0·053, 62-60 pairs ; anterior sucker 0·087-0·116×0·043-0·048; pharynx diameter 0·03-0·043 ; cirrus spine length 0·079 ; testis diameter 0·082, 38-50 follicles.

Pathology and breeding.—The two species of *Microcotyle* dealt with above were found in small numbers, not exceeding five, and attached to and between the gill filaments. They feed on the blood of the fish as seen in *M. pamae,* but in no case was there any deterioration in the size or distortion in the form of the gill or any other pathological effect. It is probable, however, that the parasite may increase in number very rapidly if kept in confined waters, to the extent of proving fatal to the fish especially in marine aquaria as reported by Brown (1929), MacCallum (1915, 1918), Nigrelli (1940) and Sproston (1946). No control methods have so far been tried.

The parasites collected in February and March in the river Hoogly were with eggs when the temperature of the water varied between 22-29°C. In *M. polynemi* there were 4-6 eggs in the uterus in the month of April.

Genus **Diplasiocoyle** Sanders, 1944.

Diplasiocotyle chorinemi, sp. nov.

(Text-Fig. 2, a-e.)

Parasite very long, haptor relatively wider and nearly 2-3 times the length of the main part of the body. Anterior end rounded with two semi-lunar suckers at the sides. 32-41 pairs of clamps of which the posterior 6-10 pairs are smaller in size than the anterior ones. Ratio of width of larger to smaller clamps nearly 2·5 : 1. Anchors absent. Anterior suckers spherical. Pharynx oval. Oesophagus short.

Testes 12-16 in number, oval to irregular in shape, situated in the posterior part of the body, extending a little in the haptoral region. Vas deferens stout and sinuous. Genital atrium spinous with two long central spines around which are circles of curved spines. Anterior spines smaller. Ovary convoluted. Vagina unarmed, with muscular dorsal opening. Eggs oval with long coiled filament at the posterior end. Vitellaria follicular extending from the vaginal pore to the end of the haptor.

Measurements.—Total length, 4·7-10·0 ; width, 0·45-0·48 ; haptor 2·46-6·65×0·58-0·81 ; clamp width, larger pair 0·087-0·106, smaller pair 0·034-0·038 ; anterior sucker, 0·022×0·022 ; pharynx, 0·022-0·034 × 0·034-0·041 ; testis, 0·038 ×0·057-0·064 ; cirrus spines : long spine 0·095-0·115, smaller spine 0·02-0·03 ; egg, 0·114-0·125×0·076-0·106 ; egg filament, 0·136-0·152.

Remarks.—This species resembles *D. centrodonti* (Brown) and *D. sargi* (Parona & Perugia) only in the ratio of the width of the clamp, but they differ in other respects. (See Table II.) The small suckers at the anterior end, the very long haptor and the spines of the genital atrium, differentiate the new species from all the other known species of the genus *Diplasiocotyle.*

Genus **Bicotyle** Gen. nov.

Bicotyle stromatea, sp. nov.

(Text-Figs. 3, a-f.)

Body fusiform, anterior quarter of the body long and thin. Haptor triangular, nearly a third of the total length. Two rows of clamps unequal in size and number. Large clamps 10-17 in number on the left side. Anterior clamps bigger than posterior clamps in this row. Smaller clamps 35-40 in number on the right side. Clamps microcotylid in structure.

Anterior suckers spherical, aseptate, on either side of oval muscular pharynx. Oesophagus long and thin bifurcating into intestinal crura in front of genital atrium. Caeca having dark pigment granules. Vitellaria follicular, extending from vaginal pore to the end of haptor.

Testes spherical, many, post ovarial, extending into the haptor. Vas deferens long, thin and sinuous. Genital atrium armed with 12-15 spines, with curved tips, arising from a circular muscular cushion. Ovary long and convoluted, pointing posteriorly. The common vitelline duct and the germi duct join to form the ootype, from which the long uterus proceeds anteriorly. Genito-intestinal canal present. Eggs fusiform, and filamented at both poles. Vaginal opening dorsal, behind the genital pore. Its terminal part surrounded by four long corrugated cuticular plates which give a crinkled appearance to the opening which is surrounded by muscles.

Measurements.—Total length, 6·85-7·84 ; breadth, 1·01-1·96 ; haptor, 2·61-3·26×1·63-1·96 ; anterior sucker, 0·041-0·045 ; pharynx, 0·09-0·1 × 0·152-0·188 ; clamps, left side, anterior 0·174-0·21×0·217-0·29, posterior 0·087×0·087, right side 0·027×0·116 ; testicular mass, 2·04-2·28×1·06 ; cirrus spine, 0·017×0·002 ; vaginal opening, diameter, 0·038.

Generic diagnosis.—Microcotylinae, clamps on either side of the haptor unequal in size and number; genital pore armed with 12-15 spines; vagina armed or unarmed ; testes and vitellaria extending into the haptor ; ovary convoluted.

Type species.—B. stromatea, sp. nov. other species *B. reticulata* (Goto)

Genus **Megamicrocotyle** Gen. nov.

Megamicrocotyle chirccentrus, sp. nov.

(Text-Fig. 1, g-k.)

Body long, anterior end truncate, posteriorly thinner to broaden again at the beginning of the haptor, and tapering at the posterior end. Anchors absent. Clamps unequal in size and number on the two sides. Bigger clamps pedunculate, 26-36 in number ; peduncles in the anterior one-third of the haptor longer than in the posterior part. Clamps typically microcotylid in structure. Smaller clamps sessile, 43-56 in number with their lateral bars more rounded.

Anterior suckers spherical and muscular. Pharynx spherical, situated between the two suckers. Gland cells present near the anterior end of the body. Oesophagus small dividing into two long intestinal crura, extending into the haptor.

Testes globular, 40-58 in number, arranged in three to four longitudinal rows. Vas deferens long and straight, opening in the genital atrium. Base of the atrium with two hooks, and the distal end with four cuticular triangular structures undulated on the inner margin. Genital pore circular. Ovary long, recurved and tapering at the posterior end. Germiduct anteriorly curved and joining with the common vitelline duct. Vagina small, unarmed, surrounded by circular muscle fibres, and opening dorsally lateral to the ovary. Receptaculum seminis small and spherical. Eggs elliptical, drawn into filaments at both poles. Vitellaria extending from the cirrus to the haptor.

Measurements.—Total length, 2·05-2·4 ; breadth, 0·11-0·145 ; haptor 0·065-1·04×0·33 ; pharynx, diameter 0·019 ; anterior sucker, diameter 0·019 ; clamps, large 0·03-0·034×0·038-0·041, small 0·0076×0·015-0·019 genital atrial hook, 0·022 long ; egg, 0·10×0·076 ; egg filament, 0·114.

Generic diagnosis.—Microcotylinae, with two types of clamps, one larger and pedunculate on right side, and the other small and sessile on the left side. Basic structure of the clamp microcotylid in type. Genital atrium with two curved hooks and four triangular undulated plates. Testes spherical, 40-58 in number. Ovary convoluted. Vagina unarmed. situated in the ovarian region. Anterior suckers spherical. Anchors absent.

Type species *M. chirocentrus*, sp. nov. (only species).

Sub-family : *GASTROCOTYLINAE* Sproston, 1946.

Genus **Thoracocotyle** MacCallum, 1913.

Thoracocotyle ovale, sp. nov.

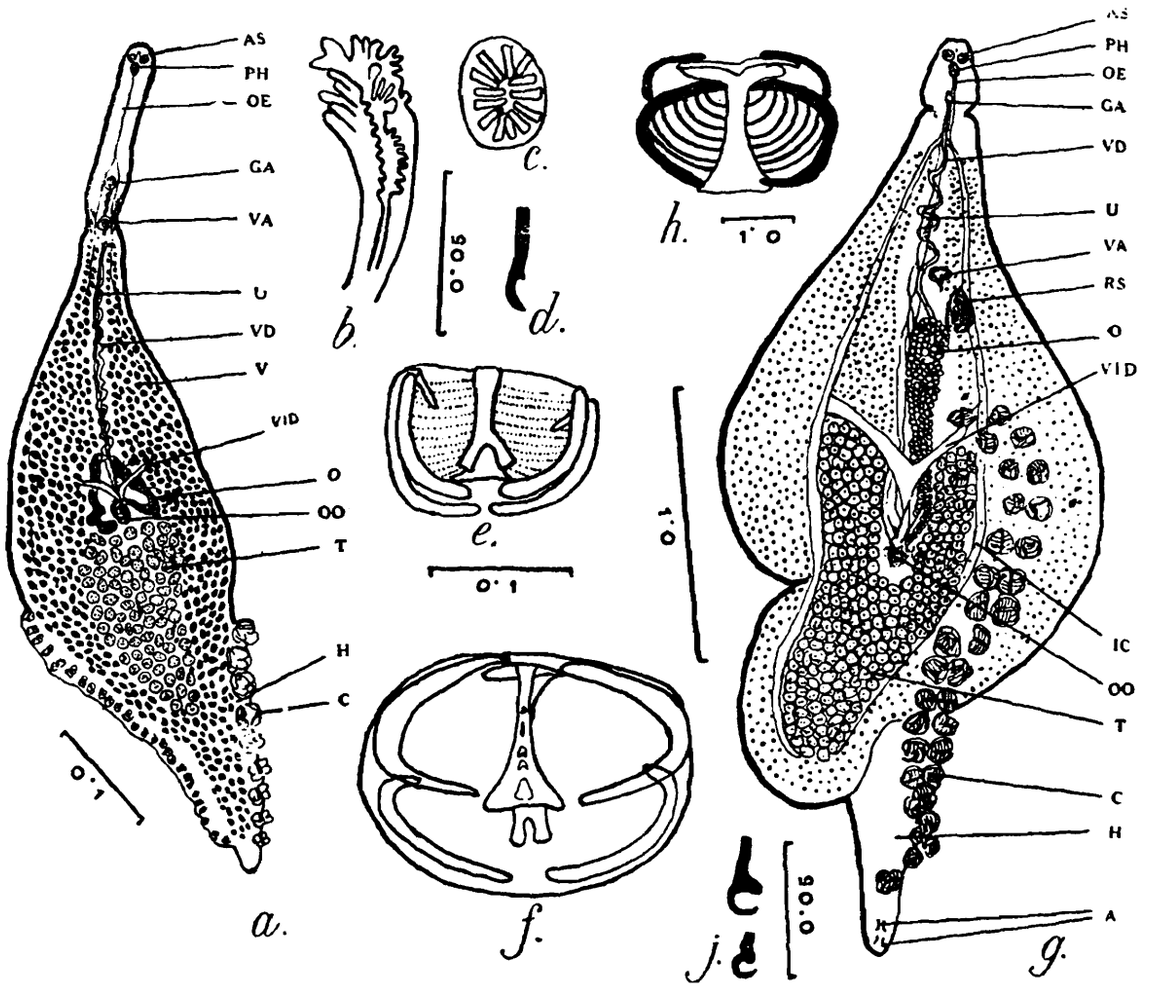
(Text-Fig. 3, g, h & j.)

Body oval, anterior portion cylindrical. Haptor elliptical with 16-19 pairs of clamps extending up to the ovary. Two pairs of sickle shaped anchors at the posterior end, the anterior pair being the longer. Circular anterior suckers with oval pharynx behind them. Oesophagus long, bifurcating into two intestinal crura a little behind the genital opening. 13-20 pairs of clamps, consisting of a longer dorsal and a more curved ventral pair of lateral arcuate bars. Middle-piece anchor shaped. Ventral wall of clamp capsule with 7-8 pairs of curved thickenings. The middle pairs of clamps being bigger than anterior or posterior pairs.

Testes spherical, inter-crural and numerous. Vas deferens long and sinuous, opening into the pyriform muscular cirrus. Genital opening cuticularized. Ovary long and curved, tapering posteriorly at its junction with the common vitelline duct. Uterus long and straight with 3-8 fusiform filamented eggs. Vaginal opening muscular and

anterior to the ovary. Receptaculum seminis oval, on the outer side of the anterior part of the ovary. Vitellaria extra-crural and not extending into the haptor.

Measurements.—Total length, 2·47-4·45 ; breadth, 0·43-2·03 ; haptor length, 1·26-3·19 ; clamps, anterior and posterior pairs, width 0·072-0·095, middle pair width 0·114-0·145 ; anchors length, anterior pair 0·022, posterior pair 0·015 ; anterior sucker, diameter 0·03-0·041 ; pharynx, 0·026-0·038×0·038-0·057 ; testis diameter, 0·072-0·145 ; receptaculum seminis, 0·116-0·145×0·217 ; cirrus, length 0·038 ; egg, 0·11–×0·045 egg filament, 0·19 and 0·133.



Text-fig. 3.—*Bicotyle stromatei*, gen. *et.* sp. nov.
(*a*) Complete worm, (*b*) Vagina, side view, (*c*) Cirrus, (*d*) Cirrus hook, (*e*) Smaller clamp, (*f*) Larger clamp.

Text-fig. 3.—*Thoracocotyle ovale* sp. nov.
(*g*) Complete worm (*h*) Clamp, (*j*) Anchors.

Remarks.—This species resembles *T crocea* MacCallum, 1913 in the number and structure of the clamps, but differs in the position of the genital organs. The haptor extends anteriorly beyond the ovary in *T crocea*, but in the new species it ends at the middle of the ovary. From *T. coryphaenae* Yamaguti, 1938, it differs in the number of clamps, testes and the shape of the body. *T. paradoxina* Meserve, 1938 has only 28 pairs of clamps and the haptor is laterally extended.

Four species of *Thoracocotyle* are now known including the one described here.

Genus **Lithidiocotyle** Sproston, 1946.

Lithidiocotyle secundus, sp. nov.

(Text-Fig. 2, f-h.)

Body of parasite long and thin, tapering at both ends, greatest width being in the ovarian region. Haptor about one third of the total length with 50-55 pairs of pedunculated clamps, and a pair of clamps at the posterior end. Clamp with two pairs of lateral curved bars and a middle piece in addition to four accessory bars, two of which are oblique and the other two vertical. Six rib-like thickenings between the middle-piece and the outer bars, which are present on one side only.

Anterior suckers oval and bilocular. Pharynx small and oval. Oesophagus bifurcating into intestinal crura in front of the cirrus. Crura without caeca, extending into haptor.

Testes, 48-60 spherical masses situated in the posterior half of the body without extending into haptor. Vas deferens long and sinuous, opening at the base of spiny eversible cirrus. Cirrus spines numerous, long and curved at the tip. Ovary curved and lateral with, oval receptaculum seminis behind it. Ootype posterior to ovary. Uterus long and dorsal to vas deferens. Vaginal opening oval surrounded by circular muscle fibres, lateral or central in position. Vitelline follicles lateral, extending from behind the cirrus to the beginning of the haptor.

Measurements.—Total length, 2·175-3·963 ; breadth, 0·145-0·377 ; haptor, 0·899-1·711 × 0·145-0·29 ; clamp, 0·06×0·03-0·038 ; anchor, total length 0·03-0·041, root 0·019, point 0·007-0·011 ; anterior sucker, 0·034-0·038×0·019-0·026 ; pharynx, 0·034-0·038×0·038 ; testis, 0·057-0·068×0·053-0·076 ; ovary, 0·21×0·07 ; cirrus, 0·114-0·152×0·03 ; cirrus spine, 0·022 long ; vagina, 0·045-0·083×0·03-0·07 ; vagina from anterior end, 0·507-1·16.

Remarks.—This species differs from *L. acanthophallus* (MacCallum & MacCallum, 1913), the only other species of the genus, in the structure of the accessory piece of the clamp, the presence of anchors on the haptor, and in the smaller size of the body and the oral sucker.

TAXONOMIC POSITION OF THE GENERA

The family Microcotylidae was created by Taschenberg (1879) to include *Microcotyle*, *Axine*, *Aspidogaster* and *Cotylapsis*. Monticelli (1892) divided the family into Microcotylinae for *Microcotyle*, and Axiniae for *Axine*, *Pseudaxine* and *Gastrocotyle*. Price (1943) placed *Gastrocotyle* in a new family Gastrocotylidae, and included it along with Microcotylidae in the super-family Diclidophoroidea. Sproston (1946) reduced Gastrocotylidae to sub-family status in Microcotylidae and placed *Axine* and its allies under Micocotylinae.

The sub-family Microcotylinae is here confined only to those genera in which the haptor is bilaterally symmetrical or asymmetrical and the morphological posterior end is at the posterior end of the body.

Axine, Hetraxine and *Axinoides* are placed in the sub-family Axininae Monticelli, 1892 which is revived here because of the morphological differences between the haptors of *Microcotyle* and *Axine.*

Sproston (1946) included the following genera in the sub-family Microcotylinae (besides the three genera now placed in *Axininae*)—*Pyragraphorus, Cemocotyle, Microcotyle, Gotocotyla,* and *Lintaxine. Microcotyloides, Gonoplasius* and *Diplasiocotyle* were placed as addenda to *Microcotyle.* I have now added two new genera *Bicotyle* and *Megamicrocotyle.* The inter-relationship of these genera is discussed, and a key for their identification is given below.

Pyragraphorus Sproston, 1946 and *Cemocotyle* Sproston, 1946 have some clamps modified in which the sclerites are elongated, and not curved as in other genera. *Gonoplasius* Sanders, 1944 is made synonymus with *Microcotyle,* because the former differs from the latter only in possessing the gland cells in the buccal region, a character which is not of any generic importance. *Gotocotyla* Ishi, 1936 retains anchors in the adult stage. *Microcotyloides* Fuji, 1944 is characterised by the presence of prostatic bulb in connection with the male genitalia.

In the above genera the haptor is bilaterally symmetrical and the clamps are of the same size. *Diplasiocotyle* Sanders, 1944 is similar to *Microcotyle* in all characters except that the clamps decrease or increase in size antero-posteriorly. *Microcotyle centrodonti, M. sargi* and *M. sebastis* have the anterior pair of clamps bigger than the posterior pair as in *Diplasiocotyle johnstoni* Sanders. In *M. macroura* and *M. trachini* the median pair of clamps are bigger than the anterior or the posterior pairs. Because of the similarity of the haptor of these species of *Microcotyle* to *Diplasiocotyle* they are transferred to the latter genus. The number and size of the clamps and the nature of the genital atrium and the vagina are given in Table II.

TABLE II.

Species.	Genital atrium.	Vagina.	No. of clamps.	Width of clamps in microns size.	Ratio of clamp.
D. centrodonti (Brown, 1929)	unarmed	unarmed	63—80	80 & 30	2·6
D. chorinemi sp. nov.	armed	unarmed	32—42	87—95 & 34—38	·25
D. johnstoni (Sanders, 1944)	armed	unarmed	8—10	375—425 & 25	17·48
D. macroura (MacCallum & MacCallum, 1913).	unarmed	unarmed	25	120, 330 40	8·5
D. sargi (Par. & Per., 1889)	armed	armed	60—70	78 & 28	2·7
D. sebastis (Goto, 1894)	armed	unarmed	29—31	128 & 68	1·8
D. trachini (Par. & Per. 1889)	unarmed	unarmed	8—10	126 & 42	3·0

In *Bicotyle* the haptor is symmetrical but the clamps on the two sides are unequal in number and size, due to their unequal growth-potentials. *Microcotyle reticulata* Goto, 1894, found on *Stromateus argentius* in Japan,

is also transferred to this genus. It has 23 clamps on one side and 42 clamps on the other side, but the vagina is unarmed. Now there are two species under *Bicotyle* which differ from one another in the size and number of their clamps.

The asymmetry in the growth of the clamps as seen in *Bicotyle* goes a step further in *Megamicrocotyle*, where the haptor is also asymmetrical, and the vagina is situated near the ovary, unlike the other genera, in which it is near the genital atrium.

Lintaxine Sproston, 1946, is not recognised here and is placed as *gen. inq.* in Microcotylinae.

Microcotyle is now left with only those species in which the clamps are equal in size. In only seven species is the number of clamps on the two sides unequal. They are, *M. carangis* (syn. *Gonoplasius carangis* Sanders), *M. caudata*, *M. heteracantha*, *M. pamae*, *M. sciaenae*, *M. scorpis* and *M. seriola*. All the species of *Microcotyle* are divided into sub-genera based on the characters of the cirrus and vagina. Eighteen species could not be included in these sub-genera because of inadequate descriptions.

I. *Microcotyle* sub-genus nov.—Cirrus armed, vagina unarmed. It includes the following species :—

M. aigoi Ishii & Sawada, 1938.

M. angelichthys MacCallum, 1913.

M. a. townsendi MacCallum, 1916.

M. bassensis Murray, 1931.

M. branchiostegi Yamaguti, 1937.

M. caudata Goto, 1894.

M. centropristes MacCallum, 1915.

M. cephalus Azim, 1937.

M. cepolae Yamaguti, 1937.

M. chiri Goto, 1894.

M. chrysophryi van Beneden & Hesse, 1863.

M. ditrematis Yamaguti, 1940.

M. donavani van Beneden & Hesse, 1863.

M. elegans Goto, 1894.

M. eriensis Bengham & Hunter, 1936.

M. erythrini van Beneden & Hesse, 1863.

M. furcata Linton, 1940.

M. fusiformis Goto, 1894.

M. gotoi Yamaguti 1934.

M. heteracantha Manter, 1938.

M. hiatulae Goto, 1899.

M. inada Ishii & Sawada, 1938.

M. longicauda Goto, 1899.

M. mormyri Lorenz, 1878.

M. mouwoi Ishii & Sawada, 1938.

M. mugilis Vogt, 1878.

M. pomacanthi MacCallum, 1915.

M. pomatomi Goto, 1899.

M. poronoti MacCallum, 1915.

M. priacanthi Meserve, 1938.

M. salpae Par. & Per., 1890.

M. sciaenae Goto, 1894.

M. spinicirrus MacCallum, 1918.

M. stenotomi Goto, 1899.

M. suzuki Ishii & Sawada, 1938.

M. tanago Yamaguti, 1940.

M. toba Ishii & Sawada, 1938.

M. truncata Goto, 1894.

M. victoriae Woolcock, 1936.

II. *Bispina* sub-genus nov.—Cirrus and vagina armed.

It includes the following species :—

M. archosargi MacCallum, 1913.
M. canthari van Beneden & Hesse, 1863.
M. labracis van Beneden & Hesse, 1863.
M. polynemi MacCallum, 1917.
M. pamae sp. nov.

III. *Vaginaespina* sub-genus nov.—Cirrus unarmed, vagina armed.

It includes the following species :—

M. alcedinis Par. & Per., 1890.
M. baumi Sprehn, 1929.
M. ichimidai Ishii & Sawada, 1938.
M. pagrosomi Murray, 1931.

IV. *Aspina* sub-genus nov.—Cirrus and vagina unarmed.

It includes the following species :—

M. acanthogobii Yamaguti, 1940.
M. australis Murray, 1931.
M. pogoniae MacCallum, 1913.
M. sciaenicola Murray, 1932.
M. seriolae Yamaguti, 1940.
M. sillaginae Woolcock, 1936.
M. spari Yamaguti, 1937.
M. tai Yamaguti, 1938.
M. virgatarum Tubangui, 1931.

In the following species the cirrus is armed, but no information about the vagina is given :—

M. agnostomi Sanders, 1945.
M. arripis Sanders, 1945.
M. australiensis MacCallum, 1921.
M. carangis (Sanders, 1944).
M. eueides MacCallum & MacCallum, 1913.
M. helotes Sanders, 1944.
M. odacis Sanders, 1945.
M. aparasillaginae Sanders, 1945.
M. pentapodi Sanders, 1944.
M. pancerii Sonsino, 1891.
M. scorpis Sanders, 1944.
M. temnodontis Sanders, 1945.

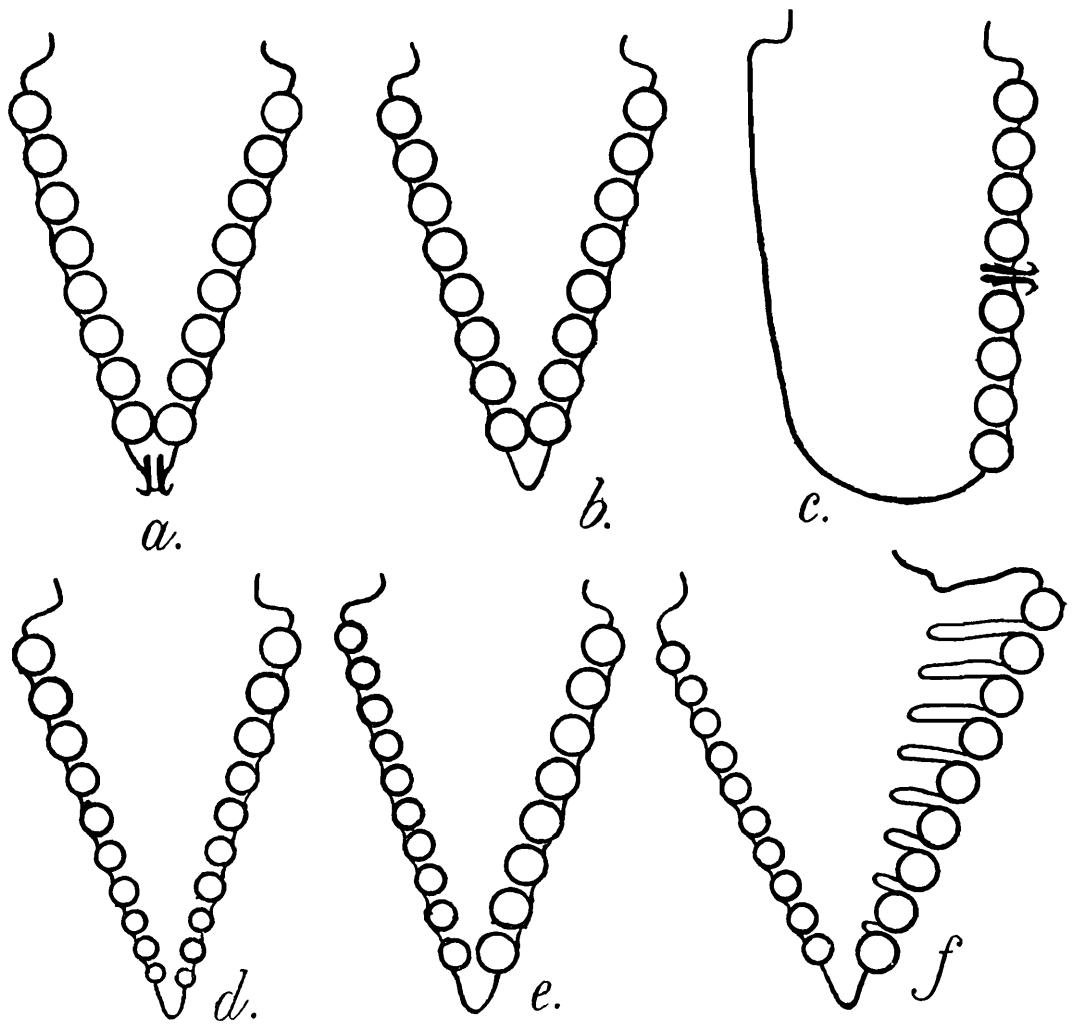
M. gerres Sanders, 1944 : has armed cirrus but no information is given about the vagina.

No information about the cirrus or vagina is given for the following species :—

M. atrynetri Pearse, 1951.
M. draconsis Briot, 1904.
M. incomparabilis MacCallum, 1917.
M. peprili Pearse, 1951.
M. lichiae Ariola, 1899.

In conclusion, it may be stated that there is a graded asymmetry of the clamps and the haptor, from the basic Microcotylid pattern, in

which *Gotocotyla* represents the primitive form. The probable relationships of the various genera of Microcotylinae are given in Text Fig. 4, and a key to their identification is given below :



Text-fig. 4.—Diagrammatic arrangement of the clamps on the haptor of (*a*) *Gotocotyla*, (*b*) *Microcotyle*, (*c*) *Axine*, (*d*) *Diplasiocotyle*, (*e*) *Bicotyle*, (*f*) *Megamicrocotyle*.

Key to the genera of Microcotylinae.

1. Outer sclerites of the clamps elongated or modified.	2.
1. Clamp sclerites of normal pattern	3.
2. Haptor bifid and set off from the body, anchors absent.	*Pyragraphorus* Sproston, 1946.
2. Unilateral extension of haptor bearing modified clamps, anchors present.	*Cemocotyle* Sproston, 1946.
3. Clamps of equal size on either side of haptor	4.
3. Clamps unequal in size	6.
4. Vagina mid-dorsal	5.
4. Vagina opening laterally on right margin	*Microcotyloides* Fujii, 1944.
5. Anchors absent in adult	*Microcotyle* van Beneden & Hesse, 1863.
5. Anchors present in adult	*Gotocotyla* Ishii, 1936.
6. Clamps decrease in size antero-posteriorly, haptor symmetrical.	*Diplasiocotyle* Sanders, 1944.
6. Clamps on one side smaller than on the other, haptor symmetrical.	*Bicotyle* gen. nov.
6. Clamps on one side smaller than on the other, hapter asymmetrical.	*Megemicrocotyle* gen. nov.

The sub-family Gastrocotylinae contains *Gastrocotyle* van Beneden & Hesse, 1963, *Pseudaxine* Par. & Per., 1890, *Thoracocotyle* MacCallum, 1913, *Lithidiocotyle* Sproston, 1946, and *Pricea* Chauhan, 1945. Sproston (1946) separated *Lithidiocotyle* and *Pricea* on the basis of the absence of anchors in the former genus and the presence of the body hooks in the latter genus. But anchors are present in *L. secundus*, sp. nov. and the body hooks are not present in all the species of *Pricea* (Ramlingam, 1952). In view of the above, the following characters are suggested to differentiate the two genera. In *Lithidiocotyle* the cirrus is long with many spines and the vagina is smooth, whereas in *Pricea* the cirrus has 10-15 spines only and the vagina has a U shaped spine at its base.

Sanders (1947) has described a new genus *Pseudomicrocotyle* and placed it in Microcotylidae, without assigning it to any subfamily. The clamp has three main pieces hooked at the distal end and five accessory sclerites. To one of the main pieces "eight closely set hooklets are attached" These are similar to the rib-like thickenings in the clamp capsule of *Thoracocotyle*, *Pricea* and *Lithidiocotyle*. The clamp is formed on the Gastrocotylid pattern. A pair of anchors is also present at the end of the haptor. These characters assign the genus to *Gastrocotylinae*.

Summary.

Six new species and two new genera of the family Microcotylidae are described. They are, *Microcotyle pamae*, sp. nov., *Diplasiocotyle chorinemi*, sp. nov., *Bicotyle stromatea*, Gen. et. sp. nov., *Megamicrocotyle chirocentrus*, Gen. et. sp. nov., *Thoracocotyle ovale*, sp. nov., and *Lithidiocotyle secundus*, sp. nov. *Microcotyle polynemi* MacCallum, 1917 is recorded from a new host.

The sub-family Axininae Monticelli, 1892 is revised to include *Axine*.

The species of Microcotyle are divided in four new sub-genera ; *Microcytyle*, *Bispina*, *Vaginaespina*, and *Aspina*.

Pseudomicrocotyle Sanders, 1944 is placed in the sub-family Gastrocotylinae.

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Key to lettering :—

A—Anchor.	OO—Ootype.
AS—Anterior sucker.	PH—Pharynx.
C—Clamp.	RS—Receptaculum seminis.
GA—Genital aperture.	T—Testis.
GIC—Genito-intestinal canal.	U—Uterus.
H—Haptor.	V—Vitellaria.
IC—Intestinal caeca.	VA—Vagina.
O—Ovary.	VD—Vas deferens.
OE—Oesophagus.	VID—Vitellineduct.

The scales along with the figures are in millimeters.

ON A NEW SPECIES OF MARINE LEECH OF THE GENUS *BRANCHELLION* (FAMILY ICHTHYOBDELLIDÆ), FROM THE INDIAN COAST.

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INTRODUCTION.

The genus *Branchellion* Savigny (1822) has not been hitherto recorded from the Indian seas although it has been reported from various parts of the Atlantic Ocean (Johnston 1865, Holt 1907, Leigh-Sharpe 1933a and Meyer 1941), the Mediterranean Sea ((Leigh-Sharpe 1933b), and from the Pacific Coast of Australia (Baird 1869, MacDonald 1877, Leigh-Sharpe 1916, and Richardson 1949). Harding (1927), however, anticipated its possible occurrence on the Indian coast and hence included in the *Fauna of British India* a brief diagnosis of the genus. More recently, Moore (1944) described a specimen of *Branchellion* (*B. torpedinis* Harding), from the British Museum, reported to have been collected by J. Hornell on July 10, 1936 from a marbled Torpedo Ray, from the Assumption Island (Lat. 9·44 S; Long. 46·30E), which is at least 2,300 miles from Cape Comorin. Hornell's specimen, being the only record of *Branchellion*, from anywhere near India, its present record from the Madras coast thus represents the first actual record of the genus from India.

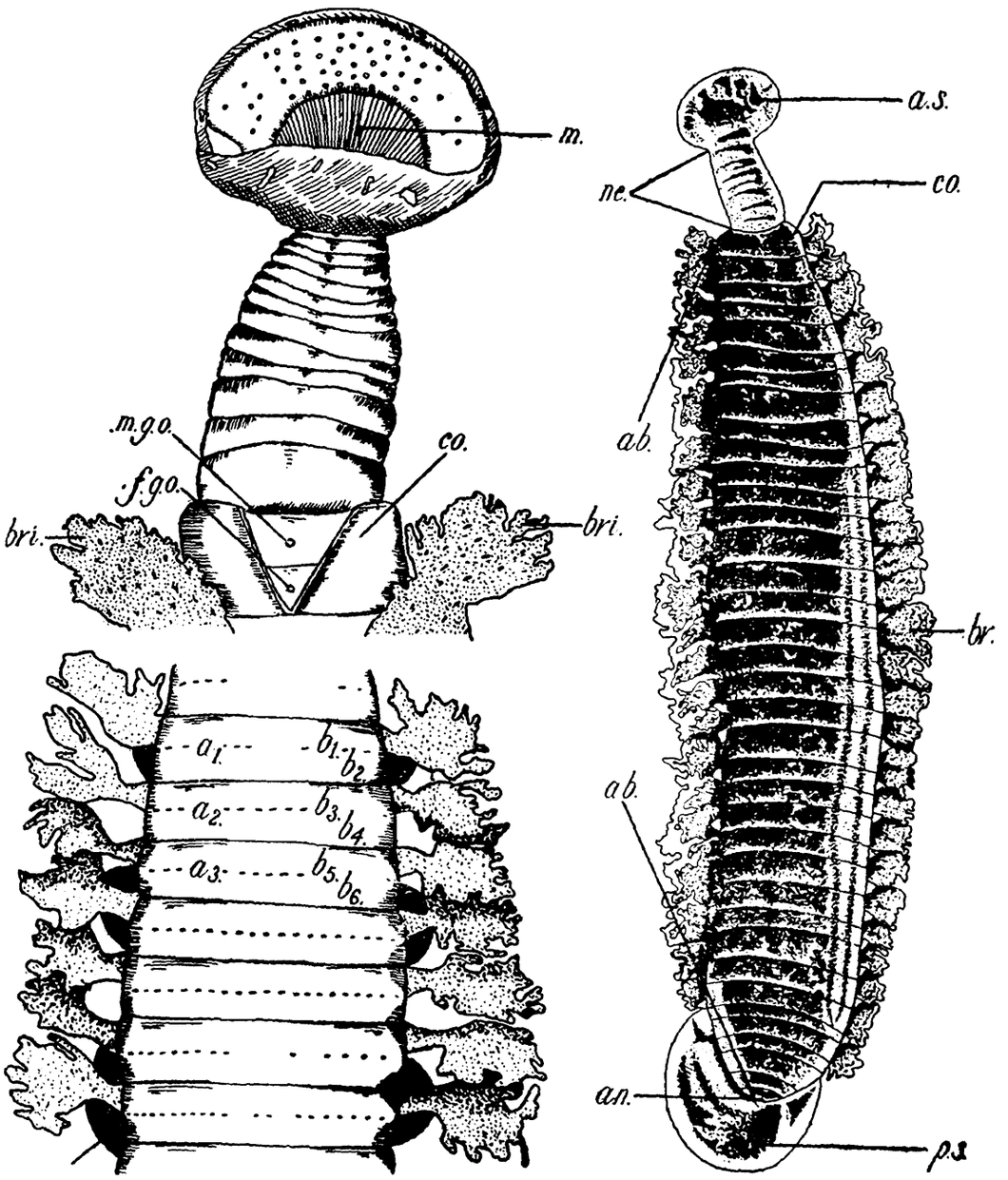
A single specimen of *Branchellion* was kindly given to me by my colleague, Mr. G. J. Phanuel, who collected it on 28th December 1952, from a fisherman's basket in which fish were brought from the coast to the fishmarket at Royapuram, Madras. It is usual for one to find in the unloaded fish basket, or near it, specimens of molluscs, and fish either damaged, or too small for consumption, and this specimen of leech was found along with such refuse. Therefore, its host is unknown. It is in an undamaged condition and in the preservative it has retained its normal form, without shrinkage. In its diagnosis, it differs considerably from the known members of the genus *Branchellion*, and hence it is described here as a new species *Branchellion plicusbranchus* sp. nov.[1]

Branchellion plicusbranchus, sp. nov.

The preserved specimen measures 64 m.m. in length with a maximum width of 15·5 m. including the branchiae. The body (Text-Fig. 1) is divisible into a narrow anterior neck, bearing a sucker at its anterior extremity, and a posterior broad branchiate abdomen terminating in a larger posterior sucker. The abdomen is distinctly annulated, more conspicuously so on the ventral side.

[1] Since writing this paper Dr. P. N. Ganapathy, Andhra University, kindly forwarded a specimen of *Branchellion* collected by him in May 1952, from the nostril of *Carcharias* from Lawson's Bay, Vizagapatam. His specimen of *Branchellion* resembles the present specimen described in all features excep in size, for it measures only 37 mm. in length and 8 mm. in breadth.

Neck.—(Text-Fig. 1, *top left*) is only about one-tenth of the whole length of the body, slightly broader and more cylindrical posteriorly, where on the ventral side the genital openings are situated on segments XI and XII, constituting the clitellum. The anterior sucker which is smaller than the posterior sucker is oval in shape, elongated transversely and is directed ventrally. No eyes are visible either on the surface



TEXT-FIG. 1.—*Branchellion plicusbranchus*, sp. nov.

RIGHT : Dorsal view (viewed slightly from the left) × 1⅔ ; LEFT TOP : Ventral view of anterior region × 5 ; LEFT BOTTOM : Branchiae and pulsating vesicles of two adjacent segments enlarged (diagrammatic).

$a.^1$—$a.^5$, primary annuli ; *ab.*, abdomen ; *an.*, anus ; *as.*, anterior sucker, b^1—b^5., secondary annuli ; *br.*, branchia ; br^1., first branchia ; *co.*, collar (preputial fold) ; *f.g.o.*, female genital opening ; *m.* mouth ; *m.g.o.*, male genital opening ; *n.e.*, neck ; *p.s.*, posterior sucker ; *p. v.*, pulsating vesicles.

of the anterior sucker or on the neck, although Harding (1910) reported six eyespots anteriodorsally on the sucker. Probably they are merged with the dark mottling pattern of the anterior sucker. Since there is only one specimen, no microscopic preparations could be made to

verify this point. Ventrally the anterior sucker bears the small transverse slit like mouth opening towards the posterior end of the sucker.

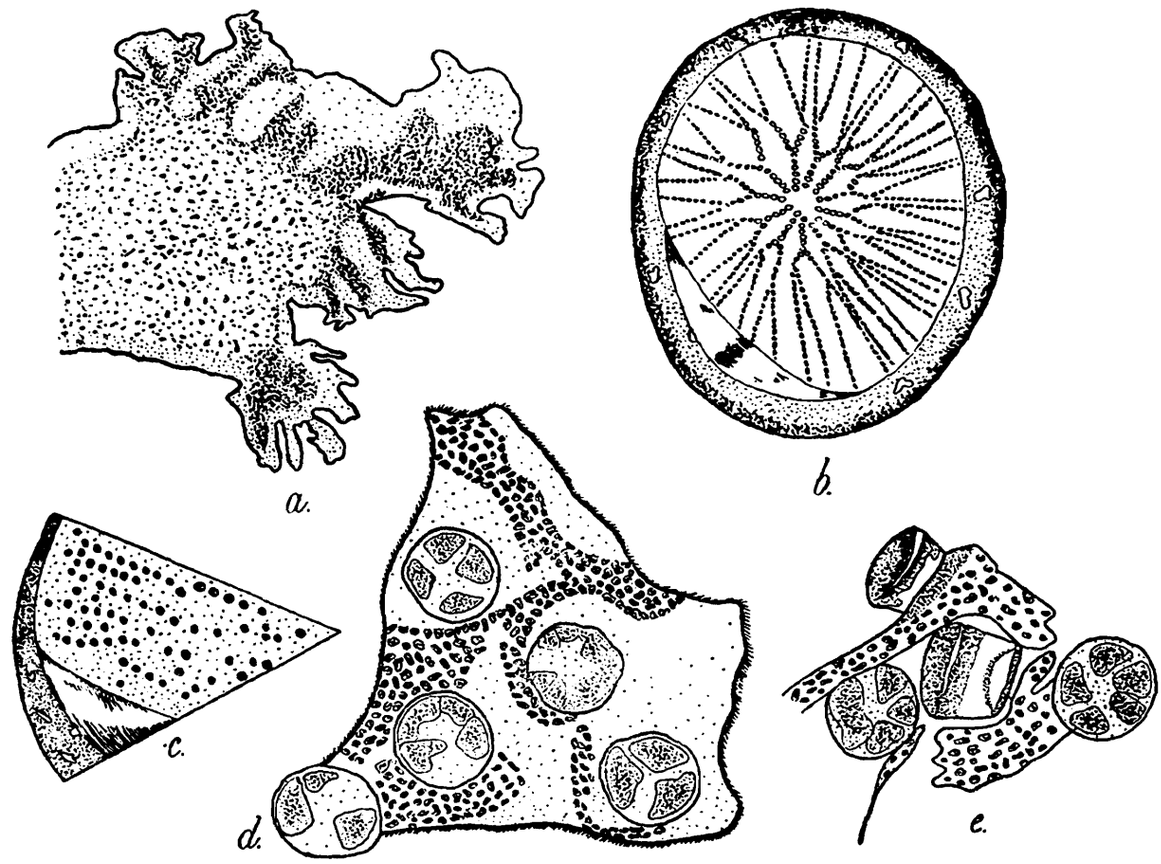
Abdomen is convex dorsally and flat ventrally. It is composed of 14 segments, all of which carry branchiae at the sides excepting the first and the last three segments. The first segment of the abdomen (segment XIII) forms a sort of conspicuous collar ("Preputial fold"; Apathy 1888), covering the last two segments, *i.e.*, XI and XII of the clitellum and bearing the genital openings ventrally. The skin is smooth and even, without any warts. Arising from the branchial stems, at regular intervals, some of the branchiae carry swollen projections at their bases, a feature also noticed in all other species of *Branchellion* and in species of *Piscicola*, etc. These are termed the pulsating vesicles of which there are eleven pairs noticeable in the specimen. The anus is situated mid-dorsally at the junction of segment XXV and XXVI.

Posteriorly the abdomen terminates in a large and ventrally directed sucker. The characteristic caudal papillae of the genus *Branchellion* are found in the posterior sucker of this specimen also. (Text-Fig. 2*b*). These papillae are mere outgrowths of the membrane lining the interior of the posterior sucker, which is continuous round the rim of the sucker with the outermost layer of bodywall, the mucous epithelium. The cellular structure and pattern are the same on this membrane lining the sucker, as on the epithelium lining the general surface of the body. These outgrowths are shaped (Text-Fig. 2*d* and 2*e*) like the adhesive pads or low suckers, but it is difficult to understand how these could function inside a large powerful and concave sucker. The papillae along the rim or the periphery of the sucker are smaller and more numerous and are densely packed than those at the centre. In the centre, the papillae are distributed sparsely in rows radiating from the centre to the periphery. By branching twice dichotomously, each radial row from the centre ends in four rows. Thus the papillae at the periphery are not only numerous but also more closely packed (Text-Fig. 2*c*). There are at least twelve radial rows at the centre.

Colouration.—In the preserved state, dorsally the anterior sucker is pale black in colour, with small yellowish streaks. The neck also is pale black with narrow transverse yellowish white streaks corresponding to the interannular regions. Abdomen and posterior sucker are deep dark dorsally, with white streaks here and there, but ventrally it is pale and all the annuli are clearly seen. The posterior sucker is flesh coloured in the interior. The branchiae are as dark as the dorsal side of the abdomen. The white spots and streaks of the abdomen extend to the branchiae also in different places. The pulsating vesicles are transparent.

Segmentation and annulation.—The whole body, as in all leeches, is composed of 34 segments. The exact number of annuli in each segment in the neck region is difficult to determine, but the total number of annuli in the whole neck region is 16. The genital openings are situated on the ventral side of the 15th and 16th annuli. These two annuli are covered over by the collar. The first annulus of the neck is very narrow and is merged with the anterior sucker.

In the abdominal region there are 38 annuli, and are grouped into distinct segments. In the branchiate region, *i.e.* from segment XIV—XXIV, there are 3 pairs of branchiae on each segment. This region shows on the dorsal side, grooves indicating biannulation, thereby showing 6 annuli for each segment. (Text-Fig. 1, *left bottom*). However, ventrally this biannulation is absent, but each segment presents only 3 primary annuli. In front of this branchiate region segment XIII presents a collar, the inner fold of which is represented by the anterior annulus and the outer by the posterior. Behind the last branchia, there are 5 annuli belonging to 3 segments, *i.e.* XXV, XXVI and XXVII, each having two annuli, excepting the last which has only a single annulus.



TEXT-FIG. 2.—*Branchellion plicusbranchus*, sp. nov.

(*a*). A single branchia viewed from anterior side to show the frilled edge×5 ; (*b*). diagrammatic ventral view of posterior sucker enlarged ; (*c*). a section of the interior of the same showing papillae×5 ; (*d*). inner membraneous lining bearing papillae×42⅔ ; (*e*). side view of papillae ×42⅔.

The branchiae.—There are thirty three pairs of branchiae symmetrically arranged at the sides of the abdomen, extending between the segments XIV and XXIV Each segment being triannulate carries a pair of branchiae on each primary annulus. Each branchia (Text-Fig. 2*a*) is plate like, attached to the primary annulus proximally, at right angles to the long axis of the body. Each branchia has a broad almost squarish proximal region, the anterior and lateral ends of which are folded. Each of these folds is further frilled at the edges. All these frills being in the same plane many of these ultimate frills overlap, and the outline is irrigular, and deeply furrowed. The proximal part of the branchia

which may correspond to a stem, in its attachment to the side of the primary annulus is strictly confined to the anterior half of each primary annulus. The maximum length of each branchia is 3 m.m. and the maximum width is 10 m.m.

The *pulsating vesicles.*—(Text-Fig. 1, *left bottom*). The branchiae of primary annulus of each segment is at its base provided with the pulsating vesicles. They are eleven pairs. The first two pairs differ from the others in that the vesicle is found only on the posterior aspect of the branchial stem, whereas in others it is found that the pulsating vesicle bulges on both the anterior and posterior aspects of the branchial stem. The last one is also slightly different in being too small as to almost become inconspicuous, though it is found on both sides of the branchial stem. Whether this shrinkage in size is natural or an artificial is difficult to say. The fusion of the pulsating vesicles is not flush with the dorsolateral edge of the abdomen, but on the ventrolateral edge, they bulge and therefore are more clear on the ventral side rather than on the dorsal.

Measurements of the Holotype preserved in alcohol :—

1. Length of the leech (from the anterior end of the anterior sucker to the posterior end of the posterior sucker)	64·0 m.m.
2. Length of anterior sucker	4·5 m.m.
3. Maximum width of anterior sucker	6·0 m.m.
4. Length of neck	5·5 m.m.
5. Maximum width of neck	4·0 m.m.
6. Length of abdomen (including posterior sucker)	54·0 m.m.
7. Maximum width of abdomen (excluding branchiae)	10·0 m.m.
8. Maximum width of abdomen (including branchiae)	15·5 m.m.
9. Maximum length of branchia	3·0 m.m.
10. Diameter of posterior sucker	10·0 m.m.
11. Maximum depth of the body	5·0 m.m.

Type-specimen.—Holotype, No. W 3859/1, Zoological Survey of India, Calcutta.

DISCUSSION.

The new species of *Branchellion* described in this paper is the largest recorded so far. The colouration consists of white spots and streaks scattered irregularly on a dark background unlike the regular longitudinal rows of white spots on the first annulus of each segment described in *B. borealis* (Leigh-Sharpe, 1916) and *B. torpedinis* (Harding, 1910). The eyes are not visible in this specimen although they have been described in other species like *B. torpedinis* (Harding 1910). No warts are observed on the surface of the body as are seen in *B. borealis* (Leigh-Sharpe 1916) and *B. torpedinis* (Harding 1910). The posterior sucker with papillae in its interior is characteristic of the genus *Branchellion*. Concerning the

distribution of the papillae in this specimen, the larger ones which are sparsely distributed are at the centre agreeing with Moore's (1944) description, and unlike MacDonald's (1877) who described the larger ones at the periphery. (Text-Fig. 2c).

The clear biannulation of the dorsal side of the abdomen in this specimen is a feature described only in *B. torpedinis* (Moore 1944 and Apathy 1888). The number of branchiae and the distribution is the same as in the type specimen of *B. torpedinis*. The attachment of the branchial stem on each primary annulus, however, is different from all the other descriptions excepting that of Moore (1944). The branchial stem does not stretch the whole side of the primary annulus but takes its origin from and is mainly restricted to only the anterior half of the primary annulus. Since the primary annulus shows biannulation on the dorsal side it can be more precisely expressed that the branchial stems of a segment are restricted to only b^1, b^3 and b^5 of each segment (Moore's 1927 nomenclature). The edge of the branchiae is highly frilled and lobed and is very different from that of *B. torpedinis* (Harding 1910 and Moore 1944), or any other known species of *Branchellion*.

The position of the pulsating vesicles on the branchial stems is the same as in the type *B. torpedinis* (Harding 1910), but differs from that of *B. torpedinis* (Moore 1944), in being situated on the branchial stem of the first primary annulus of each segment and not on the second. Moore's specimen of *B. torpedinis* was unique in having the pulsating vesicles confined to only the posterior aspect of the branchial stems, *i.e.*, on b^4 of each segment. But the type specimen of *B. torpedinis* (Harding 1910) has the pulsating vesicles on both the anterior and posterior aspects of the branchial stems. In the present specimen the first two pairs of pulsating vesicles are on the posterior aspect of the branchial stem alone, but the rest are on both the anterior and posterior aspects of the branchial stems. Thus *Branchellion* shows a great amount of variation with regard to the nature and location of the pulsating vesicles. The accompanying table shows the important characters of the nearly related forms for an easier comparsion.

Table 1.

Table giving the relationships of *B. plicusbranchus*, sp. nov.

Important taxonomic characters.	*B. torpedinis* Type specimen.	*B. torpedinis* Moore's specimen.	*B. borealis* Leigh-Sharpe.	*B. orbinensis* Quatrefages	*Branchellion plicusbranchus*, sp. nov.
1. Biannulation of the abdomen on the dorsal side.	X	—	X	X	—
2. No. of pairs of branchiae –.	—	—	X	—	—
3. Position of branchial stem	X	—	X	X	—
4. Frilled edge of branchiae –.	X	X	X	X	—
5. No. of pairs of pulsating vesicles.	—	—	—	—	—
6. Location of vesicles on primary annulus.	—	X	—	—	—
7. Extension of vesicles on branchial stem.	X	X	X	X	—
8. Eyes . .	X	?	—	X	—
9. Length of body . .	X	X	X	X	—
10. Warts on the surface of the body.	X	?	X	—	—

"—" indicates resemblance, and "X" indicates difference from the characters of the present specimen given in the last column.

CONCLUSION.

This specimen conforms to the main generic features of the genus *Branchellion* Sav. in the form of the body, number of branchiae and vesicles, and in the presence of caudal papillae, but differs in some minor points such as length of the body, and details of the attachment of the branchial stem and extension of the pulsating vesicles. A noteworthy feature here is the conspicuous biannulation seen on the dorsal side of the abdomen described only in Moore's specimen. In all the other characters it agrees either with the majority of the described forms or with only one of them. In the nature of the frills and folds of the branchiae, the present specimen is unique. Since the possession of the branchiae is an outstanding characteristic of the genus *Branchellion* Sav. and as the present specimen presents a unique feature of the branchiae with their frilled and folded edge, there is sufficient justification for assigning the specimen to a distinct species.

ACKNOWLEDGMENT.

I gratefully acknowledge my thanks to Mr. G. J. Phanuel, for placing the specimen at my disposal for study; to my professor, Dr. J. P. Joshua, for his help and guidance in the preparation of this paper; to Dr. P. N. Ganapathy, for kindly sending a specimen of *Branchellion* for comparison, and to Mr. S. Shankar, for helping me with the drawings.

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SYSTEMATIC AND BIOLOGICAL NOTES ON THE LADY-BIRD BEETLES PREDACIOUS ON THE SAN JOSE SCALE IN KASHMIR WITH DESCRIPTION OF A NEW SPECIES (COLEOPTERA: COCCINELLIDAE).

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CONTENTS.

INTRODUCTION.

Predacious lady-bird beetles (Coccinellidae) play an important role in nature by keeping down the numbers of many noxious insects, such as the green-fly, white-fly, mealy-bugs and scale-insects. Several species of the lady-bird beetles have been employed in the past for regulating insect pests. A more recent example is worthy of note: Vesey-Fitzerald (1953) has described how *Chilocorus nigritus* (Fabr.), introduced from India at the end of 1938 into the Seychelles, has exercised a successful control of the coccids of coconut palms in those islands.

The present paper deals with four species of Coccinellidae which feed upon the San José Scale, *Quadraspidiotus perniciosus* (Comst.), in Kashmir. Besides clarifying the identities of these species, biological and distributional notes have also been added in each case. As the San José Scale is a serious pest of fruit trees in Kashmir and in several other parts of the world, it is hoped that the present account would be of more than local interest.

The author takes this opportunity of recording his sincere thanks to Dr. S. L. Hora, Director of this Survey, for taking interest in this work and for providing facilities for the same.

EARLIER RECORDS OF THE COCCINELLID PREDATORS ON THE SAN JOSÉ SCALE.

The following statement gives a list of the species of Coccinellidae that have been hitherto known to feed upon the San José Scale in different parts of the world. Of the sixteen species recorded there is uncertainty regarding the identity of the host-insect in a couple of cases (No. 13 and 15) only. The majority of species belong to the tribe CHILOCORINI Costa,

which is widely distributed and is well known for its habit of feeding on the scale-insects. The other species are either of Australian or Nearctic origin. The two species of Sticholotini from the Oriental Region recorded here for the first time as predatory on the San José Scale are, therefore, of special interest.

List of COCCINELLIDAE recorded as predators on the San José Scale in different parts of the world.

No.	Name of species.	General distribution.	Country where recorded as predator and the reference.
	Tribe CHILOCORINI Costa, 1849.		
1.	*Chilocorus bijugus*, ssp. *infernalis* Muls.	Palaearctic.	Kashmir (Fotidar, 1941).
2.	*C. bipustulatus* (Linn.) . .	,,	Russia (Popova, 1936), Austria (Fulmek, 1941), Hungary (Janeck, 1941).
3.	*C. kuwanae* Silvestri . . .	,,	Japan (Ishii, 1937).
4.	*C. renipustulatus* (Scriba). .	,,	Russia (Popova, 1936); Japan (Kuwana, 1904).
5.	*C. similis* (Rossi) . . .	,,	France (Feytaud, 1913).
6.	*C. stigma* ? (Say) (=*bivulnerus* Muls.).	Nearctic.	U. S. A. (Parrott, 1914; Alden, 1930).
7.	*Orcus australasiae* (Boisd.) .	Australian.	Australia (Jarvis, 1925).
8.	*O. chalybeus* (Boisd.) .	,,	Australia (Jarvis, 1925).
9.	*Exochomus quadripustulatus* L. .	Palaearctic.	Austria (Fulmek, 1941).
	Tribe PENTILINI Casey, 1899.		
10.	*Pentilia* (=*Microweisea*) *misella* (J. Lec.).	Nearctic.	N. America (Quaintance, 1915).
	Tribe COCCIDULINI Costa, 1849.		
11.	*Rhizobius hirtellus* Crotch. .	Australian.	Queensland (Jarvis, 1925).
12.	*R. ventralis* (Erichs.) .	,,	Queensland (Jarvis, 1925); introduced into U. S. A. (Parrott, 1914).
13.	*Lindorus lophantae* (Blaisd.) .	,,	Introduced into California (Uncertain record; Smith, 1896).
	Tribe SCYMNINI Costa, 1849.		
14.	*Cryptolaemus montrouzieri* Muls.	Australian.	World-wide introduction. Feeding in insectary in Egypt (Hall, 1925).
15.	*Scymnus marginicollis* Mannh. .	Nearctic.	U. S. A. (Uncertain—Smith, 1896).
	Tribe SCYMNILINI Casey, 1899.		
16.	*Scymnillus aterrimus* Horn . .	Nearctic.	Idaho (Wakeland, 1938).

Chilocorus bijugus Mulsant.

hilocorus bijugus Mulsant, 1853. *Ann. Soc. linn. Lyon* (2) **1** : 189, (Type locality : East Indies). Crotch, 1874, *A revision of the coleopterous family Coccinellidae* (London) : 183. Korschefsky, 1932, *Coleopt. Cat., Berl.* **16**, 120, Coccinellidae II : 242.

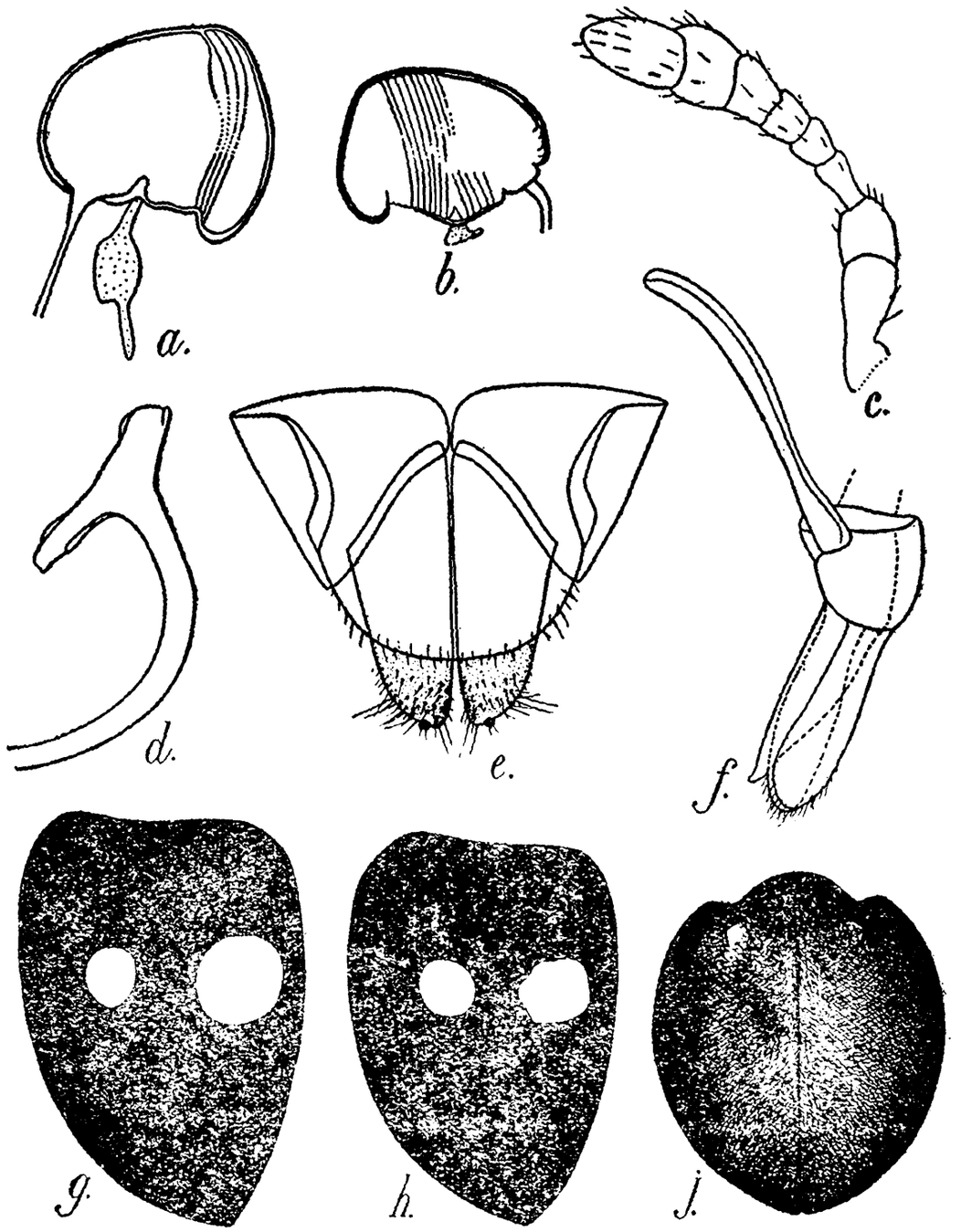
Chilocorus infernalis Mulsant, 1853, *Ann. Soc. linn. Lyon.* (2) **1** : 189—190. (Type locality : North India). Crotch, 1874, *A revision of the coleopterous family Coccinellidae* (London) : 183 (Synonymy).

Chilocorus bijugus sub-sp. *infernalis* Mulsant, Korschefsky, 1932, *Coleopt. Cat., Berl.* **16**, 120, Coccinellidae II : 242. Fotidar, 1941, *Indian Fmg.* **2** (5) : 236.

Body subhemispherical and moderately compressed. Head black on the front except for the greyish eyes and reddish brown labrum. Pronotum and scutellum black and shining, having in certain cases a rather greenish lustre. Elytra of the same colour as the pronotum except for a pair of roundish, testaceous or reddish testaceous spots on each elytron. Both the spots are situated (Text-fig. 1, *g*, *h*) in a transverse line at two-fifths of the length of elytron and are unequal in size, the inner (near the suture) being relatively larger than the outer spot. The diameter of the inner spot in the examples examined, varies between one-third and one-fourths of the greatest width of the elytron. Mulsant (1853) stated that in certain cases it may be even one-sixth of the width. The distance between the suture and the inner spot is equal to the radius of the latter and the distance between the inner and the outer spot is generally equal to the diameter of the former. The size of the outer spot varies, being between three-fifths and three-fourths of the size of the inner spot. Underside black on the thoracic sternites, legs and elytral epipleurae ; the abdominal sternites are reddish testaceous.

Head finely and fairly closely punctate and with short, thin and greyish pubescence. Pronotum strongly arched, narrower anteriorly, anterior emargination deep and subquadrate, lateral and anterior angles rounded, punctation fine and sparse except on the sides where it is coarse and close and is clothed with thin, short and greyish pubescence. Scutellum triangular with the base slightly shorter than the sides and with about four fine punctures in the centre. Elytra with distinct shoulder-boil, slightly expanded near the anterolateral margin ; punctures fine and sparse on the disc and coarse towards the lateral margins. In the female spermatheca is strongly chitinized and compact (Text-fig. 1, *b*) ; the genital plates (ninths sternite) are moderately elongate and the tenth tergite subrounded at the apical margin (Text-fig. 1,*e*).

Length 4·35—5·5. mm. *Width* 4·0—4·9 mm.



TEXT-FIG. 1. *a.*—spermatheca of *Chilocorus rubidus* Hope. *b.*—spermatheca of *C. bijugus* Muls. *c.*—antenna of *C. bijugus*. *d.*—siphonal capsule of *C. rubidus*. *e.*—terminal abdominal segments of ♀ *C. bijugus*. *f.*—male genitalia (except sipho) of *C. rubidus*. *g.* & *h.*—elytral pattern of *C. bijugus*. *j.*—outline of *C. rubidus*.

Biological notes.—Fotidar (1941) recorded *C. bijugus* sub-sp. *infernalis* Mulsant as a predator on the San José Scale in Kashmir. The beetles were observed by the present writer in October 1939 at Tangmarg (7,000-7,500 ft.) on trees infested with the San José Scale, many of which showed signs of attack by the beetles which were, however, not active owing to the cold weather. In the laboratory the beetles fed upon the Scale in large numbers. The beetles were subsequently found at Srinagar and other places, and a study of their life-history made in June-July 1943, yielded the following results.

Eggs were laid freely in captivity on the bark and crevices of the scale-infested twigs, throughout June and July. These were of the usual cigar shape and yellow when freshly laid. In June-July the incubation period was three to four days, the average duration for five batches being 3·4 days. The larvae were predacious, like the adult beetles. There were four larval instars which occupied on an average (based on 10 examples in each case) 4·1, 3·1, 3·0 and 6·1 days respectively. In the last instar, after an active period of three to four days, the larvae ceased feeding and attached themselves to the bark, etc. The pupal stage followed after the last larval moult had been cast ; the duration of the pupal stage varied from six to eight days, the average for ten examples being 7·2 days. The total development period from the egg to the adult stage varied beween 24 and 29 days (average 26·9 days). Since the adults did not lay eggs for a considerable time after emergence, it seemed that in spite of a fairly quick development of the immature stages, the majority of the beetles passed through only one generation a year. Towards the end of summer when their numbers began to increase in the field to make them effective against the pest, the larval and pupal stages were attacked frequently by the Encyrtid *Homalotylus* sp. which was in turn attacked by certain other Chalcid parasites. The adult beetles, however, remained free of the parasite attack and successfully passed through the winter.

Material examined.—INDIA—Kashmir: Tangmarg (7,000-7,500 ft.) predating on the San José Scale, 15.x.1939 (*A. P. Kapur*); Srinagar (5,000 ft.), feeding on the San José scale, 10. iv. 1943 (*A. P. Kapur*). Uttar Pradesh: Kumaon Hills: Almora (5,500 ft.), 2. vii. 1923 (*R. N. Parker*). Assam: Shillong (4,900 ft.), 31.v.1918 (*A.G.R.*).

Remarks.—The type locality for *Chilocorus bijugus* is East Indies while for *S. infernalis* it is North India. Exact localities in these parts were not mentioned by Mulsant in the original descriptions of the species which appear to have been distinguished on minor difference of variable characters such as colour of the body and the size of the elytral spots. Mulsant stated that in *C. bijugus* the inner spot was a little larger than the outer spot and covered about one-sixth to one-third of the elytral width and that the outer spot was nearly one-third, one-fourth and one-sixth of the width. In the case of *C. infernalis* he stated that the inner spot was also larger than the outer spot and was equal to one-sixth to nearly one-third of the width of the elytron and that the outer spot was equal to about three-fifths of the width of the latter. In other words, whereas the outer spot may be smaller or subequal to the inner spot in *bijugus* it was about three-fifths of the size of inner spot in *infernalis*. As has been observed in the description given above, the colour of elytra and the size of spots are variable in the material under report. Crotch (1874) who seems to have seen Mulsant's material, stated that the latter's descriptions referred to the same species. Although the name *bijugus* could claim priority (line) over the name *infernalis*, Crotch retained the latter name without giving any reason for the same. The present observations seem to support Crotch's view that the two names be regarded as synonymous. However, it would be necessary and correct to retain the name *C. bijugus* for the species.

Korschefsky (1932) in his catalogue employed the name *bijugus* for the species and gave its distribution as " South China " and he used the name *infernalis* for what he considered to be the sub-species occurring in India. He did not give any characters by which the two could be separated and his mention of " South China " instead of the clearly atated East Indies as the type locality for *bijugus* is obviously due to an error.

Chilocorus rubidus Hope

Chilocorus rubidus Hope, in Gray, 1831, *Zoological miscellany* (London) : 31. Mulsant, 1850, *Ann. Soc. Agric. Lyon* (2)**2** :453. Crotch, 1874, *A revision of the coleopterous family Coccinellidae* (London) : 183. Weise, 1887, *Arch Naturgesch.* **53** : 210. Blackburn (1889) 1890, *Proc. linn. Soc. N.S. Wales* (2) **4** : 1275. Lewis, 1896, *Ann. Mag. nat. Hist.* (6) **17** : 31. Korschefsky, 1932, *Coleopt. Cat., Berl.* **16**, 120, Coccinellidae II : 241. Maslovskii, 1936, *Plant Prot., Leningrad*, **8** : 157-158.

Coccinella tristis Faldermann, 1835, *Mem. Acad. St. Petersbg.* **2** : 452.

Chilocorus tristis (Fald.), Mulsant, 1850, *Ann. Soc. Agric. Lyon* (2) **2** : 452-453 Crotch, 1874, *A revision of the coleopterous family Coccinellidae* (London) : 183 (Syn.), Weise, 1887, *Arch. Naturgesch.* **53** : 210 (Syn.).

Chilocorus rubidus Hope, ab. *tristis* (Fald.), Korschefsky, 1932, *Coleopt. Cat., Berl.*, **16**, 120 Coccinellidae II : 241—242.

Body subhemispherical and moderately compressed. Head black in the front except for the distal parts of antennae and mouth-parts which are piceous or reddish-brown. Pronotum and scutellum normally black. Elytra (Text-fig. 1, *j*) deep red except on the borders along the external margins where the colour is usually black. The width of the black border varies and may be between one-fourth and one-eighth of the width of an elytron. The border in each case becomes slightly narrower towards the apex. In some apparently teneral specimens whereas the head and pronotum are piceous or black, the elytra are light brown and their external margins are either free from black pigment or have very little of it. Underside reddish except for the head, prosternum, legs and the external epipleurae which are black.

Head finely and moderately punctate and with short, thin and greyish pubescence. Antennae (Text-fig. 1, *c*) eight segemented, mouth-parts (Text-fig. 2, *f*, *b-o*) also typical of the genus. Pronotum strongly arched, with a subquadrate anterior emargination, only slightly narrowed anteriorly ; punctation rather fine and moderately close in the middle and coarse and fairly close towards the sides which have in addition, thin, short and greyish pubescence. Scutellum triangular with the base slightly shorter than the sides and with four or five minute and irregularly scattered punctures. Elytra with distinct shoulder-boils, slightly produced and raised near the anterolateral margins ; for the most parts, especially on the discal region, the punctuation is rather fine and moderately close while towards the external margins it gradually becomes coarse ; short and sparse pubescence also appears on the borders along the external margins. In the female the spermatheca (Text-fig. 1, *a*) is compact and well chitinized ; the genital plates (ninth sternite) are

tubular, the tenth tergite is subquardate apically (Text-fig. 2, *g*). Male genitalia as shown in text-figure 1, *d* (part sipho) and 1, *f* (trab, basal piece, penis and parameres).

Length 5·6—6·5 mm. *Width* 4·5—6 mm.

Biological notes.—Under the name *Chilocorus tristis* (Fald.) this species was reported to attack the larvae of the Chinese white-wax scale, *Ericerus pela* Chavannes, in Japan (*Vide* Kuwana, 1923 : 402). In the Far-eastern districts of Russia, the larvae of *C. rubidus* were reported to destroy 40—90 per cent of adult mealybug, *Lecanium corni* Boh. The beetles were stated to pass through one generation a year, and complete the life cycle in 53-58 days at 19-26°C. (Telenga and Bagunova, 1936). At about the same time, Maslovskii (1936) remarked that observations on the activity of *C. rubidus* and the fact that several other species of the genus feed on Diaspine coccids, suggested that it might be utilized against the Californian scale [*Quadraspidiotus* (*Aonidiella*) *perniciosus* (Comst.)] in the Caucasus and other parts of Russia.

In August 1940, the present writer observed a large number of these beetles on pear trees which were heavily infested with the San José Scale at Zaura, a village at about 9 miles from Srinagar, Kashmir. The beetles were seen feeding on the scale in the field and continued to do so in the cages in which some of these were subsequently placed. The beetles were observed in and arround Srinagar at later occasions also but never in such large numbers as were first observed at Zaura.

Material examined.—INDIA—Kashmir: Srinagar (5,500 ft.),-iv. 1923 (*T. B. Fletcher*). Zaura, 9 miles from Srinagar, feeding on the San José Scale on pear trees, 12. viii. 1940 (*A. P. Kapur*). Lalmandi, Srinagar, feeding on the San José Scale, 8.vii. 1941 (*A. P. Kapur*). Uttar Pradesh: Kumaon Hills, Almora (5,500 ft.), 11.x.—31.xii. 1911 (*C. Paiva*). PAKISTAN—Chitral: Izha, Lutkoh valley,—.viii. 1929 (*B. N. Chopra*); Buni, Mastunj valley,—viii. 1929 (*B. N. Chopra*). (Many examples in the Zoological Survey of India collection). MALAYA—Penang (No. further data; a single specimen in poor condition from the late East India Company's Museum collection, No. 7920/3).

Remarks.—The type locality for *Chilocorus rubidus* Hope (1831) is Nepal and that for *Coccinella tristis* Faldermann (1835) is Russia. Mulsant (1850) who transferred the latter to the genus *Chilocorus* recognized *tristis* and *rubidus* as two distinct species while Crotch (1874) synonymized the two under the name *C. tristis*. Apparently for reasons of priority Weise (1887) revived the older name *C. rubidus*, and described two new varieties under the names *fenestratus* (elytron black with a single subsutural vittaeform reddish spot) and *niger* (elytra black throughout) from Amur, U.S.S.R. Without giving reasons or pointing out the precise characters distinguishing *tristis* from *rubidus*, Korschefsky (1932) regarded the former as a variety (*ab.*) of the latter. In the opinion of the present writer this arrangement should be rejected in favour of the earlier synonymy proposed by Weise (1887).

The species is widely distributed; Korschefsky gives the following geographical distribution: "U.S.S.R.; Manchuria, Mongolia, China,

Japan, Nepal, India, Celebes and Australia ". However, its occurrence from Australia ever since it was first recorded by Mulsant (1850) from New Holland (Old name for Australia), has been rather doubtful (Crotch, 1874 ; Blackburn, 1890).

Pharoscymnus flexibilis (Mulsant)

Scymnus (*Diomus*) *flexibilis* Mulsant, 1853, *Ann. Soc. linn. Lyon* (2) **1** : 271-272.

Scymnus flexibilis Mulsant, Crotch, 1874, *A revision of the coleopterous family Coccinellidae* (*London*): 252. Korschefsky, 1932, *Coleopt. Cat., Berl,* **16**, 120, *Coccinellidae* II : 142 ; 586.

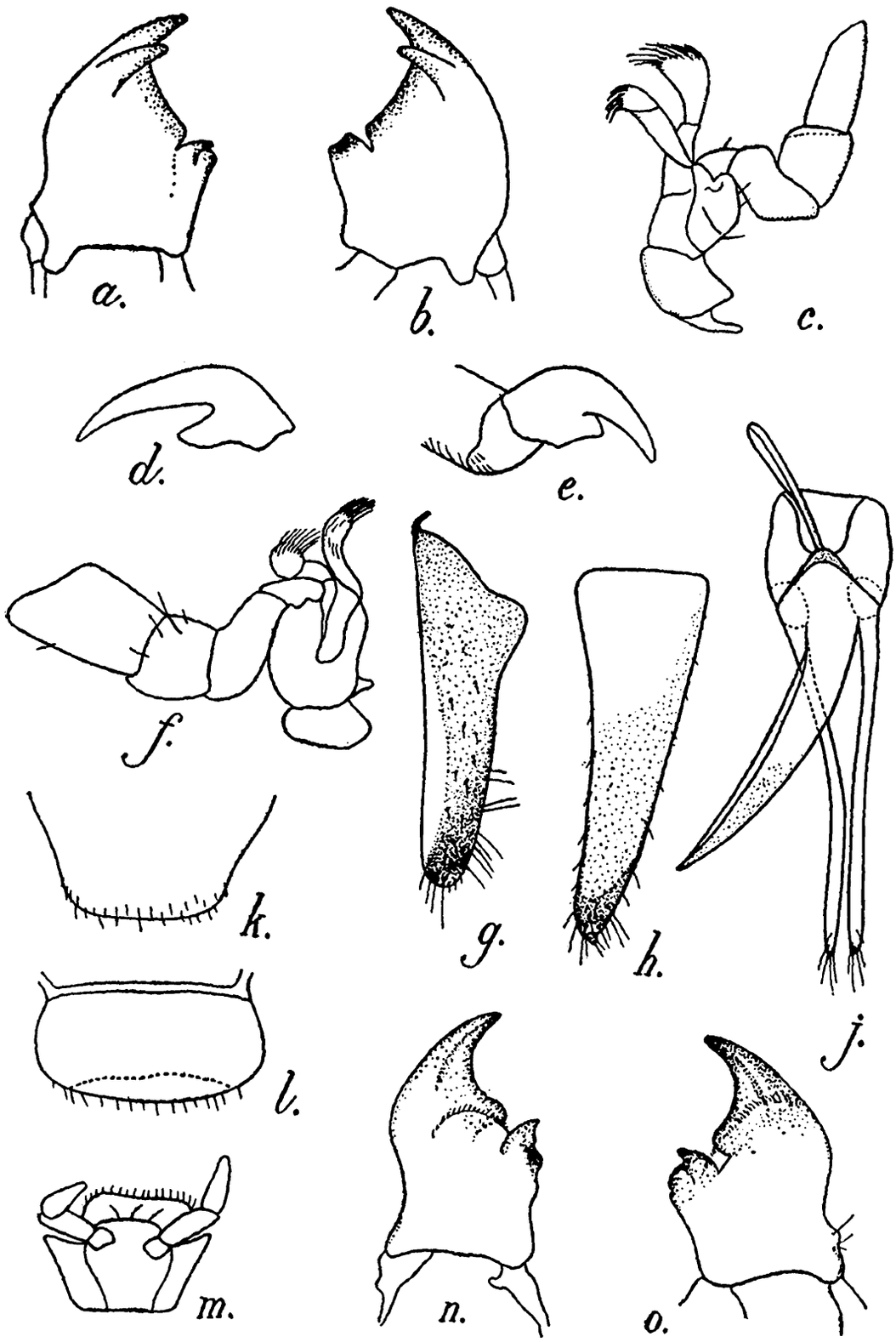
Pharus flexibilis (Mulsant), Weise, 1900, *Dtsch. ent. Z.* **1900** : 435.

Pharoscymnus flexibilis (Mulsant), Korschefsky, 1932, *Colepot. Cat., Berl.* **16**, 120. *Coccinellidae* II : 215.

Body subhemispherical (Text-fig. 3). Head testaceous to reddish testaceous except for the greyish eyes and pubescence. Pronotum and scutellum similar in colour to the head ; the latter occasionally lighter towards the lateral margins. The ground colour of elytra similar in colour to that of the pronotum ; elytral spots which are piceous to black in colour are very variable both in number and size. The maximum number of spots on an elytron may be five and the minimum two. When all the five spots are present these are arranged as follows : The first spot (numbered on the left elytron from right to left and from base to apex) is subrounded, usually small, being one-fourth to one-sixth of the width of elytron. It is situated near the base and at equal distances from the shoulder-boil and the suture. In certain examples it is altogether absent (Text-fig. 4, *a*, *b*). The second spot is situated on the suture and, together with its opposite number on the other elytron, it forms an oblong or rounded spot which may be a little larger than the first spot. It is variable in size and shape and is altogether absent in certain examples (Text-fig. 4,*a*). The third or the central spot is one of the most persistent spots which may be equal to or a little larger or smaller than the second spot (Text-fig. 4, *b*, *d*, *e*). The fourth spot lies near or on the suture in the apical one-third of the elytron and may be subrounded or semicircular in shape and is usually smaller (in an exceptional case larger) than the central spot. Though this spot is present in all the specimens examined, in certain examples it is very much faded. The fifth spot lies at the same level as the fourth spot and is equidistant from the latter and the external margin of the elytron ; when present it may be oval or rounded in shape ; in the former case its external margin runs parallel to the external margin of the elytron. On the whole the elytral spots remain small in size and usually incomplete in number. Underside generally testaceous but in examples where the elytral markings are more prominent, the thoracic and abdominal sternites may be fumous or fuscous.

Head with moderately fine and close punctures and with thin, short and depressed pubescence. Antennae ten segmented ; labrum subovate ; mandible (Text-fig. 2, *a*, *b*) with a bifid apex and a fairly strongly chitinized basal tooth ; galeae and laciniae with well defined setae, maxillary palpus with the last segment filiform rather than securiform (Text-fig. 2,*c*) ; labium subquadrate. Pronotum with the punctation and pubescence similar to that on the head. Scutellum very small,

triangular, with a few minute punctures and short grey hair. Elytar with slightly visible shoulder-boils and with punctation and pubescence similar to that of the head and pronotum except that the punctures appear to be a little shallower. Underside finely and fairly closely



TEXT-FIG. 2. *a, b.*—mandibles of *Pharoscymnus flexibilis* (Muls.). *c.*—maxilla of the same. *d.*—claw of the same (highly enlarged). *e.*—claw of *Chilocorus rubidus*. *f.*—maxilla of the same. *g.*—genital plate of the same. *h.*—genital plate of *P. flexibilis*. *j.*—male genitalia (except sipho) of the same. *k.*—tenth tergite of *C. rubidus*. *l.* & *m.*—labram and labium of the same. *n.* & *o.*—mandibles of the same.

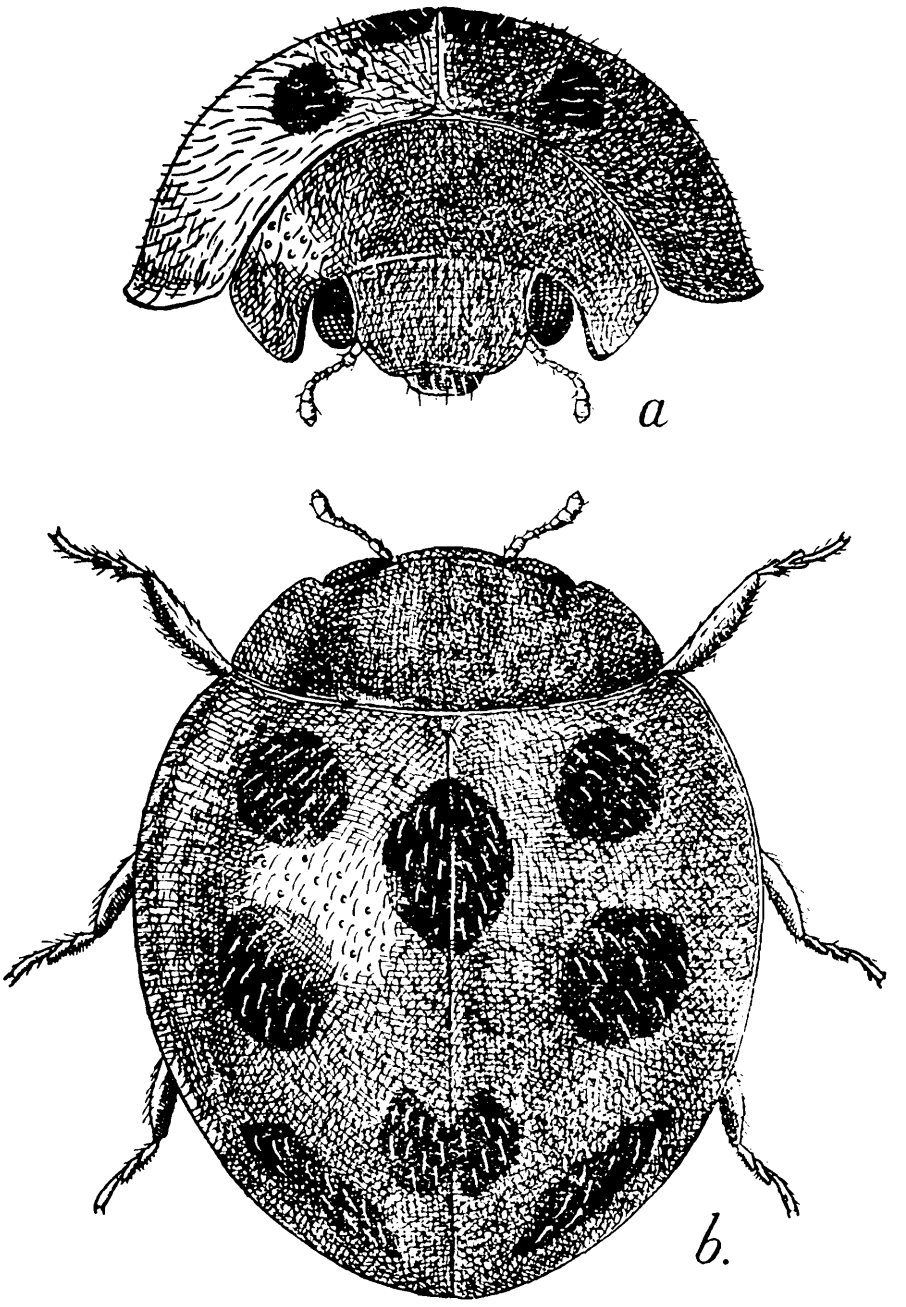
punctate except on the median parts of meso- and metasternum where the punctures are sparse; pubescence depressed, thin and short except on the distal abdominal sternites, where the hair are relatively longer. Prosternal carinae subparallel and slightly longer than the distance between the two of them; the claws are rather long (Text-fig. 2,*d*) abdominal lines terminal and incomplete; the fifth or the last visible segment entire and rounded at the apex in both sexes which remain indistinguishable on external characters except that of the size, the females being a little larger than the males. Male genitalia (Text-fig. 2, *j*) with the penis gradually narrowed towards the apex which is pointed; parameres narrow, slightly longer than the penis; sipho fairly long and narrow like the parameres. In the female the ovipositor is tubular, the genital plates (ninth sternite) elongate (Text-fig. 2, *h*) and the tenth tergite long and slightly truncate at the apex.

Length 1·82—2·0 mm.; *width* 1·48—1·65 mm.

Biological notes.—Very little is known about the feeding habits of the members of the genus *Pharoscymnus* Balachowsky (1925) recorded *P. anchorago* (Fairm.) as a predator of the armoured scale, *Parlatoria blanchardii*, in Algier and more recently Puttarudriah and Basavanna (1953) have recorded "*P. ? flexibilis* Muls." in Mysore as feeding "on an undetermined hard scale on citrus" and have further observed that it "acts as a good controlling agent." An examination of the material kindly sent by the latter authors leaves no doubt that the beetles belong to *P. flexibilis* (Mulsant).

Material examined.—INDIA and PAKISTAN-Punjab: Gandhara Reserve Forest, Choa Saidan Shah, Salt Range, 25. iv. 1931 (*H. S. Pruthi*); Lahore, 15. iv. 1935 (*A. P. Kapur*); Lahore, on peach tree attacked by coccids,—. ii. 1936, (*A. P. Kapur*). Lyallpur (no further data). Bihar: Kundri, Daltongunj Dist., 29. iv. 1951 (*A. P. Kapur*). Mysore: Bangalore, on scales on citrus leaves,— .v.1952 (*G. P. C. Basavanna*).

Remarks.—As is implied by the name of the species, there is a considerable degree of colour variation especially in the size and number of elytral spots. Mulsant stated that spots number one, two and four were indistinct and that perhaps his examples possessed incomplete markings. Mulsant made no mention of the fifth elytral spot which is no doubt more frequently absent in the material examined. The present writer had the opportunity of comparing some of his own material with the example of this species identified by Mulsant and deposited in the British Museum (N. H.) and is reasonably certain of the identity of his material. Mulsant gave the type locality as "Northern India" The fore-mentioned material which comes mostly from northern India agrees with Mulsant's description except for the presence of the additional fifth spot in certain examples. The two examples from Mysore (Text-fig. 4,*c*) also agree with Mulsant's description and do not possess the fifth spot. The material from Kashmir and other hilly tracts of northern India shows rather marked differences in colour and size and deserves to be mentioned separately.



TEXT-FIG. 3. *Pharoscymnus flexibilis* (Muls.), *a*.—front view. *b*.—dorsal view.

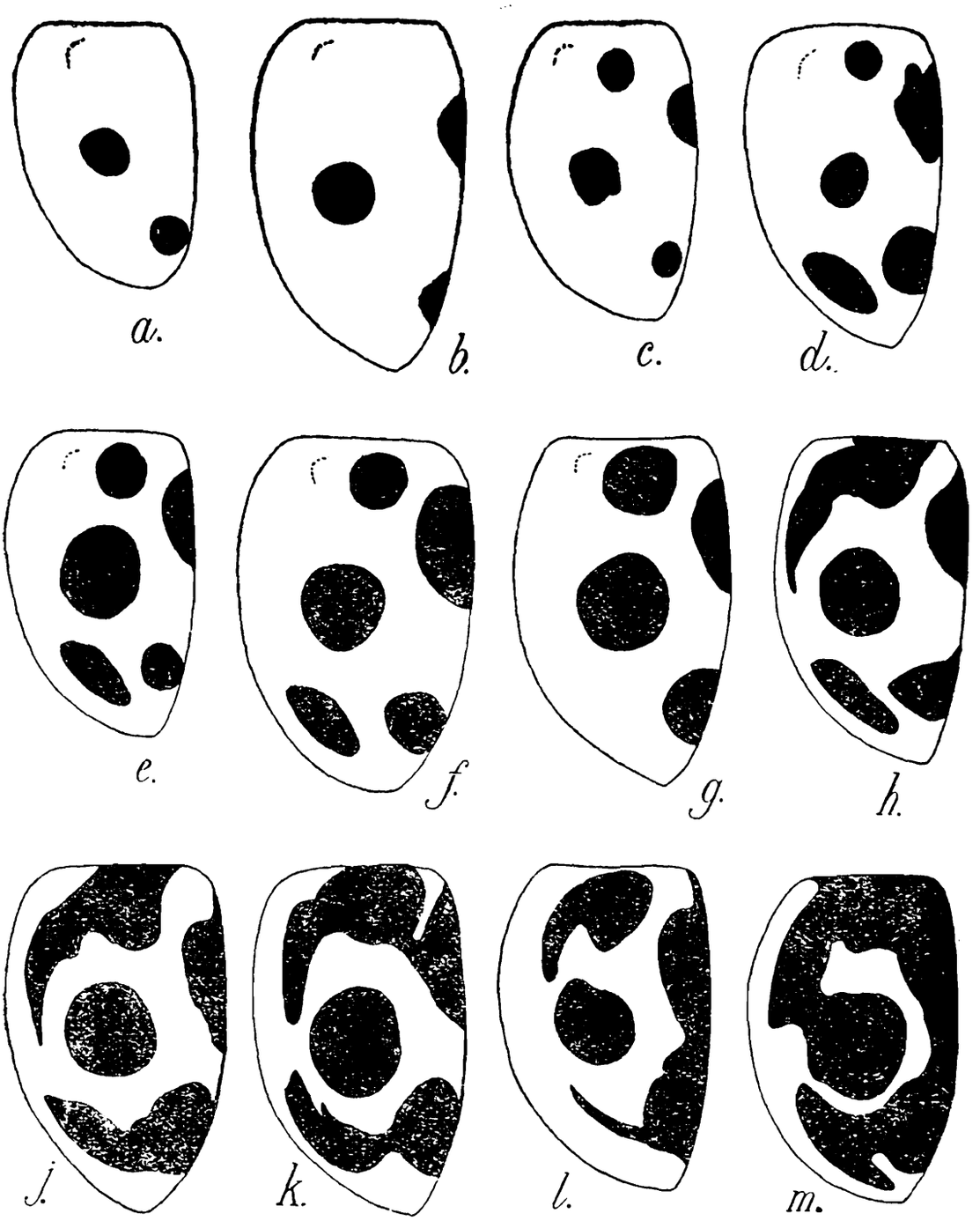
P. flexibilis kashmirensis, subsp. nov.

In structural details of genitalia (♂, ♀) and of various other parts and in punctation and pubescence, the material coming from Kashmir and neighbouring hilly tracts, tallies with the description of the species given above. In colouration and size, however, the bulk of this material is different, being more heavily pigmented and larger in size than the material from the plains of northern and other parts of India. Dealing with the material from Kashmir first, the colouration may be described as follows :

Head fuscous in front and piceous at the vertex or entirely piceous. Pronotum also fuscous to piceous and usually a little lighter towards the lateral marg ns. Elytra (Text-fig. 4, *g-m*) with four or five spots on each elytron ; when with four spots, it is the spot No. 5 that is absent (*g*) but the size of the spots remains large, being equal to one-third to two-fifths of the maximum width of the elytron ; very often when all the

five spots are present, these are much enlarged in size and show a tendency to meet the other spots (*h*). In the examples where the spots have become confluent, their arrangement may be as follows (+indicates the confluence of spots): 1+2, 3, 4+5 (*k*); 1, 2+4, 3 (*l*); 1, 2, 3, 4+5 (*j*); 3+2+1+4+5 (*m*). Underside also variable in colour at the thoracic and abdominal sternites and may be fuscous or piceous; the legs and epipleurae (thoracic and elytral), however, always remain testaceous or reddish testaceous.

Measurements of six specimens chosen at random from (A) the material from Kashmir and similarly from (B) the material from the



TEXT-FIG. 4. Elytral patterns of *Pharoscymnus flexibilis* from *a.*—Lyallpur; *b.* & *d.*—Lahore; *c.*—Bangalore. The same of *P. flexibilis kashmirensis* from *e.*—Almora (5,500 ft.); *f.*—Cherat (4,000 ft.); *g*—*m.*—Kashmir, Srinagar (5,500 ft.).

plains of Punjab, Bihar and Mysore (described in preceeding account of the species) are given below. Besides the geographical factors, the abundance or scarcity of food may also be quite important in determining the size of the beetles. In the Kashmir valley their food is plentiful.

A. (1) Length 2·173 mm., width 1·826 mm. (2) Length 2·173 mm., width 1·826 mm. (3) Length 2·130 mm., width 1·782 mm. (4) Length 2·086 mm., width 1·739 mm. (5) Length 2·130 mm., width 1·782 mm. (6) Length 2·086 mm., width 1·739 mm. *Average length* 2·130 mm. ; *average width* 1·782 mm.

B. (1) Length 1·913 mm., width 1·565 mm. (2) Length 1·826 mm. width 1·482 mm. (3) Length 1·913 mm., width 1·565 mm. (4) Length 1·913 mm., width 1·565 mm. (5) Length 2·000 mm., width 1·652 mm. (6) Length 1·913 mm., width 1·565 mm. *Average length* 1·913 mm. ; *average width* 1·565 mm.

The material from other neighbouring hilly tracts is represented by only one specimen each from Cherat (4,000 ft., in N. W F. Province) and W Almora (5,500 ft., Kumaon Hills, Uttar Pradesh). In the former specimen the head and pronotum are fuscous and the thoracic and abdominal sternites as piceous as in the case of certain examples from Kashmir ; the elytral spots (Text-fig. 4,*f*) are five in number and are relatively large in size but these do not show the same tendency to coalesce with the neighbouring spots. The specimen is also comparable in size to the material from Kashmir and may well be regarded as belonging to the same subspecies until more information is brought to light. The second example which is from W Almora, has the following colouration. Head piceous ; pronotum piceous except for a small testaceous area near each of the lateral margins ; elytral spots (Text-fig. 4,*e*) five, all deeply piceous and relatively large ; underside with piceous thoracic and abdominal sterna ; length 2·00 mm., width 1·56 mm. This specimen may also be provisionally placed along with the forementioned material for similar reasons.

Holotype.—INDIA—Kashmir : Srinagar (5,500 ft.) feeding on the San José Scale, 14. viii. 1940 (*A. P. Kapur*) ; a female (elytral pattern as in Text-fig. 4,*l*) in the Zoological Survey of India, Indian Museum, (Regd. No. 9623/H4).

Paratypes.—INDIA—Kashmir : Srinagar (5,500 ft.) feeding on the San José, Scale, 4.x.1939 ; 14.viii.1940 (*A. P. Kapur*). Six examples

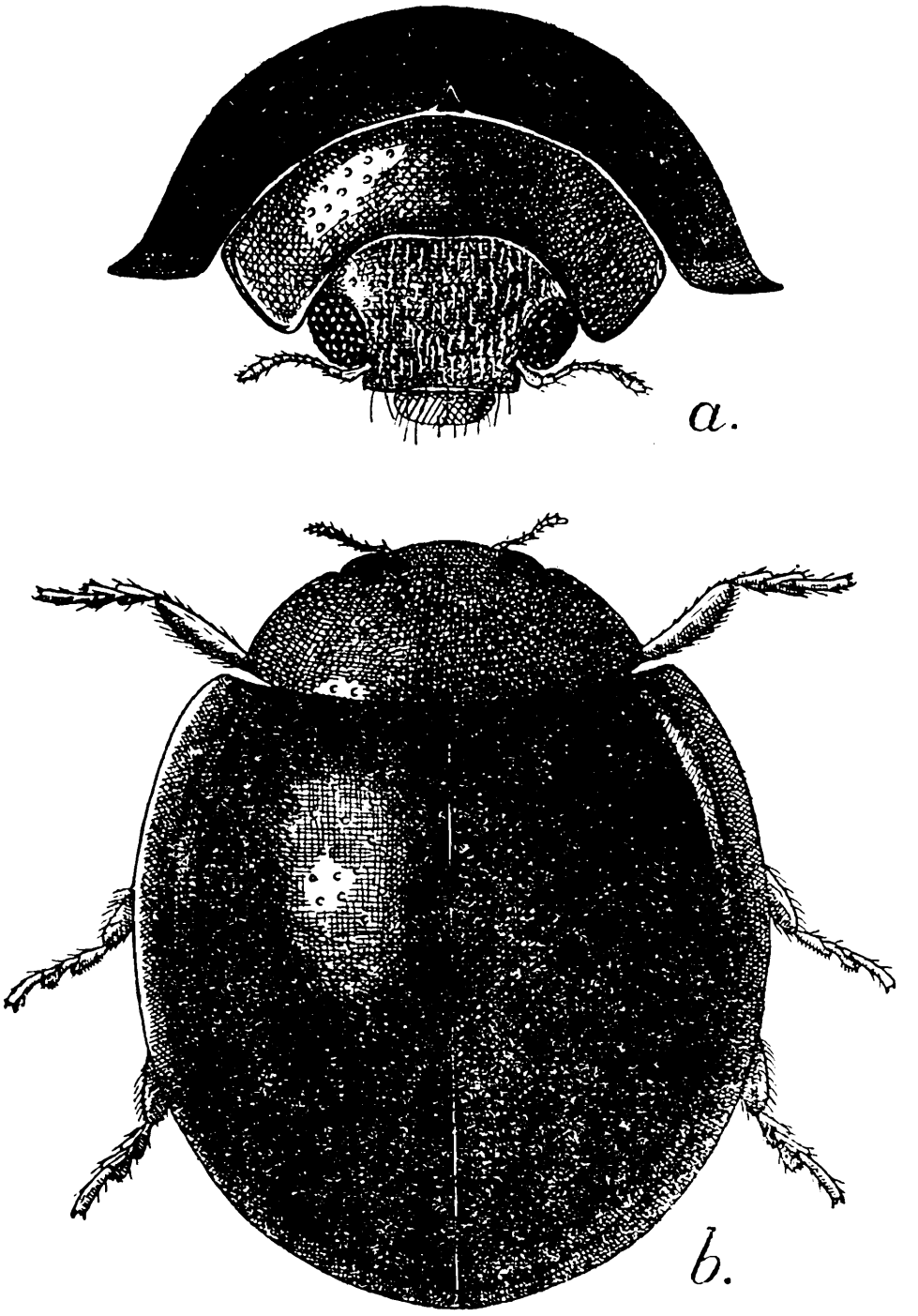
representing both sexes; some dissected for genitalia study and other parts mounted on slides, etc.; all in the Zoological Survey of India (Regd. Nos. 9624—9629/H4). One example each from Cherat and W. Almora bear the following data: (1) N. W. F. Province: Cherat (4,000 ft.), on *Pinus longifolia* infected with Coccids,—. v. 1916 (*T. B. Fletcher*). (2) Uttar Pradesh: Kumaon Hills, W. Almora (5,500 ft.) (*H. G. Champion*) (Example on loan for study from the British Museum (N. H.). A number of other examples from Kashmir also dissected and mounted.

Remarks.—The beetles are important natural enemies of the San José Scale in Kashmir. Their larvae which have a dull colour like the adults are also voracious feeders and destroy a large number of the scales. The larvae are well clothed with moderately long setae, and pupate in the open or under bark on the trees. The pupae are also of dull colour and are not protected by the larval skin which remains cast at the proximal end of the pupa. Hibernation takes place in the adult stage. There is very little incidence of parasite attack and the beetles are more common in the valley than either of the preceeding two species.

Sticholotis marginalis, sp. nov.

Body subrounded, a little longer than wide, convex. Head castaneous except for the black eyes and the light castaneous mouth-parts Pronotum uniformly of the same colour as the head. Scutellum black or piceous, like the colour of the elytral disc. Elytra black or piceous except for a castaneous, narrow border (as wide as about one-eighth of the width of the elytron) along the external margin. Underside with the meso and metasternum and the proximal abdominal sternites black or piceous and with the prosternum, epipleurae and legs-brown or castaneous but usually lighter than the colour of pronotum.

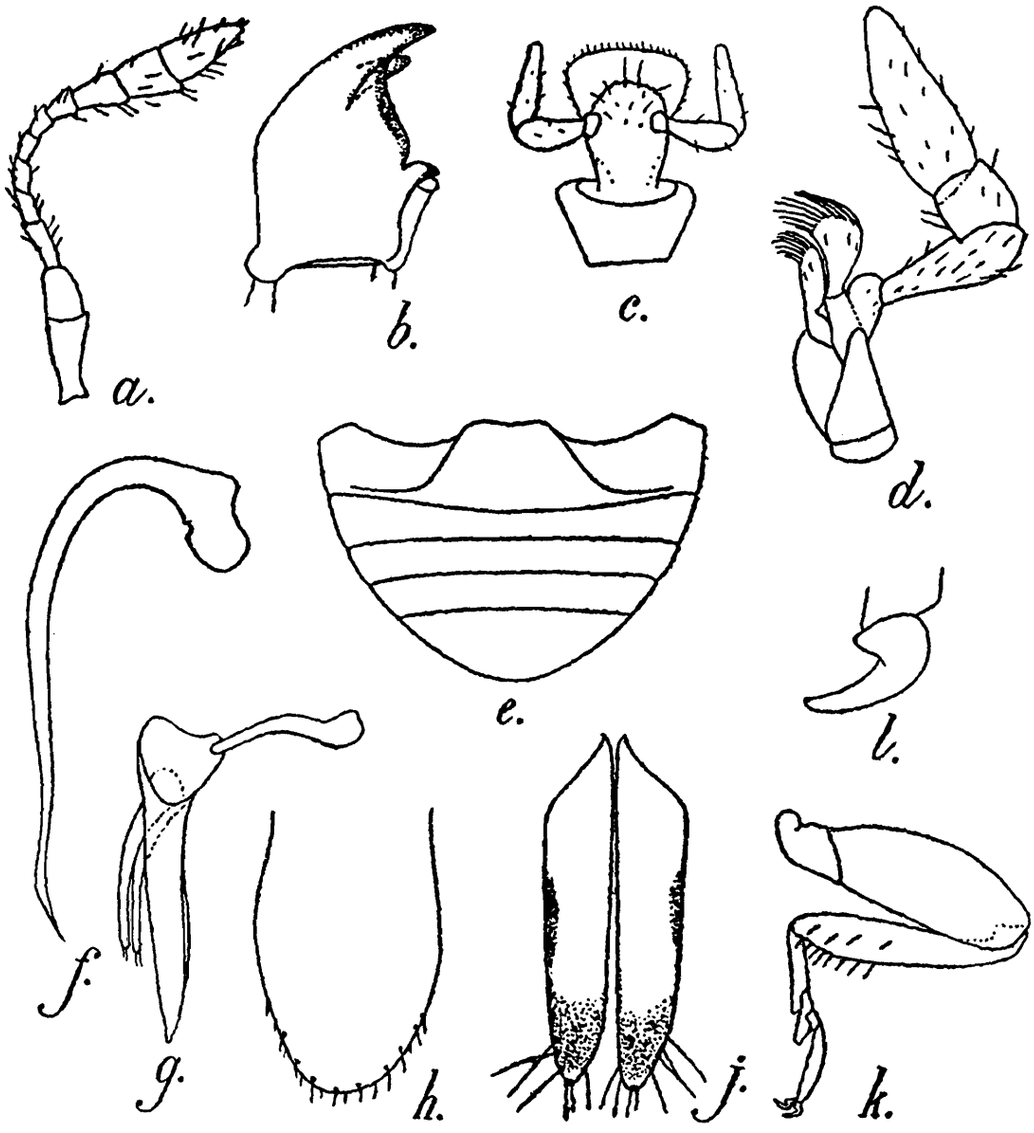
Head slightly convex in front, with fine, well impressed and fairly close punctation and thin, short, sparse and rather golden pubescence. Eyes coarsely granulated. Antennae (Text-fig. 6,*a*) eleven segmented, with the terminal segment subconical; labrum ovate; mandible bifid at the apex, with strongly chitinized inner margin and basal tooth (Text-fig. 6,*b*); maxillary palpi fairly long with the last segment conical rather than securiform (Text-fig. 6,*d*); mentum subquadrate (Text-fig. 6,*c*).



TEXT-FIG. 5. *Sticholotis marginalis*, sp. nov. *a*.—front view ; *b*.—dorsal view.

Pronotum fairly convex, widely emarginate in front, with the punctation similar to that on the front of the head and with a trace of very short pubescence present only near the sides which together with the base are narrowly margined. Scutellum very small, triangular and with a few fine punctures. Elytra with rather indistinct shoulder-boils ; slightly raised on the external extremity which is narrowly margined ; punctation mixed, coarser punctures moderately impressed, well-spaced and arranged in rather indistinct rows which are usually not more than five on an elytron ; in between the rows the punctation is fine, rather shallow and moderately close. Underside with the prosternum having a pair of carinae which are not parallel but slightly convergent towards the

apex ; the space between the carina has a few fine punctures. Mesosternum coarsely and sparsely punctate ; metasternum with relatively fine and rather close punctures ; legs sparsely and finely punctate with the claws pointed at apex and each having a small basal tooths (Text-fig. 6, *k*, *l*). Abdominal lines terminal and incomplete ; the fifth or the last abdominal sternite rounded along the external margin in both sexes (Text-fig. 6,*e*). Male genitalia, and the elongate genital plates (ninth sternite) and the apically rounded tenth tergite of the female, as shown in text-figure 6, *f-j*.



TEXT-FIG. 6. *Sticholotis marginalis*, sp. nov. *a.*—antenna ; *b.*—mandible ; *c.*—labium ; *d.*—maxilla ; *e.*—abdominal sternites (♂) ; *f.*—sipho ; *g.*—male genitalia (except sipho) ; *h.*—tenth tergite of female ; *j.*—genital plates (ninth sternite of female) ; *k.*—leg ; *l.*—claw (highly magnified).

Length.- 1·9-2·0 mm. ; *width* 1·5-1·6 mm.

Holotype.—INDIA—Kashmir : Srinagar, feeding on the San José Scale, 16.vi.1943 (*A. P. Kapur*)—A male in the Zoological Survey of India, Indian Museum (Regd. No. 9631/H4). Genitalia and abdomen mounted on a slide.

Allotype and 2 Paratypes.—All females, with the same data as the holotype, in the Indian Museum—Zoological Survey of India (Regd. No. 9632—9634/H4). Text-fig. 5 of the beetle is of a paratype. Female genitalia of allotype mounted between two coverslips and attached to the specimen the same of a paratype on a slide.

Remarks.—The species can be easily distinguished from other Indian species of the genus by its shape of the body, the colouration of elytra and the character of the punctation. The genus is widely spread in the Oriental and Australian Regions but its species are very inadequately known.

The beetles of this species feed on the San José Scale in Srinagar and several other places in the Valley. Occasionally nymphs of the woolly aphis (*Eriosoma lanigerum* Hausm.) are also attacked.

SUMMARY.

The San José Scale is a serious pest of fruit trees in Kashmir and several other parts of the world. A study of its natural enemies is, therefore, of more than local interest. A list is given of all the recorded Coccinellid predators on the San José Scale in different parts of the world. Although four species of these beetles were observed to feed on the Scale in Kashmir, only one of these, namely *Chilocorus bijugus* sub-sp. *infernalis* Muls., seems to have been recorded in literature. This species together with *C. rubidus* Hope, has been redescribed in this paper and notes on their taxonomy and biology added. *Pharoscymnus flexibilis* (Mulsant) has also been dealt with similarly and a new subspecies which feeds on the Scale in Kashmir has been named as *P. flexibilis kashmirensis*. The fourth species which also appears to be new, has been described and named as *Sticholotis marginalis*.

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NOTES ON CUMACEA (SYMPODA) IN THE ZOOLOGICAL SURVEY OF INDIA.

By C. V. KURIAN, *M.Sc., Fisheries Research Station, Ayiromthengu, University of Travancore.*

The collection of cumacea dealt with in this paper was entrusted to me for examination by Dr. S. L. Hora, Director, Zoological Survey of India, Calcutta. To him as well as to the former director, Dr. B. N. Chopra, my thanks are due, not only for giving me the opportunity to study these very interesting specimens, but also for permission to work in the laboratories of the Zoological Survey, where part of this work was carried out. The work was completed in the Marine Biological Laboratory, Trivandrum and at the Fisheries Research Station, Ayiromthengu, University of Travancore, under the guidance of Dr. C. C. John, Director of Research, to whom I am greatly indebted for all help and encouragement. My thanks are also due to Dr. Herbert M. Hale, Director of the South Australian Museum, for his valuable advice and help in the identification of certain doubtful forms.

The collection includes material gathered by the late Dr. Stanley Kemp, of the Zoological Survey of India, thirty years ago, from the Indian Coasts and stations around Andaman Islands; and some specimens received by him from the University of Amoy, China; from Prof. Ramunni Menon of the Madras University and 'Investigator' expedition.

The entire material is in a very good state of preservation and so it was possible to identify all of them except three badly damaged ones. Altogether, there are 23 species of Bodotriidae, 3 species of Diastylidae, 4 species of Nannastacidae and 1 species of Campylaspididae. One new genus and 6 new species have been proposed for the inclusion of certain hitherto unrecorded forms.

The following is a list of species :—

Family BODOTRIIDAE.

Subfamily BODOTRIINAE.

Bodotria similis Calman.
Iphinöe crassipes Hansen.
Iphinöe calmani Fage.
Cyclaspis cingulata Calman.
Cyclaspis uniplicata Calman.
Cyclaspis coelebs Calman.
Cyclaspis herdmani Calman.
Cyclaspis cretata Hale.
Cyclaspis munda Hale.
Cyclaspis strumosa Hale.
Cyclaspis calmani Hale.
Cyclaspis bengalensis, sp. nov.
Cyclaspis sp.
Eocuma taprobanicum Calman.
Eocuma latum Calman.
Eocuma kempi, sp. nov.

Subfamily VAUNTHOMPSONIINAE.

Gigacuma halei Kurian.
Heterocuma andamani, sp. nov.
Heterocuma sarsi Miers.
Heterocuma africana Zimmer.
Heterocuma armata, sp. nov.
Pseudosympodomma indica, Gen. et. sp. nov.
Vaunthompsonia arabica Calman

Family DIASTYLIDAE.

Paradiastylis culicoides Kemp. *Gynodiastylis* sp.
Dimorphostylis horai, sp. nov.

Family NANNASTACIDAE.

Nannastacus johnstoni Hale. *Nannastacus inflatus* Hale.
Nannastacus gibbosus Calman. *Nannastacus* sp.

Family CAMPYLASPIDIDAE.

Campylaspis maculata Zimmer.

Family BODOTRIIDAE.

Genus **Bodotria** Goodsir.

Bodotria similis Calman.

1907. *Bodotria similis*, Calman, *Trans. Zool. Soc. London* XVIII, 1, p. 4, pl. I, figs. 4-9.
1913. *Bodotria similis*, Stebbing, *Das Tierriech* XXXIX, p. 27.
1951. *Bodotria similis*, Kurian, *Bull. Cent. Res. Inst. Trivandrum* II, C, pp. 81-82.

Locality.—

Andamans, off pier, Ross Island, in sand and a little weed, 3-4 fathoms. 22/23-ii-1915. 1 adult ♂ 2·6 mm. long.

Closely resembles the specimens collected from Trivandrum. Inner side of peduncle of uropod bears serrations. Setae on peduncle and rami mostly broken.

Distribution.—Gulf of Siam 6-10 fathoms, Trivandrum and Cape Comorin 13-15 fathoms.

Genus **Iphinöe** Bate.

Iphinöe crassipes Hansen.

1895. *Iphinoe crassipes*, Hansen, *Ergeb. der. plankton Exped.* II, p. 53, pl. vi, figs. 4-4f.
1904. *Iphinoe macrobrachium*, Calman, *Cey. Pearl. Oyst. Fish. Rept.* II, p. 173, pl. iv, figs. 72-75.
1951. *Iphinoe crassipes*, Kurian, *Bull. Cent. Res. Inst. Trivandrum*, C. II, pp. 85-87.

Locality.—

Andamans, off pier, Ross Island, in sand and a little weed, 3-4 fathoms. 22, 23-ii-1915. 1 adult ♂ 6·0 mm. and 1 immature ♀ 3·4 mm.

Andamans, Ross Channel, 2-9 fathoms. 1921. 1 adult ♂ 5·7 mm. and 1 adult ♀ 5·9 mm.

The immature female agrees with *I. macrobrachium* Calman, from the Gulf of Manaar. In adult female dorsal median carina not prominent and no teeth visible except the small tubercles on the carapace. Eye-lobe large, with 3 prominent pigmented lenses. Peduncle in male bears 12 spines on inner margin, of which 4 are large. In female 8 large spines and about a dozen smaller ones present on inner side of peduncle as against 5 or 6 strong spines described by Calman *loc. cit* First joint of endopod of male only slightly longer than second and bears 11 spines on inner margin ; second joint with 12 spines, of which the distal 4 very long and plumose.

Distribution.—Gulf of Guinea, Gulf of Manaar, South Africa 4-38 fathoms and Trivandrum 13-16 fathoms.

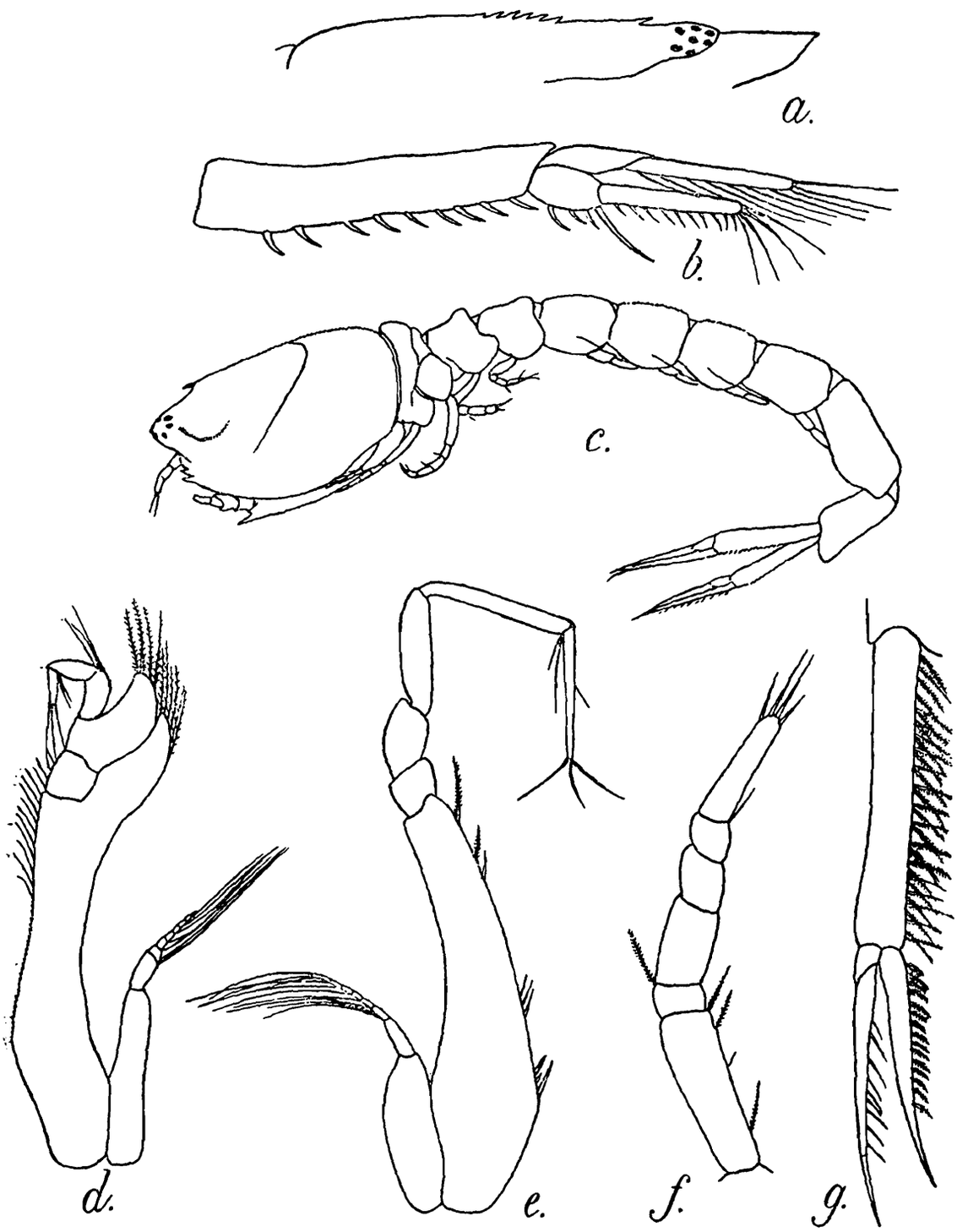
Iphinöe calmani Fage.

1907. *Iphinoe sp.*, Calman, *Trans. Zool. Soc. London* XVIII, p. 28.
1945. *Iphinoe calmani*, Fage, *Archiv. de Zool. Expt. et. Gen.* 84 (3), p. 189, figs. 15-19.

Locality.—

Andamans, Brigade creek, 2-5 fathoms, on bottom of decaying vegetation. 21-ii-1915. 4 adult ♀♀, the largest 5·3 mm. long.

Teeth on carapace (fig. 1*a*) 7 prominent, the first one large, and separated from the rest by a wide space. Length of carapace slightly more than double its height.



TEXT-FIG. 1.—*Iphinoe calmani* Fage.

a. Dorsal side of carapace and pseudorostrum, female × 35 ; *b*. Uropod, female × 58 ; *c*. *Cyclaspis uniplicata*, juv. male, lateral view × 22 ; *d*. *Cyclaspis calmani*. Third maxilliped, male × 47 *e*. First peraeopod male × 47 ; *f*. Second peraeopod, male × 85 ; *g*. Uropod, male × 47.

Peduncle of uropod (fig. 1*b*) longer than rami, bears 9 spines on inner margin: inner ramus smaller than the outer, two-jointed, first joint less than half as long as second.

Distribution.—Annam. Fage considers that immature specimens recorded from Siam as *Iphinoe* sp. by Calman *loc. cit.* is also referable to this species.

Genus **Cyclaspis** Sars.

Cyclaspis cingulata Calman.

1907. *Cyclaspis cingulata*, Calman, *Trans. Zool. Soc. London* XVIII, 1, p. 7, 15, pl. iv, figs. 1-10.

1913. *Cyclaspis cingulata*, Stebbing, *Das Tierreich* XXXIX, p. 36, 37, fig. 16.

Locality.—

"Kilakarai, Ramnad District, S. India, 0-2 fathoms, from weeds. February 1913." 5 adult ♀♀ 4·5-4·9 mm.

The specimens in the present collection almost agree with the description and figures of immature female of Calman (*loc. cit.*).

Dorsal median keel extends from 5th pedigerous somite to 5th pleon somite and bears backwardly directed serrations. Peduncle of uropod as long as telsonic somite, which is produced in between uropods. Inner and outer margins of peduncle slightly serrated, the serrations on inner margin being more prominent. Endopod slightly longer than exopod and bears 8-11 small teeth followed by a stout spine on inner side. Distal end of endopod more tapering than in Calman's figure of immature female. Exopod with slightly serrated margins and possessing a few small spines on outer margin in its proxinal half.

Distribution.—Gulf of Siam 9-18 m., immature females and adult males 4·2 mm.

Cyclaspis uniplicata Calman.

1907. *Cyclaspis uniplicata*, Calman, *Trans. Zool. Soc. London* XVIII, 1, p. 13, pl. iv, figs. 11-20.

1913. *Cyclaspis uniplicata*, Stebbing, *Das Tierreich* XXXIX, p. 36.

Locality.—

Andamans, off pier, Ross Island, in sand and a little weed. 22/23-ii-1915. 2 immature ♂♂ 3·5 mm., 2 adult ♀♀ 4·4 mm. long.

Adult female.—The specimens almost agree with the original description of immature female by Calman (*loc. cit.*). The bifid tooth at the antero-lateral border of carapace longer and more pointed than what is shown in Calman's figure. The single tooth on the carapace very distinct, and the dorsal profile behind it faintly serrated. First pedigerous somite distinct dorsally as a narrow band. Peduncle of uropod without setae, but strongly serrated on inner edge. Endopod as long as exopod, tapering to a sharp point, serrated on both sides, and bearing about 8 short spines ; exopod with serrated margins, 2 terminal setae, and 3 spines on inner edge.

Immature male.—Body more strongly built than in female. Abdomen thicker. Serrations on the dorsal side of carapace behind the tooth more prominent than in female. Teeth at the antero-lateral corner of carapace better developed and slightly separated from each other.

First pedigerous somite indistinct (fig. 1-*c*), second dorsally crested, and the last somite shows dark brown pigment spots in the alcohol preserved specimens.

Peduncle of uropod unarmed, except for the serrations on inner edge. Endopod with 9 spines on inner side and exopod with 7 setae on inner edge and two at the tip.

Distribution.—Gulf of Siam 5-10 fathoms, immature females 4·9 mm. long.

Two young and imperfect specimens recorded by Calman[1] from the Gulf of Manaar as "*Cyclaspis sp.*" are also referred to this species by Stebbing.

Cyclaspis coelebs Calman.

1917. *Cyclaspis coelebs*, Calman, *Brit. Ant Exped.* 1910, *N.H. Rept.* III, 5 pp. 150, 151, fig. 5.

Locality.—

Andamans, off pier Ross Island, in sand and a little weed, 3-4 fathoms. 22/23-ii-1915. 1 adult ♂ 4·2 mm.

Anterior median half of carapace carries 4 blunt prominences, which give a wavy appearance to the dorsal profile. Exo-skeleton strongly calcified, carapace and the rest of body showing a pitted appearance. The faintly marked oblique ridge described by Calman (*loc. cit.*) behind the middle of carapace not discernible.

Peduncle of uropod one-ninth[2] longer than the last abdominal somite and slightly shorter than rami[3].

Distribution.—Spirits Bay, New Zealand, 0-2 m., 5 males.

Cyclaspis herdmani Calman.

1904. *Cyclaspis herdmani*, Calman, *Ceyl, Pearl Oyst. Fish. Rept.* II. pp. 171, 172, pls. iii, iv, figs. 56-66.

1913. *Cyclaspis herdmani*, Stebbing, *Das Tierreich* XXXIX, p. 32.

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1 Calman *Rept. Ceyl. Pearl. Oyst. Fish.* II, p. 160 (1904).

2 One-fourth longer than the last abdominal Somite—Calman, *Brit. Ant. Exped.* 1010 N.H. Rept. III, 5, pp. 150, 151.

3 Peduncle of uropod slightly longer than the rami—Calman *loc. cit.*

Locality.—

Andamans, off pier, Ross Island, in sand and a little weed, 3-4 fathoms. 22/23-ii-1915. 1 ovigerous ♀ 3·6 mm., and 1 adult ♂ 4·7 mm.

In female, ocular lobe large, with distinct eye lenses. Surface of carapace shows pitted appearance. Peduncle of uropod 1-1/3 the length of the last abdominal somite (1-3/5 in Calman's specimens).

Distribution.—Gulf of Manaar, 7 fathoms; several specimens.

Cyclaspis cretata Hale.

1944. *Cyclaspis cretata*, Hale, *Rec. S. Austral. Mus.* VIII, 1, pp. 91-95, figs. 19, 20.

Locality.—

Andamans, off pier, Ross Island, in sand and a little weed, 3-4 fathoms. 22/23-ii-1915. 1 ♀ 4·1 mm., 2 ♂♂ 4·4 mm.

Nine corneal lenses distinct in males, but lenses smaller and less conspicuous in females. In both sexes, the total length of the exposed pedigerous somites more than half the length of carapace, though according to Hale, *loc. cit.*, the exposed pedigerous somites together are less than half as long as the carapace in female. The dorsal notch on the telsonic somite deeper in male than in female and propodus of first peraeopod in female slightly shorter than in Hale's specimens.

Peduncle of uropod about two-thirds as long again as telsonic somite (only one-third as long again as telsonic somite—Hale), bears numerous plumose setae and spines on inner margin. Endopod, with about 8 proximal spines on inner margin, followed by a row of smaller spines and serrations, up to about two-third its length.

Distribution.—New South Wales, 8 ft.; South Australia, 3-9 fathoms.

Cyclaspis munda Hale.

1944. *Cyclaspis munda*, Hale, *Rec. S. Austral. Mus.* VIII, 1, pp. 134-136, figs. 53, 54.

Locality.—

Andamans, off pier, Ross Island, in sand and a little weed, 3-4 fathoms. 22/23-ii-1915. 1 adult ♂ 4·0 mm. long.

In lateral view dorsal margin of carapace shows three tubercular projections in the anterior half and a slight elevation at the posterior end. Dorsal carina of carapace more prominent in its anterior half. Antero-lateral tubercles behind pseude-rostral sutures more pronounced than in the specimens from New South Wales (Hale *loc. cit.*); oculae lobe large, with distinct corneal lenses, pseudorostral lobes do not meet in front of eye-lobe. Second, fourth and fifth pedigerous somites crested dorsally. Appendages same as in type specimen.

Distribution.—New South Wales, 30-35 m.

Cyclaspis strumosa Hale.

1948. *Cyclaspis strumosa*, *Hale*, *Rec. S. Austral Mus.* IX, 1, pp. 13-19, flag. 7-9.

Locality.—

Andamans, Ross channel, 2-9 fathoms. 1921. 1 Sub-adult ♂ 3·5 mm.

Andamans, off pier, Ross Island, 3-4 fathoms. 22/23-ii-1915. 3 immature ♀♀ 3·8 mm. and 1 sub-adult ♂ 3·7 mm.

In both sexes carapace, free thoracic somites and first five pleon somites dorsally carinated. In female, lateral tubercles in the middle region of carapace well developed. Pleon, in male, only as long as the cephalothorax where as in Hale's description of sub-adult male, pleon is one-tenth longer than cephalothorax. Pleopods stumpy, pleon somites with rough, slightly serrated dorsal margin. Basis of first peraeopod in male about twice as long as rest of limb though in Hale's specimens it is only one and a half times as long as rest of limb, Hale *loc. cit.* Its outer margin weekly serrated. Peduncle of uropod slightly shorter than the sub-equal rami, rami of male longer than that of female ; both peduncle and rami with slight serrations and spinules.

Distribution.—Western Australia, Queensland.

Cyclaspis calmani Hale.

1907. *Cyclaspis levis*, Calman, *Trans. Zool, Soc. London* XVIII, 1, pp. 8, 9, pl. V, figs. 6-8.

1944. *Cyclaspis calmani*, Hale, *Rec. S. Austral. Mus.* VIII, 1, p. 112.

Locality.—

Andamans, Stream at Corbyn's Cove North, Stone bed. 5 adult ♂♂ 4·8 to 5·9 mm. long (2 damaged).

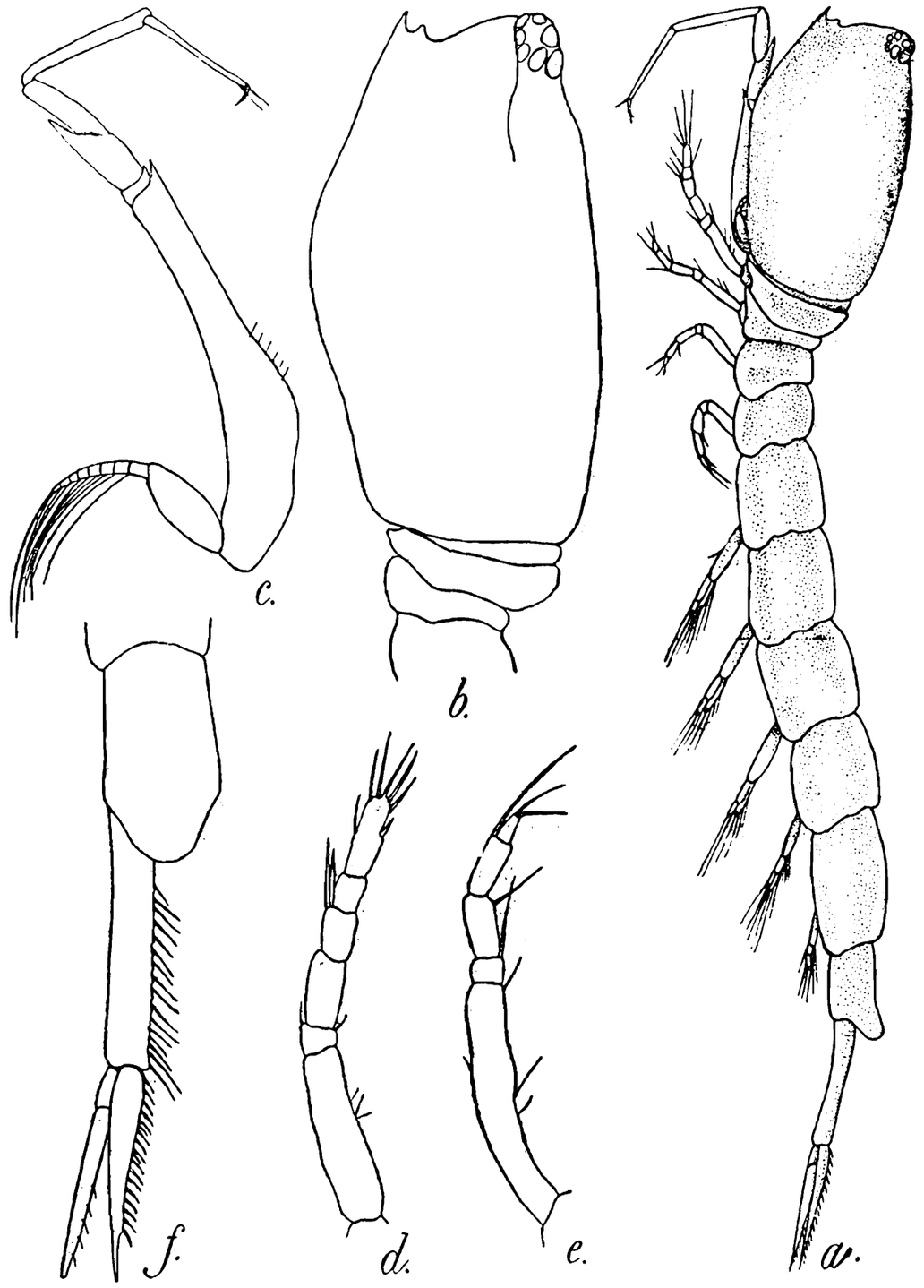
Calman (*loc. cit.*) identified some adult females of *Cyclaspis* measuring 7·16 mm. and a single damaged male from New Zealand as belonging to *C. levis* Thompson. But later, Hale (*loc. cit.*) observed that Calman's specimens were different from Thomson's and created a new species for the reception of Calman's specimens. His description however did not include the characters of the male, since the single specimen which he had at his disposal was badly damaged. The important characters of the males in the present collection are therefore discussed here.

Adult male.—Integument slightly calcified and finely reticulated, giving the appearance of very shallow pittings on the surface. Carapace not much compressed, a faint median carina visible. Pseudo-rostral lobes barely meet in front of the ocular lobe ; ocular lobe large, with prominent lenses. Carapace about twice as long as its height, breadth slightly greater than height. Free thoracic somites carinated on the sides, together about half as long as carapace. Abdomen sub-equal to cephalo-thorax.

Third maxilliped (fig. 1*d*) short, basis and merus with prominent lateral projections bearing setae.

First peraeopod (fig. 1*e*) with basis having 6 to 7 teeth and plumose setae on inner side. Basis shorter than rest of the appendage by the length of ischium, dactylus and carpus sub-equal, propodus about one and a half times as long as dactylus.

Second peraeopod (fig. 1*f*) stout, with basis as long as the next three tionts ; dactylus longer than the preceding two joints, bears 4 spines at jhe extremity. Peduncle of uropod (fig. 1*g*) slightly longer than rami. with numerous plumose setae and hairs on inner side. Rami sub-equal to last abdominal somite. Exopod smaller than endopod, bears a long



TEXT-FIG. 2.—*Cyclaspis bengalensis*, sp. nov.

a. Lateral view, male × 24 ; *b*. Side view of carapace, male × 50 ; *c*. First peraeopod, male × 85 ; *d*. Second peraeoped male × 85 ; *e*. Third peraeopod, male × 85 ; *f*. Uropod, male × 47.

stout spine at the extremity and 9 spines on inner margin. Endopod with 15 plumose spines and numerous short teeth on inner side.

Distribution.—New Zealand, surface to 15 fathoms.

Cyclaspis bengalensis, sp. nov.

Locality.—

Andamans, Ross channel, 2-9 fathoms. 1921 Single adult ♂ 4·6 mm. long.

Adult male.—(fig. 2*a*). Integument thick. Eye-lobe large, with three large and a few small corneal lenses. Pseudo-rostral lobes do not meet in front of eye-lobe. Carapace about two-seventh as long as total length of animal, its height about half its length and width slightly greater than height. Carapace, possesses a dorsal median carina which vanishes towards the hinder part. Antero-lateral angle of carapace bears a sharp, anteriorly directed curved tooth, the tip of which stands on a level with the tip of eye-lobe. Dorsal to this tooth is a projection as in *C. caprella Hale.*[1]

All five pedigerous somites exposed dorsally, together measuring about half as long as carapace, first somite short, one-third of second.

Pleon longer than cephalothorax, with a prominent mid-dorsal carina on the first five somites. Telsonic somite distally produced between uropods.

First antenna, with basal segment long, second short, third longer, than second.

Basis of third maxilliped distally produced, its tip reaching the distal end of the similar process of merus ; distal process of both bear plumose setae. Ischium very small, merus as long as the combined length of carpus and propodus, dactylus smaller than propodus and sub-equal to ischium, carpus one and a half times as long as propodus.

First peraeopod (fig. 2*c*) extends forwards beyond eye-lobe by the last two segments. Basis equal to the combined length of next four joints, broad inner margin bears 6-8 slender spines at about the middle, its apex which extends beyond ischium bears a long tooth on inner side, ischium short ; merus with a tooth-like prolongation on outer side, which reaches to about the middle of carpus. Propodus as long as the preceding two segments. Dactylus slender, slightly smaller than propodus, bears a curved spine at the tip subtended by two setae.

Basis of second peraeopod (fig. 2*d*) also equal to the combined length of next four joints. Dactylus long, equal to total length of carpus and propodus, carpus with two long spines at its distal end.

Third peraeopod (fig. 2*e*) has basis longer than rest of the limb.

Fourth and fifth peraeopods smaller, due to shortening of basis of the appendages.

Peduncle of uropod (fig. 2*f*) longer than telsonic somite, shows faint serrations on both sides and bears numerous setae on inner side as in *C. herdmani* Calman.[2] Exopod[3] slightly shorter than peduncle. Endopod

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[1] *Hale, Rec. S. Austral. Mus.* V, 4, fig. 2 a. (1936).

[2] Calman, *Rept. Cey. Pearl. Fish.* II, p. 171. (1904).

[3] As the tip of the only exopod in the specimen is broken the presence of spines or mucrones at the tip, which Hale (1944, *Rec. S. Austral. Mus.* VIII, pp. 63-142) mentions as an important character for the identification of the species of this genus could not be

sub-equal to exopod, slightly serrated on both sides, resembles that of *C. herdmani*, and bears 18 indurated spines. On inner side of exopod 5 spines visible.

Type specimen.—C3182/1, Zoological Survey of India, Calcutta.

Cyclaspis bengalensis sp. nov. agrees with *C. caprella* Hale from S. Australia in the presence of an acute forwardly directed spine on each side, below the antennal angle and in the nature of the third maxilliped. But it differs remarkably in the shape of carapace, pedigerous somites and first peraeopod.

The resemblance of this species with *C. herdmani* Calman is only superficial, for there is marked difference in the nature of the first, second, and third peraeopods and the carapace. *C. bengalensis* sp. nov. resembles *C. hornelli* Calman[1] in the nature of the peraeopods and uropods, but the presence of two antero-lateral teeth on each side of carapace and a distincly visible first pedigerous somite distinguishes it from the other related species.

Cyclaspis sp.

Locality.—

Andamans, stream at Corbyn's cove North, Stony bed, 1 damaged ♂ 4·7 mm.

Carapace laterally compressed. Pseudo-rostral lobes just meet in front of the large eye-lobe, which has prominent lenses. Integument with well marked reticulations and pittings. Carapace about two-fifth as long as total length of animal, its height slightly less than its length.

Third maxilliped with distal elongated lobe of basis reaching the extremity of similar process of merus.

Second peraeopod with basis about two-fifth the length of the appendage, ischium half of merus, sub-equal to carpus and propodus. Dactylus long , more than double the length of propodus, bears 4 stout spines at its extremity. Carpus with a plumose seta at the inner edge of its distal end.

As uropods and first peraeopods are missing and the abdomen crushed, identification of the species is not possible. However, it seems to belong to the "*levis*" group of Hale[2].

Genus **Eocuma** Marcusen.

Eocuma taprobanicum Calman.

1904. *Eocuma taprobanicum*, Calman, *Cey. Peral. Oyst. Fish. Rept.* II, p. 161, pl. i, ii, figs. 1-28.

1913. *Eocuma taprobanicum*, Stebbing, *Das Tierreich* XXXIX, p. 20.

1951. *Eocuma taprobanicum*, Kurian, *Bull. Cent. Res. Inst. Trivandrum* II, C, pp. 94-95.

Locality.—

"Port Blair, Andamans 2-5 fathoms, S. Kemp". Reg. No. 9250/10 1 adult ♀ 8·7 mm. long and 1 adult ♂ 10·4 mm. long.

Andamans, Brigade creek, 2-5 fathoms, 21-ii-1915 3 ♀♀, largest 5·1 mm. long and 2 ♂♂ 5·7 mm. long (specimens slightly damaged).

Orissa Coast; 24-ii-1916 1 damaged ♂.

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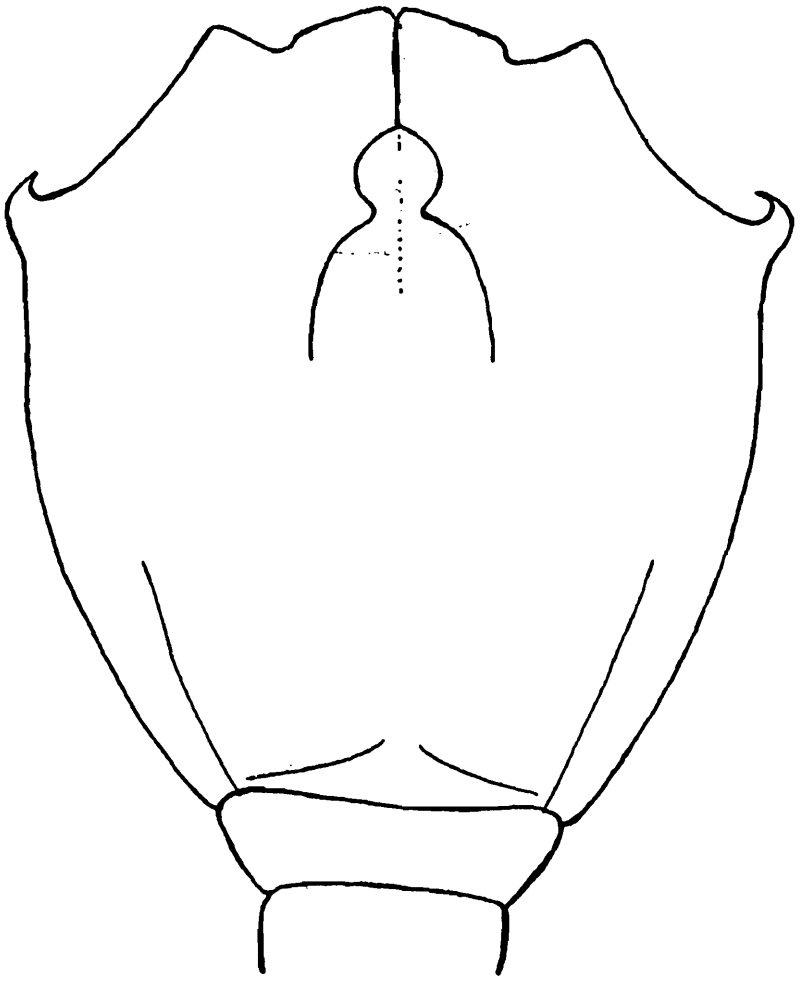
1. Calman, *Rept. Cey. Pearl. Fish.* II, p. 172. (1904).
2. Hale, *Rec. S. Austral. Mus*, VIII, pp. 63-142 (1944).

Male specimens closely agree with the type description of Calman *loc. cit.* In female, external to pseudorostrum, antero-lateral angle shows a small curved tooth, directed forwards, the tip of which stands behind the extremity of pseudo-rostrum. Peduncle of uropod in female bears three or four plumose setae as in the specimens from Trivandrum, Kurian *loc. cit.* Endopod possesses in its proximal half, seven plumose setae on inner edge ; exopod naked, except for minute serrations on outer edge.

Distribution.—Gulf of Manaar 6 to 9 fathoms, Travancore coast 12 to 15 fathoms.



TEXT-FIG. 3.—*Eocuma latum*, Calman. Female, dorsal view of carapace ×28.

Eocuma latum Calman.

1907. *Eocuma lata*, Calman, *Trans. Zool. Soc. London* XVIII, 1, pp. 22, 23, pl. vi, figs. 7-12.

1913. *Eocuma latum*, Stebbing, *Das Tierreich* XXXIX, p. 22.

1951. *Eocuma latum*, Kurian, *Bull. Cent. Res. Inst. Trivandrum* II, C, pp. 96-97.

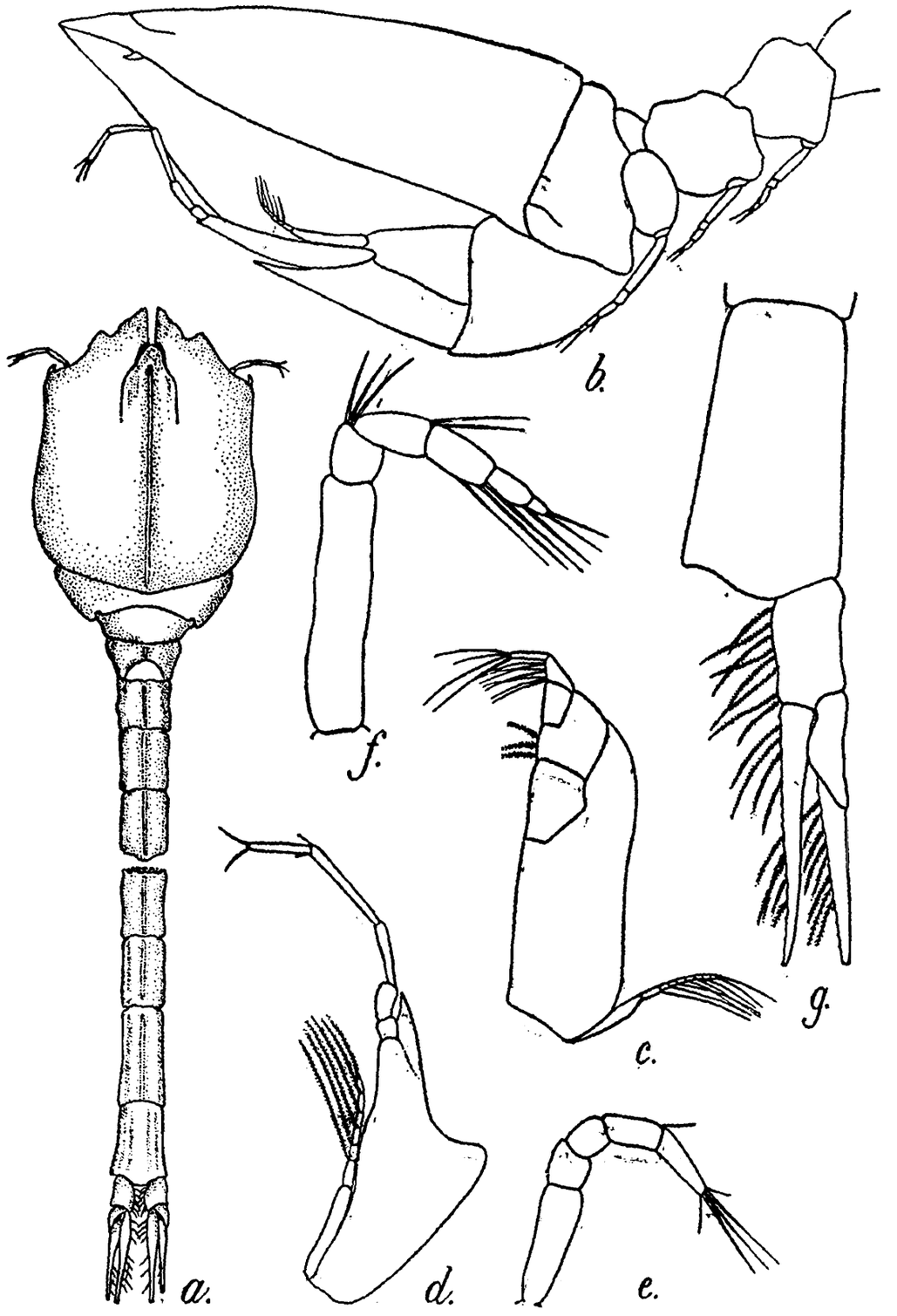
Locality.—

"Byichkwaaw Bay, Tavoy, Surface tow net, 'Investigator'—1911" Single adult ♀ 9·4 mm. long.

In his description of immature female, Calman (*loc. cit.*) observes that "the pseudo-rostrum is prominent and formed as seen from above of two rounded lobes. External to these on each side, the antero-lateral margin forms and obtusely triangular tooth, with an acute spiniform point turned forwards. . " But in the present specimen, th

pseudo-rostral lobes are not distinctly rounded and instead of the obtusely triangular tooth at the antero-lateral margin, there is only a rounded knob-like projection on each side (fig. 3).

Difference is also noticed in the armature of the uropods. There are four plumose setae on the inner edge of the peduncle as against one



TEXT-FIG. 4.—*Eocuma kempi*, sp. nov.

a Dorsal view, female × 6; *b*. Side view of cephalo thorax, female × 13; *c*. Third maxilliped, female × 24; *d*. First peraeopod female × 24; *e*. Second peraeopod, female × 85; *f*. Third peraeopod female × 85; *g*. Telsonic segment and uropod, female × 24.

mentioned by Calman and about a dozen plumose setae on the inner side of endopod (Calman *ibid* mentions only one plumose seta and three spinules). Exopod also possesses four smaller setae on the inner side of its proximal half.

The differences from the type may be due to the disparity in age of the individuals ; the present specimen is an adult female where as the type is only immature female 3·9 mm. long.

Distribution.—Gulf of Siam 5 to 10 fathoms, Trivandrum 12 fathoms.

Eocuma kempi, sp. nov.[1]

Locality.—

"Madras, collected by Prof. Ramunni Menon, 19-ii-1911" 1 ovigerous ♀ 14·2 mm. long.

Ovigerous female (fig. 4*a*). Body rigid, integument calcareous and brittle, with reticulations. Ocular lobe longer than broad and pseudo-rostral plates meet in front of it for about one sixth the length of carapace. Lenses and pigment in eye-lobe indistinct.

Carapace one-third as long as total length of body ; depth about one-third its own length ; maximum width three-quarters its length, the widest part being towards the hinder region. Carapace bears a prominent dorsal median carina commencing from the centre of eye-lobe and extending to hind end. Lateral cornua small and tooth like, mounted on antero-lateral lobes of carapace, and not formed as lateral prominences of antero-lateral lobes of carapace as in other species of the genus. A second lobe present on each side of carapace in between lateral cornua and pseudo-rostrum as in *E. lata* Calman,[2] but here a spine absent at the summit of the lobe.

Free pedigerous somites together about as long as half the length of carapace ; first somite indistinct, second large, third small and partially covered dorsally by the projections of second and fourth somites. A dorsal median carina prominent on second, fourth and fifth pedigerous somites. Lateral tumidities present on all free pedigerous somites.

Pleon[3] long and slender, longer than cephalothorax ; penultimate segment longest ; telsonic somite expanded towards hind end for the articulation of uropods. Dorsal median carina present on first four somites.

Joints of third maxilliped (fig. 4*c*), expanded sideways to function like opercles ; basis very broad, about as long as total length of the succeeding four joints, its distal outer corner produced into a long curved process which reaches to about half the length of a similar process of merus ; ischium two and a half times as long as merus excluding its distal process ; carpus slender, slightly longer than merus, external distal process of merus reaches the extremity of carpus ; propodus smaller than merus, conical and bears long setae on its inner edge ; dactylus double the length of propodus with setae at the free end.

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[1] Named in honour of the Late Dr. Stanley Kemp.

[2] Calman, *Trans. Zool. Soc. London* XVIII, 1, pp. 22, 23, pl. vi, figs. 7-12 (1907).

[3] Pleon broken in to two.

First peraeopod (fig. 4*d*) small and slender, not extending beyond pseudo-rostrum ; basis broad and flattend, slightly smaller than rest of limb, its distal half tapering and produced beyond articulation of ischium into a long sharply pointed process as in *E. travancoricum* Kurian[1] reaching to almost the distal extremity of merus ; ischium small, only half as long as the curved merus ; carpus slender, thrice the length of ischium ; propodus longer than carpus and dactylus smaller than carpus.

Second peraeopod (fig. 4*e*) very short ; basis less than total length of next three joints ; merus and carpus sub-equal ; propodus longer than carpus and smaller than the conical dactylus, which bears three or four long setae at the extremity.

Third, fourth and fifth peraeopods almost similar, with long basis.

Peduncle of uropod (fig. 4*g*) about one-third as long as telsonic somite bears 8 plumose setae on inner margin ; rami sub-equal, more than twice the length of peduncle, both endopod and exopod bear numerous setae on their inner edges.

Type specimen.—C 3186/1, Zoological Survey of India, Calcutta.

E kempi, sp. nov. agrees with *E. producta* Calman[2] in the shape of the eye-lobe and the pseudorostrum, but differs from it in the shape of the carapace and appendages. *E. kempi* is unique in its large size, in the presence of a tooth-like lateral cornua on the carapace and in having very broad basis for the third maxilliped and first peraeopod.

Subfamily VAUNTHOMPSONIINAE.

1944. *Vaunthompsoniinae*, Hale, *Trans. Roy. Soc. S. Austral.* 68 (2), p. 233.
1951. *Vaunthompsoniinae*, Kurian, *Bull. Cent. Res. Inst.* II, C, pp. 100, 101.

The key to the genera in the sub-family Vaunthompsoniinae, Hale (*loc.cit.*) may be modified as follows so as to include the genera, *Gigacuma* Kurian[3] and *Pseudosympodomma*, Gen. nov.

1.	Basis of third maxilliped greatly expanded interiorly. First peraeopod with joints curiously expanded	2
	Basis of third maxilliped not expanded interiorly. First peraeopod devoid of curious expansions . .	4
2.	Pleon unusually short, never more than two-thirds as long as cephalothorax. First antenna strongly geniculate with joints of peduncle sub-globose	*Gephyrocuma Hale.*
	Pleon not unusually short, at least as long as cephalothorax. First antenna not strongly geniculate and joints not globose . . .	3
3.	Telsonic somite sub-truncate, scarcely produced posteriorly. Basis of third maxilliped with large inner distal lobe and basis of first peraeopod with no distal lobe	*Zenocuma Hale.*
	Telsonic somite well produced posteriorly. Basis of third maxilliped without inner distal lobe . . .	*Pomacuma Hale.*

[1] Kurian, *Bull. Cent. Res. Inst.* II, C, pp. 97-99 (1951).
[2] Calman, *Trans. Zool. Soc. London.* XVIII, 1, pp. 24, 25 (1907).
[3] *Bull Cent. Res. Inst.* Trivandrum II (c) pp 100 101 (1951).

4.	Second peraeopod with a distal brush of setae on propodus and dactylus, but no spines. Fourth peraeopod of female with small exopod	*Leptocuma* Sar
	Second peraeopod without brushes of setae on terminal joints, but with spines at least on dactylus. Fourth peraeopod of female without exopod.	5
5.	Dorsal plate of telsonic somite subtruncate posteriorly and not produced between bases of uropods	6
	Dorsal plate of telsonic somite rounded or somewhat angular posteriorly and produced between bases of uropods	7
6.	Dorsal plate of telsonic somite truncate posteriorly. Endopod of pleopod with narrow external process. External distal portion of basis of third maxilliped not produced	*Cumopsis Sars.*
	Dorsal plate of telsonic somite excavated posteriorly. Endopod of pleopod without external process. External distal portion of basis of third maxilliped produced as a prominent lobe	*Heterocuma*, Miers.
7.	Third maxilliped with external distal portion of basis absent or not strongly produced and with ischium short (much wider than long); merus much longer than ischium, but shorter than carpus	*Vaunthompsonia* Bate.
	Third maxilliped with external distal portion of basis prominently produced and with ischium at least as long as wide, sub-equal in length to merus and carpus	8
8.	Eye absent	9
	Eye present	10
9.	Pseudo-rostral lobes meeting in front of ocular lobe. Telsonic portion of last pleon somite much shorter than rest of somite .	*Bathycuma* Hansen.
	Pseudo-rostrall obes not meeting in front of ocular lobe. Telsonic portion of last pleon somite as long as rest of somite	*Guassicuma* Zimmer.
10.	Fourth peraeopod of male with exopod	*Glyphocuma* Hale.
	Fourth peraeopod of male without exopod .	11
11.	Third peraeopod with exopod	*Sympodomma* Stebbing.
	Third peraeopod without exopod .	12
12.	Eye-lobe linguiform, with a cluster of lenses at the extremity. Distal process of basis of first peraeopod reaches beyond the extremity of merus	*Pseudosympodomma* Gen. nov.
13.	Eye-lobe not linguiform. Distal process of basis of first peraeopod stops behind the extremity of merus .	*Gigacuma* Kurian.

Genus **Gigacuma** Kurian.

Gigacuma halei Kurian.

1951. *Gigacuma halei*, Kurian, *Bull. Cent. Res. Inst.* II, C, pp. 102-105, pl. ii-iv, figs. 25-43.

Locality.—

"Off puri, Orissa 4 to 4½ fathoms, m.s. 24-iii-1916 s.w.k. Cumacea" 29 ♀♀, largest 14·2 mm. long, mostly ovigerous.

Off Ganjam 7 to 8 fathoms, Marine survey. January 1890. Reg. No. 5024/10 2 adult ♂♂ 9·0 mm. and 8·5 mm. long.

Specimens in the present collection closely agree with the type. Spine like projection at the inner distal corner of basis in first peraeopod larger and better developed. Armature of uropods also similar to that in type, but in some specimens four stout spines are prominent on peduncle.

Distribution.—Trivandrum, Vizhingom and Cape Comorin (Travancore), 12 to 15 fathoms.

Genus **Heterocuma** Miers.

1879 *Heterocuma*, Miers, *Proc. Zool. Soc.* London, p. 22.

1913. *Heterocuma*, Stebbing, *Das Tierreich* XXXIX, pp. 48, 49.

This genus is so far represented only by 4 forms collected from China and Japan Seas and Africa Coasts. Fage (1924)[1] considers that the presence of a two-jointed expodite on the second and third peraeopods in *Heterocuma intermedia* brings together the two genera *Sympodomma* and *Heterocuma* and adds justification for including both the genera in the same family—*viz.* Bodotriidae. *Heterocuma* may be identified from its ally *Cumopsis* by the excavated dorsal plate of telsonic somite which is not produced between uropods, by the absence of an external process on the endopod of pleopod and by the prominent distal lobe of the basis of third maxilliped.

Two new species are proposed here for the reception of specimens from Andamans, Madras and Orissa Coasts.

Key to the species of *Heterocuma* Miers.

1.	Carapace with distinct median dorsal carina .	2
	Carapace without a median dorsal carina	5
2.	Exopodites of second and third pairs of peraeopods simple and undivided. .	3
	Exopodites of second and third pairs of peraeopods divided into 2 articles	*intermedia* Fage.
3.	Pseudo-rostral lobes do not meet in front of eye-lobe. Fourth and fifth pedigerous somites carinated. First joint of endopod of uropod shorter than second	*andamani*, sp. nov.
	Pseudo-rostral lobes meet in front of eye-lobe. Fourth and fifth pedigerous somites not carinated. First joint of endopod of uropod longer than second	4

[1] Fage, *Bull. Mus. Nat. Hist.* XXX, pp. 364-367 (1924).

4. Carapace without granules. Carinae on pleon feeble .	*sarsi* Miers.
Carapace with tuberculiform granules. Carinae on first five pleon somites strongly marked	*sarsi* Var. *granulatum* Miers.
5. Pseudo-rostral lobes meet in front of eye-lobe. Joints of endopod of uropod sub-equal	*africana* Zimmer.
Pseudo-rostral lobes do not meet in front of eye-lobe. First joint of endopod of uropod longer than second	*armata*, sp. nov.

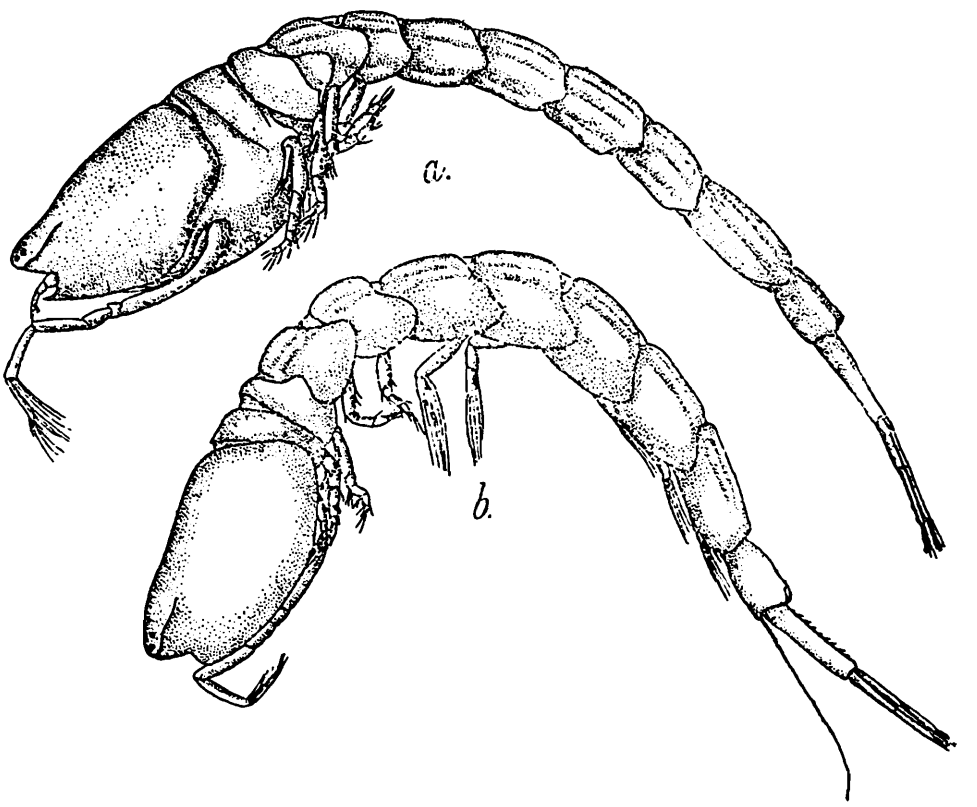
Heterocuma andamani, sp. nov.

Locality—

Andamans, Off pier, Ross Island, 3 to 4 fathoms. 22/23-ii-1915 39♀♀; 7♂♂

Andamans, Ross channel, 2 to 9 fathoms. 1921 4♀♀; 1♂.

Andamans, stream at Corbyn's cove North (Andamans 9) 1♀.



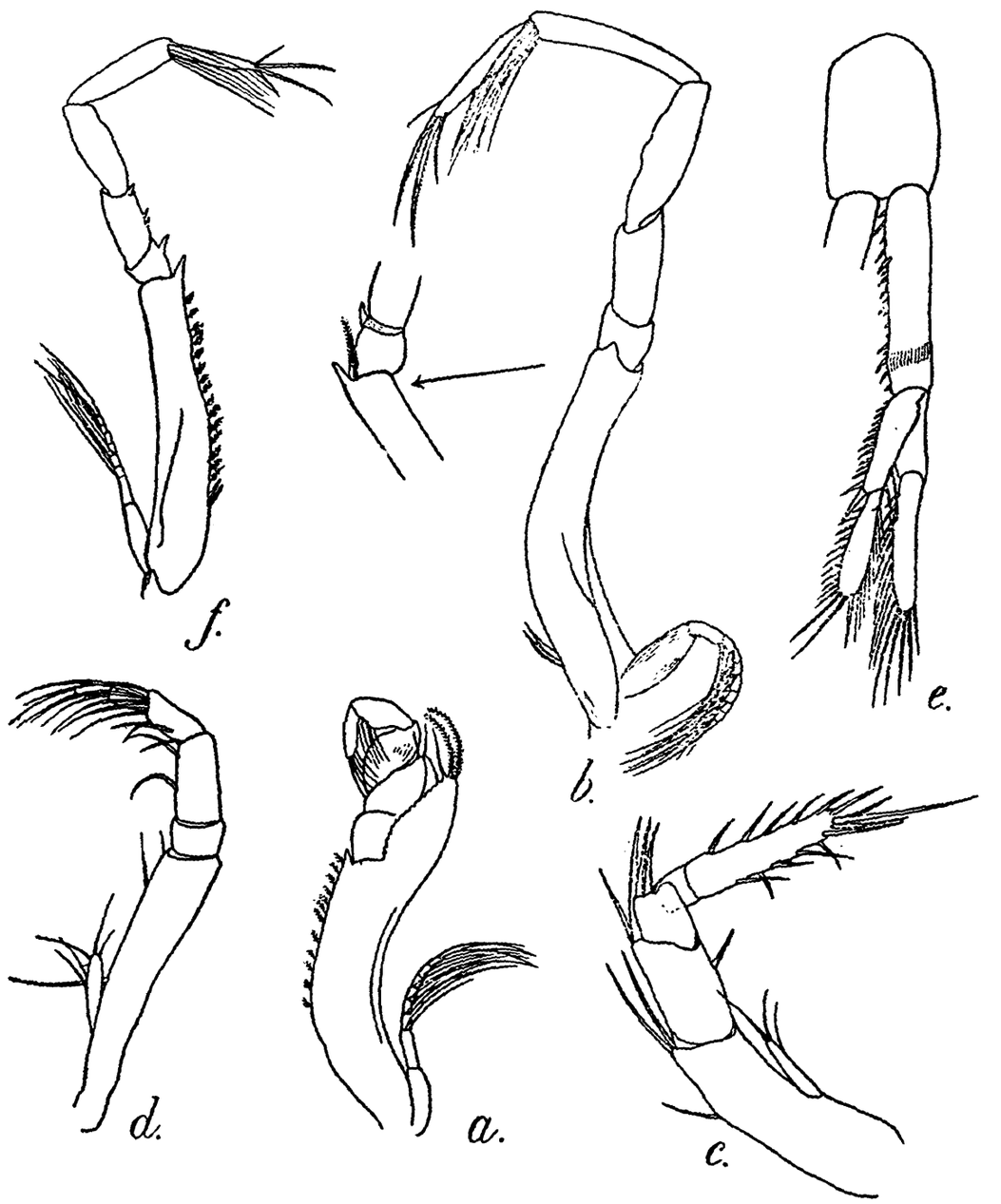
TEXT-FIG. 5.—*Heterocuma andamani*, sp. nov.
a. Lateral view, female × 12; *b*. Side view male × 12.

Ovigerous female.—Length 7·9 mm. (fig. 5*a*). Resembles *H. sarsi var. granulatum* in shape, but smaller in size. Carapace smooth, except for the dorsal median carina which is prominent in the anterior half of carapace, towards the distal half it is faint and gets doubled. Pseudo-rostral lobes do not meet in front of eye-lobe. Eye-lobe pigmented with 3 lenses, subrostral notch deep, antero-lateral angel of carapace acute, and bears a short sharp tooth. Lateral margins of carapace show faint serrations anteriorly.

Free thoracic region as long as carapace, first pedigerous somite arrow and visible only dorsally, second large and more than three times as long as the first, fourth and fifth somites with a pair of prominent carinae on each side, situated above the lateral articulation of the somites.

A dorsal median carina extends from first pedigerous somite to last pleon somite. First five somites also with prominent dorso-lateral and lateral carinae as in *var. granulatum*. A faint infero-lateral carina noticeable in the first four pleon somites. Telsonic somite, only with a single dorso-lateral pair of carina.

Basal joint of first antenna large, serrated on inner edge and slightly shorter than the combined lengths of the succeeding two sub-equal joints.



TEXT-FIG. 6 .—*Heterocuma andamani*, sp. nov.

a. Third maxilliped, female × 35 ; *b*. First peraeopod. female × 35 ; *c*. Second peraeopod, female × 50 ; *d*. Third peraeopod, female × 50 ; *e*. Telsonic segment and uropod, female × 22 ; *f*. First peraeopod, male × 35.

Second antenna resembles that of *H. sarsi*, but the large proximal joint bears 8 stout plumose setae on inner edge, where as there are only 4 setae in the allied species.

First maxilliped has a broad propodus and bears 6 sharp teeth on inner side.

Second maxilliped with broad propodus ; dactylus very small, less than half the preceding joint, bears at its tip a long, strong spine.

Basis of third maxilliped (fig. 6*a*) longer than the rest of limb, its external distal lobe almost reaching the extremity of a similar process of merus and bears two plumose setae at the summit and strong serrations and a few setae on inner side.

Basis of first peraeopod (fig. 6*b*) shorter than rest of limb. As in *H. sarsi* two spines present towards the base on inner side. Distal end of basis produced into a sharp, dagger shaped tooth on inner side. Ischium also with a short tooth on inner side towards its distal extremity ; carpus and propodus sub-equal, the latter possesses a group of long setae at its distal end ; dactylus only four-fifth as long as its preceding joint, bears at its extremity two long, stout, serrated spines in addition to the smaller setae and spines.

Basis of second peraeopod (fig. 6*c*) short, smaller than the rest of limb, bears a single jointed exopod, which does not reach the extremity of the segment that bears it. Dactylus long and clothed with spines and setae.

Third peraeopod (fig. 6*d*) slender basis longer than the total length of the succeeding joints, exopod resembles that of second peraeopod.

Peduncle of uropod (fig. 6*e*) longer than last pleon somite, bears numerous short spines on inner margin. Rami longer than peduncle. Endopod some what shorter than exopod, two jointed, first joint slightly smaller than second, bears 12 spines on inner margin, of which the last one very long and stout ; second joint also clothed with numerous long setae and spines on the margins and extremity.

Adult male.—Length 7·3 mm. (fig. 5*b*). Carapace as in female. Pseudo-rostral lobes do not meet in front of eye-lobe. Sub-rostral notch shallow. In young male, antero-lateral angle of carapace bears a tooth as in female, but in adult male antero-lateral angle not produced, but truncated.

Free thoracic portion slightly shorter than carapace, first pedigerous somite small and visible only dorsally, fourth and fifth somites bear lateral, dorso-lateral and median carinae which are distinct in young as well as in adult specimens.

Pleon longer than cephalothorax, with carinae on somites as in female.

Appendages of male more or less as in female, but smaller in size. Basis of first peraeopod (fig. 6*f*), possesses numerous small plumose hairs on inner margin, merus with a pair of small teeth on inner margin near its base.

Peduncle of uropod resembles that of female, bears 20 unequal spines on inner margin, slightly shorter than endopod, which in turn is shorter than exopod. First joint of endopod smaller than second, carries 10 spines, of which the last one large, second bears 12 graded spines, fringing inner margin and extremity. Exopod also carries numerous setae.

Type specimen.—Kept in the Zoological Survey of India.

The present species, though it superficially resembles *H. sarsi* and the *var. granulatum*, a careful study of the appendages and the proportionate lengths of the carapace, free thorax and abdomen shows that it is quite distinct from the allied Japanese forms. *H. andamani*, sp. nov. may be distinguished from the related species by the shorter pseudorostral lobes, the carinated fourth and fifth pedigerous somites, the nature of the second antenna in female, and the endopod of uropod, the first joint of which is shorter than the second.

Heterocuma sarsi Miers.

1879. *Heterocuma sarsi*, Miers, *proc. Zool. Soc. London*, pp. 22, 58, pl. iii, fig. 3.
1913. *Heterocuma sarsi*, Stebbing, *Das Tierreich* XXXIX, p. 49.
1951. *Heterocuma sarsi*, Kurian, *Bull. Cent. Res. Inst.* Trivandraum, II, C, p. 105.

Locality.—

" One tube of crustacea received from the University of Amoy, China for Dr. S. Kemp, 12-ii-1924" : One adult ♀ 16·5 mm. long.

Adult female.—Cephalothorax shorter than abdomen, dorsal median carina of carapace prominent only in its anterior half, the shallow depressions mentioned as occurring on the sides of carina[1] not noticed. Eyelobe longer than board, with dark pigmented eye, lenses indistinct.

Dorso-median carina indistinct on pleon somites. The long stout tooth at the distal end of basis of third maxilliped reaches beyond the limit of ischium ; external prolongation of merus long and bluntly produced, reaching almost the extremity of the broad carpus.

Basis of first peraeopod with a long stout tooth at its distal end, which reaches to about four-fifths the length of the next joint ; ischium also prolonged distally into two short prominences.

Slight differences also noticed in the joints and armature of uropods Peduncle longer than last pleon somite, bears 19 spines on inner margin exopod equal in length to peduncle, bears 33 plumose setae fringing inner edge and extremity. Endopod slightly smaller than exopod. (Peduncle shorter than exopod and sub-equal to endopod, Miers *loc. cit.*) First joint of endopod long, bears 18 short spines and a large distal spine on inner margin and 15 plumose setae on outer border ; second joint carries 12 spines on inner margin and 10 plumose setae on outer side.

Distribution.—Korean and Japanese Seas, 73 to 91 m., adult male and immature female ; Trivandrum 15 fathoms, immature males.

Heterocuma africana Zimmer.

1921. *Heterocuma africana*, Zimmer, *Mitt. Zoolog. Mus. Berlin* x, pp. 129-131, figs. 25-27.

Locality.—

Andamans. Off pier, Ross Island, 3 to 4 fathoms 22/23-ii-1915 : 1 adult ♀ 7·7 mm. and 1 adult ♂ 8·1 mm. long.

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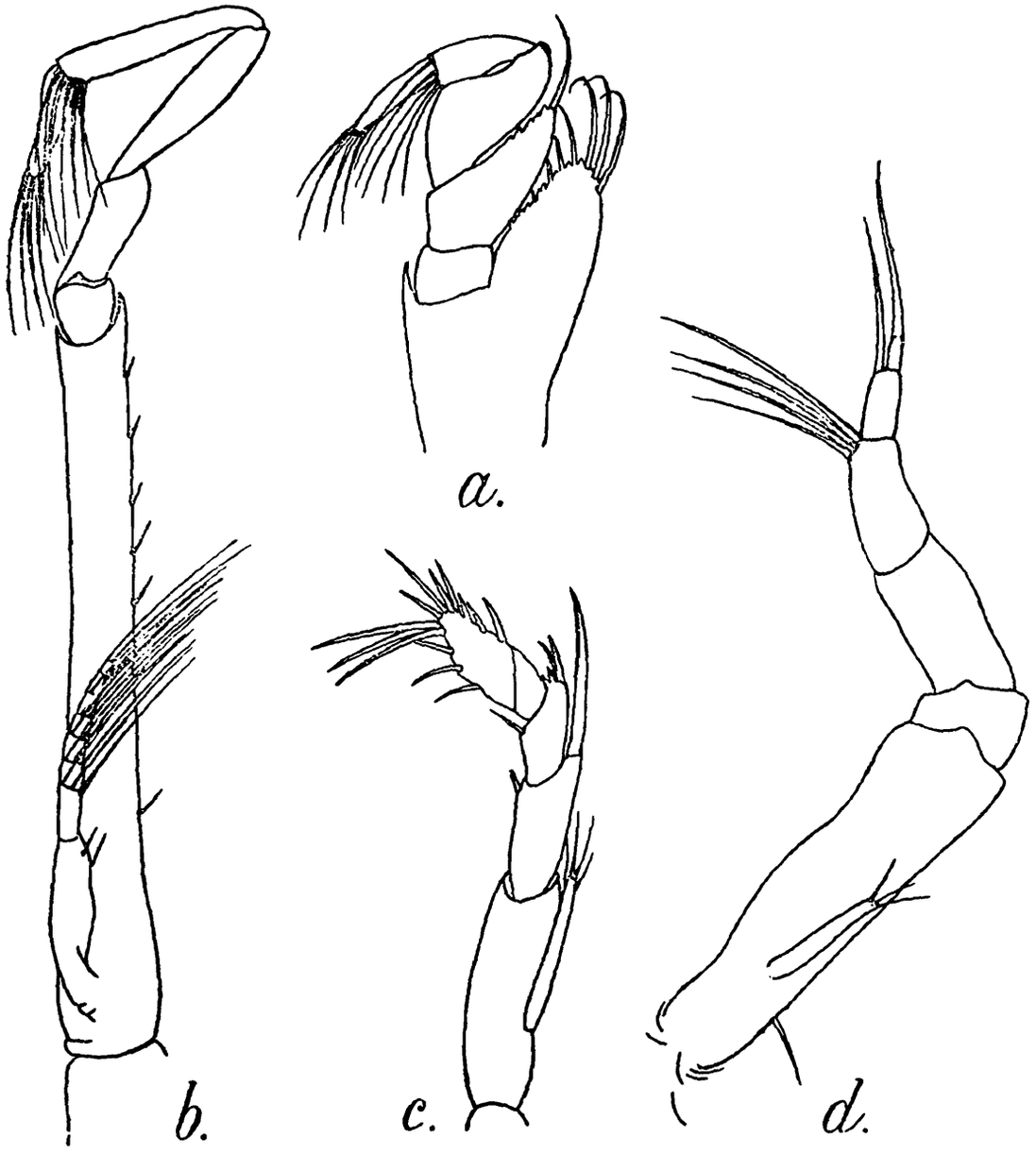
[1]. Calman, *Ann. Mag. Nat. Hist.* (8) VI, pp. 612-614, pl. x, figs. 1-13 (1910).

Zimmer (*loc. cit.*) recorded this species from "half grown animals and young forms", the largest specimen measuring only 4 mm. in length, collected from Free Town (West Africa). The notable characters of the adult specimens in the present collection and their differences with the type are given below.

Adult female.—First peraeopod longer than in type, last two joints and half of fifth joint extending in front of pseudo-rostrum ; dactylus very small, being only half the length of sub-equal carpus and propodus.



TEXT-FIG. 7.—*Heterocuma africana* Zimmer.

a. Third maxilliped (distal part) male × 65 ; *b*. First peraeopod, male × 45 ; *c*. Second peraeopod, male × 65 ; *d*. Third peraeopod, male × 65.

Second peraeopod imperfect, but basis shows the complete exopodite which resembles the one described by Zimmer (*ibid.*).

Exopod of third peraeopod smaller than in second. Peduncle of uropod slightly smaller than penultimate somite (peduncle equal to penultimate somite, Zimmer *ibid.*), carries 12 spines on inner margin in place of 7 described by Zimmer. Endopod equal to peduncle, first

joint sub-equal to second. Armature of endopod also different from that of type. Fringing inner margin and extremity of first and second joints are 10 and 11 spines respectively, compared with 6 spines on each of the two joints in type. Exopod slightly longer than endopod and bears numerous long setae and spines on inner margin and free end.

Adult male.—Resembles female in all essential characters. Height of carapace about half its length, sub-rostral notch shallow, sub-rostral angle blunt and rounded, without tooth. Eye-lobe longer than broad, with lenses indistinct as in female. Pleon slightly longer than cephalothorax, telsonic somite dorsally constricted at about its middle.

Third maxilliped (fig. 7*a*) almost as in female (Zimmer *ibid.*), basis distally produced into a lobe which bears 8 plumose setae fringing inner margin and tip.

Carpus and propodus of first peraeopod (fig. 7*b*) sub-equal, the latter with very long setae at its inner distal corner ; dactylus very short, only half as long as preceding segment, bears long terminal setae.

Basis of second peraeopod (fig. 7*c*) slightly shorter than rest of limb, ischium suppressed as in female. The strong spine at the end of merus longer than the segment that bears it. Two smaller spines also present at outer distal corner of carpus. Dactylus long and bears numerous spines around distal half and extremity of the segment. Exopod rudimentary, reaches slightly beyond the end of basis and bears terminal setae.

Third peraeopod (fig. 7*d*) with stout basis, which is sub-equal to rest of limb. Exopod short, only one-third the length of basis.

Peduncle of uropod slightly smaller than penultimate segment and bears numerous spines on inner margin. Endopod shorter than peduncle, first joint nearly equal to second and bears 10 short spines on inner margin and a large spine at its extremity ; second joint carries 13 spines fringing inner margin and free end, those at extremity being very long. Exopod slightly longer than endopod, resembles that of female in armature.

Heterocuma armata, sp. nov.

Locality.

"Off Puri, Orissa, 4-4½ fathoms. 24-iii-1916. s.w.k." : 2 ♀♀ (1 adult & 1 ovigerous 4 mm. long.

"Madras Station 13" : 1 adult ♀ 4·7 mm. long.

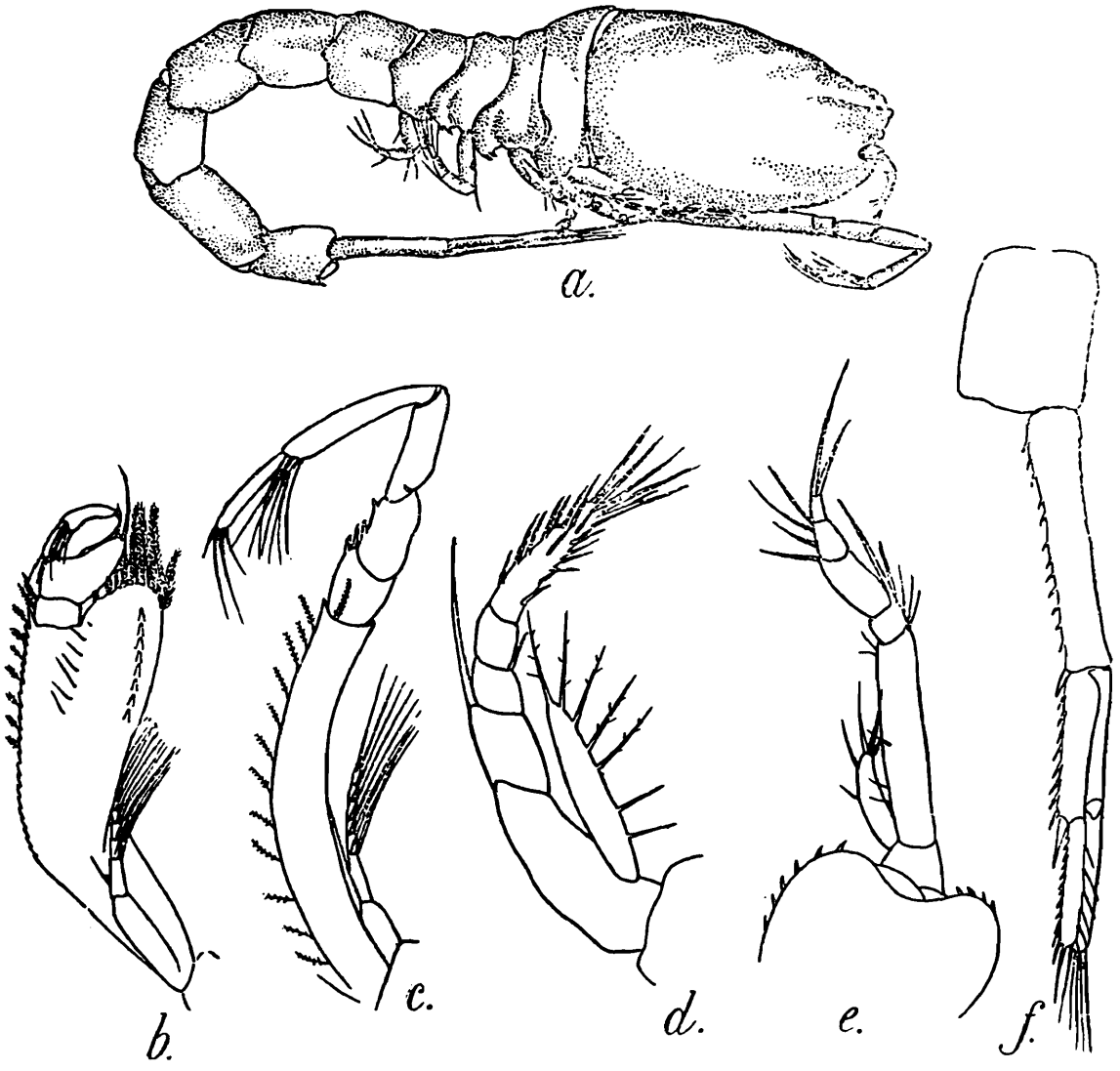
Adult female (fig. 8*a*).—Pseudo-rostral lobes do not meet in front of eye-lobe, which is slightly upturned. Eye-lobe as broad as long, eye pigmented, three small lenses discernible. Carapace stout, about one-quarter longer than the free thorax, and its dorsal profile slightly wavy. Carina not present on carapace. Sub-rostral notch deep. Antero-lateral angle slightly rounded ; lateral margins of carapace serrated in its anterior half.

Surface of body reticulated and pitted in appearance.

First pedigerous somite small, visible only dorsally; second large, about twice as long as third. All thoracic somites devoid of carinae. Pleural lobes of third and fourth somites large, each bearing on its side five or six backwardly directed sharp teeth in its hinder half, of which at least two or three are visible in side view without dissection.

Pleon slightly longer than cephalothorax, devoid of carinae, telsonic somite only two-thirds as long as its previous segment.

Basal joint of first antenna stout, serrated on inner side, slightly longer than the sub-equal second or third joint.



TEXT-FIG. 8.—*Heterocuma armata*, sp. nov.
a. Lateral view female × 22 ; *b*. Third maxilliped female × 58 : *c*. First peraeopod female × 58 ; *d*. Second peraeopod, female × 73 ; *e*. Third peraeopod, female × 73 ; *f*. Telsonic segment and uropod, female × 50.

Basis of third maxilliped (fig. 8*b*) longer than rest of limb, very broad especially at distal end, its inner margin distinctly serrated and provided with small plumose setae. Lateral side of outer distal lobe of basis bears a longitudinal ridge with 8 stout teeth.

First peraeopod (fig. 8*c*) stout, extends in front of pseudo-rostrum by the last three joints ; basis shorter than rest of limb, prolonged distally into a sharp tooth on inner side ; ischium long, with two spines at inner distal corner; merus also with two smaller teeth on its inner

margin ; carpus sub-equal to merus ; propodus longer than carpus or dactylus.

Basis of second peraeopod (fig. 8*d*) stout, smaller than rest of limb, prolonged distally into a blunt tooth on inner side ; ischium suppressed ; merus as long as total length of the succeeding two joints ; carries at inner distal corner a long stout spine which reaches to about half the length of dactylus ; dactylus long and bears numerous spines and stout setae. Exopod of second peraeopod long, single-jointed, reaches to almost the extremity of merus and carries 7 or 8 ciliated setae. Possession of a long exopod on second peraeopod distinguishes this species from other species in the genus.

Third peraeopod (fig. 8*e*) slender, with long basis. Exopod small, reaching only to half the length of basis, carries two setae at the extremity and three or four setae on the stem.

Peduncle of uropod (fig. 8*f*) longer than last pleon segment, bears 13 spines on inner edge, of which last one large. Endopod shorter than peduncle, two jointed ; first joint longer than second, bears 10 spines, of which the distal one large ; second joint serrated on inner side, bears 12 spines and 4 to 6 setae fringing inner edge and extremity. Exopod slightly longer than endopod, well clothed with setae and spines.

Type specimen.—C 3195/1, Zoological Survey of India, Calcutta.

The present species is represented only by female specimens and these can be distinguished from other allied species by the slightly wavy profile of carapace, the enlarged pleural lobes of third and fourth pedigerous somites bearing anteriorly directed teeth, the broad and flattened third maxilliped bearing a row of teeth on the lateral face of the distal lobe of basis and by the stout second peraeopod which has large single jointed exopod reaching beyond the extremity of ischium.

Genus **Pseudosympodomma** nov.

Ocular lobe narrowly linguiform, with a cluster of lenses at the anterior end as in *Sympodomma* Stebbing [1]. Pseudo-rostral lobes do not extend in front of eye-lobe. Five pedigerous somites exposed, the first short and visible only dorsally. Pleon longer than cephalotharax, telsonic somite well produced posteriorly.

First antenna with two-jointed accessory flagellum. Mandible with strong molar processes ; second maxilliped with broad basis ; basis of third maxilliped with a large distal lobe ; merus expanded as in *Sympodomma*. First two pairs of peraeopods with well developed exopods in both sexes and succeeding peraeopods as in *Gigacuma* Kurian[2] without any trace of exopod. Basis of first peraeopod not as long as rest of limb ; second peraeopod has a long and slender dactylus. Endopod of uropod two-jointed. Five pairs of pleopods in male.

Genotype : Pseudosympodomma indica, kept in the Zoological Survey of India.

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[1] Stebbing. *Rec. S. Afri. Mus.* X, p. 138 (1912).
[2] Kurian, *Bull. Cent. Res. Inst.* Trivandrum II, C, p. 100 (1951).

Evidence of sexual dimorphism is noticed in this genus as in the genus *Glyphocuma* Hale.[1] The ovigerous female specimen possesses a dentate crest on the carapace, where as in the adult male the crest is smooth and devoid of serrations. However, young specimens are not available to prove the validity of this presumption as in the case of *Glyphocuma*.

Though this genus comes close to *Glyphocuma*, it differs from the latter in the absence of exopods on the third and fourth peraeopods in both sexes and in having the merus of the third maxilliped more expanded externally. *Pseudosympodomma* resembles *Gigacuma* Kurian, chiefly in the possession of well developed exopods on the first two peraeopods and in the absence of any trace of exopod on the succeeding legs ; but differs from it in the possession of the narrow linguiform eye-lobe ; in the nature of the third maxilliped, first and second peraeopods and the incised condition of the carapace in the ovigerous female.,

The resemblance of this genus to *Sympodomma* Stebbing is not less significant. The general shape of the body, the nature of the armature on the carapace in female, the presence of carinae on the carapace, thorax and abdomen ; the linguiform eye-lobe with cluster of lenses the short pseudo-rostral lobes and the nature of the second peraeopods, agree with that of *Sympodomma*. But the present genus is distinct from the related genus in the absence of exopod on the third peraeopod in both sexes. In this connection it may not be out of place to discuss the position of Stebbing's *S. africanus*. On consulting with Dr. H. M. Hale, Director of the South Australian Museum as regards the relation of the present species with *S. africanus* Stebbing, he informs[2] " in discussing this genus (Sympodomma) one comes up against the fact that there is doubt as to whether Stebbing's *africanus* has exopods on the third legs. " In Stebbing's description of the species he says " exopods to the third pair were not satisfactorily made out, but may be presumed as they occur in both sexes of the allied Japanese species *viz. Heterocuma diomedeae* and *H. weberi* recorded by Calman " In his figure of *S. africanus*[3] no trace of exopod is shown on the third peraeopod. As exopods have been noticed by Stebbing only on the first and second peraeopods, the species may be removed from the genus *Sympodomma* and as suggested by Hale (*ibid.*) it is probable that *S. africanus* Stebbing is referable to the present genus.

Pseudosympodomma indica, Gen. *et.* sp. nov.

Locality.—

"Kilakarai, Ramnad Dist. from weeds 0-2 fathoms. February 17-1913 s.w.k."
Ovigerous ♀ 9·7 mm., adult ♂ 8·8 mm. long.

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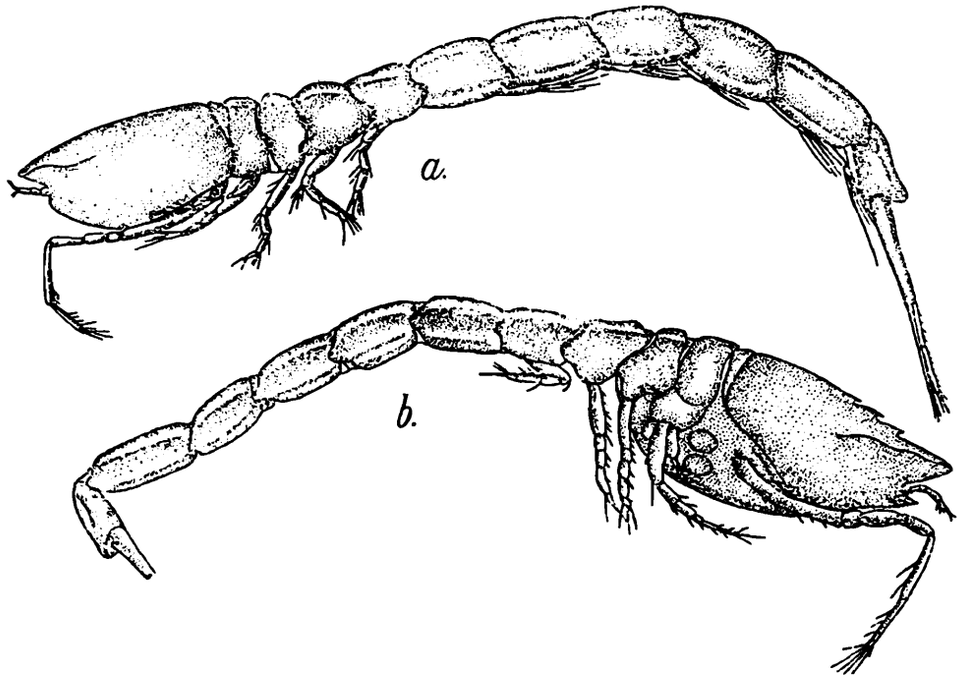
[1] Hale, *Trans. Roy, Soc. S. Austral.* 68 (2), p. 268 (1944).

[2] Extract of a letter from Dr. H. M. Hale, Director of the South Australian Museum.

[3] Stebbing, *Ann. S. Afri. Mus.* X, pl. L (1912).

Adult male.—(Fig. 9*a*). Carapace about one-fifth of total length of animal, and depth half its length ; surface smooth, except for the distinct median dorsal carina, which bifurcates towards its hinder half, the two arms running close and parallel to each other. Dorsal profile of carapace slightly arched. Antennal notch obtuse, antennal angle rounded. Anterior half of the infra-lateral margin of carapace bears about 12 serrations, of which those in front are more prominent. Ocular lobe narrow and linguiform as in *Sympodomma*, its anterior part pigmented and shows 7 large lenses. Pseudo-rostral lobes short, and not extending beyond the distal extremity of eye-lobe.

Total length of pedigerous somites same as that of carapace ; first somite small and devoid of carinae ; second about twice as long as first, and possesses a dorsal median carina ; third, fourth and fifth bear dorsal and dorso-lateral carinae, the latter being more pronounced. Fourth pedigerous somite with a narrow pleural extension, which overlaps the posterior part of the preceding somite.



TEXT-FIG. 9.—*Pseudosympodomma indica*, Gen. *et.* sp. nov.
a. Lateral view, male × 18 *b*. Lateral view, female × 18.

Pleon nearly one and a half times as long as cephalo-thorax, first five somites possess dorsal and dorso-lateral carinae as in pedigerous somites and a faint infra-lateral projection. Telsonic somite shows only a weak lateral carina which is prominent only in its centre.

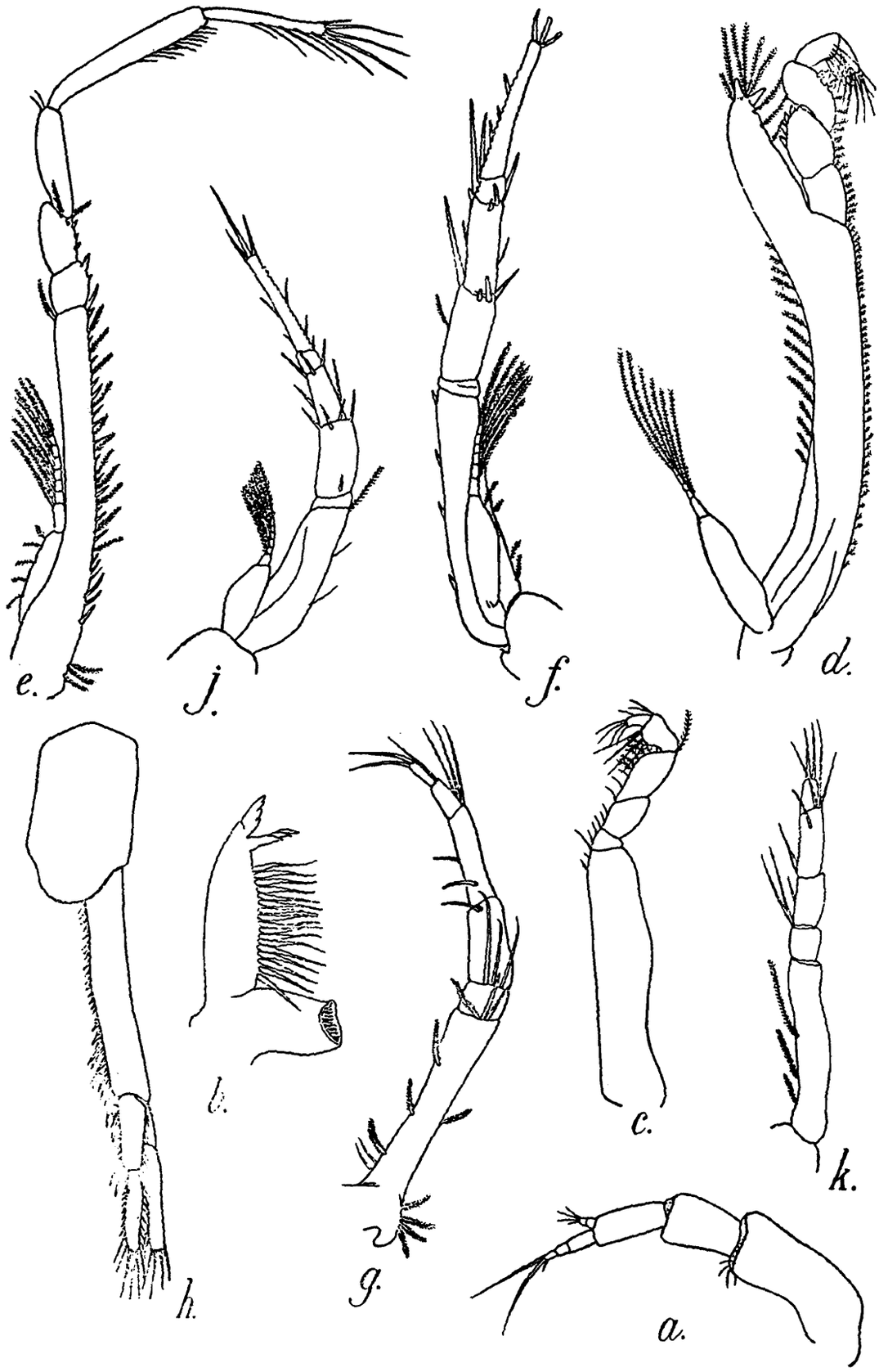
Basal joint of first antenna (fig. 10*a*) stout and as long as combined length of the suceeding two joints ; last joint slender ; accessory flagellum two-jointed.

Mandible (fig. 10*b*) with 17 spines arranged in a row and a strong molar process.

Basis of second maxilliped (fig. 10*c*) broad, $1\frac{1}{4}$ as long as rest of limb.

Basis of third maxilliped (fig. 10*d*) longer than total length of the remaining joints, clothed with setae on both sides ; its external distal lobe large, reaching beyond middle of carpus and with two strong teeth

and plumose setae ; merus expanded as in *Symoodomma*, bears a few teeth and setae on outer side ; carpus broad, with three stout teeth on



TEXT-FIG. 10.—*Pseudosympodomma indica*, Gen. *et.* sp. nov.

a. First antenna, male × 73 ; *b*. Mandible, male × 73 ; *c*. Second maxilliped, male × 50 ; *d*. Third maxilliped, male × 50 ; *e*. First peraeopod, male × 35 ; *f*. Second peraeopod, male × 50 ; *g*. Third peraeopod, male × 50 ; *h*. Telsonic segment and uropod, male × 32 ; *j*. Second peraeopod, female × 35 ; *k*. Third peraeopod, female × 35.

inner side in addition to 5 or 6 small setae ; propodus smaller than sub-equal merus and carpus, expanded distally on inner side and bearing a group of long setae ; dactylus small, with long setae on inner side and at free end.

Basis of first peraeopod (fig. 10*e*) slender, shorter than rest of limb, bears long spines and plumose setae on inner side ; ischium and merus sub-equal, the latter produced distally over carpus, which is twice as long as merus ; propodus long and stout ; dactylus slender and as long as carpus.

Second peraeopod (fig. 10*f*) with basis only $\frac{5}{7}$ as long as rest of limb, bears short blunt spines on inner side ; ischium distinct though small, merus and carpus sub-equal, merus with a long stout spine on inner side at extremity and three small spines on outer side, carpus with two long unequal spines on inner side and two or three small spines on outer side. Propodus short ; dactylus long and slender bearing spines on the serrated margin and extremity. A well developed exopod present.

Third (fig. 10*g*) fourth and fifth peraeopods resemble those of *Glyphocuma*, but devoid of any trace of exopod, peduncle of uropod (fig. 10*h*) slender, about $1\frac{1}{4}$ as long as telsonic somite and one and a half times as long as rami, bears numerous short and long spines, of which those towards the distal end longer. Endopod slightly shorter than exopod, two-jointed ; first joint shorter than second, bears 13 spines on inner side, of which the distal one very large ; second joint with 21 graded spines on inner side and extremity.

Ovigerous female.—(fig. 9*b*) Length 9·7 mm. Closely resembles the male. Body proportions as in male. Eye-lobe narrower, apex occupied by numerous small lenses. Dorsal median carina of carapace with three conspicuous teeth projecting forwards as in *Sympodomma africanus* Stebbing[1]. Carinae on carapace, thorax and abdomen as in male. Antennal notch deep. Lower margin of carapace serrated as in male, antero-lateral angle acute, with a prominent antero-lateral tooth.

First peraeopod as in male, but with a lesser number of spines and setae on basis.

Uropod missing.

S. africanus Stebbing, which as already suggested may be included in the present genus, can be differentiated from *p. indica* by the following distinctive characters :

P. indica, Gen. *et.* sp. nov.	*P. africanus* Stebbing.
1. Basis, merus and carpus of third maxilliped dentate ; distal lobe of basis reaches beyond middle of carpus.	1. Basis, merus and carpus of third maxilliped without teeth ; distal lobe of basis stands behind the extremity of merus.
2. First peraeopod has basis, ischium and merus bearing short, stout spines on inner margin.	2. First peraeopod without spines, only setae present.
3. Exopod of uropod longer than endopod. First joint of endopod, shorter than second.	3. Exopod of uropod shorter than endopod. First joint of endopod twice as long as second.

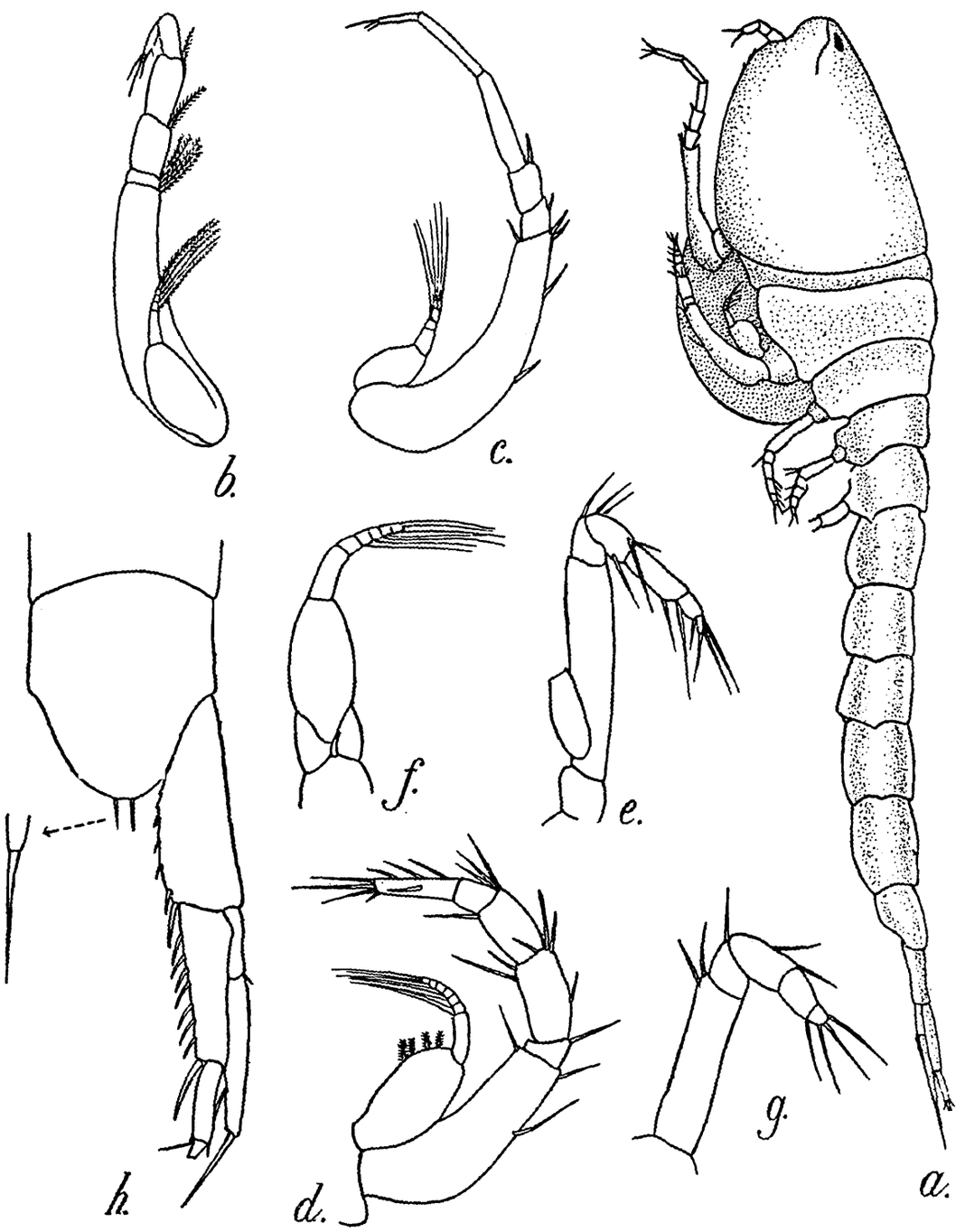
[1] Stebbing, Ann. *S. Afr. Mus.* X, pp. 138, 139 (1921).

Genus **Vaunthompsonia** Bate.

Vaunthompsonia arabica Calman.

1907. *Vaunthompsonia* arabica, Calman, *Trans.* Zool. *Soc. London.* XVIII, 1, pp. 29-30, pl. VII, figs. 20-24.

1913. *Vaunthomposonia arabica*, Stebbing, *Das Tierreich* XXXIX, p. 11.



TEXT-FIG. 11.—*Vaunthompsonia arabica* Calman.

a. Lateral view, female × 31 ; *b.* Third maxilliped female × 85 ; *c.* First peraeopod, female × 85 ; *d.* Second peraeopod female × 85 ; *e.* Third peraeopod (left side—broken exopod), female ×122 ; *f.* Third peraeopod, podexo of right side, female × 122 ; *g.* Fourth peraeopod, female × 85 ; *h.* Telsonic segment and uropod, female × 85.

1944. *Vaunthompsonia nana*, Hale, *Trans. Roy. Soc. S. Austral.* 68 (2), pp. 266-268, Figs. 28, 29.

1949. *Vaunthompsonia nana*, Hale, *Rec. S. Austral. Mus.* IX, 2, pp. 118, 119, fig. 6.

Locality.—

Andamans, stream at Corbyn's Cove North (station 9).
Signle ovigerous ♀ 3·4 mm. long.

Ovigerous female.—(fig. 11*a*) Pseudo-rostral lobes truncated as in type (Calman *loc. cit*), meet in front of the pigmented eye-lobe. Carapace about one-fourth the total length of body, dorsal profile curved, but the curve not so pronounced as in the male specimen figured by Calman (ref. fig. 20 *ibid.*), it is more marked than in the figure by Hale.[1] Width of carapace 4:5 its length, sub-equal to height. Carapace and free pedigerous segments possess a dorsal median carina; infra-lateral margins concave as in male ; antennal angle rounded, bearing 3 small teeth on each side, of which the hinder most one very small.

All five pedigerous somites well exposed, their total length more than that of carapace.

Pleon shorter than cephalothorax, last somite produced as a semicircular expansion between uropods, bearing 2 slender setae at the extremity as in male (Calman *Ibid.*), but distal end of telonsic somite not serrated, resembling fig. 29 of Hale (*Ibid.*).

Eggs in marsupium, large, and spherical.

Basal joint of first antenna stout; second small; third slender, longer than second, and carries two flagella.

Third maxilliped (fig. 11*b*) resembles that of male (Hale *ibid*, fig. 29). Basis not produced distally, with plumose setae at extremity, ischium small, merus and carpus sub-equal, propodus smaller than carpus and longer than dactylus.

First peraeopod (fig. 11*c*) short, extends beyond pseudo-rostrum by the length of its last segment, agrees with fig. 6 of Hale (1949). Basis sub-equal to combined length of next 4 joints, ischium and merus sub-equal, carpus twice the length of ischium, propodus longer than dactylus and smaller than carpus.

Second peraeopod (fig. 11*d*) stout, resembles that of male described by both Calman and Hale. Basis stout, about as long as combined length of the succeeding 4 joints ; dactylus long, more than double the length of propodus.

Third peraeopod (fig. 11*e*) with exopod well developed, basis longer than rest of limb (exopodite of left side and endopodite of right side broken).

Fourth (fig. 11*g*) and fifth peraeopods shorter, without exopod.

Peduncle of uropod (fig. 11*h*) as in male, equal in length to last abdominal somite, bears 7 spines on its inner edge, of which the distal one longest. Endopod subequal to exopod, distal joint slightly stouter than half of proximal. Proximal segment with 8 spines on inner side, of which distal one the longest. Distal joint with faintly serrated inner margin and tip bears a stout seta (only basal portion of seta present) subtended by two smaller ones.

[1] Hale, *Trans. Roy. Soc. S. Austral.* 68(2), fig. 28 (1944).

The male specimen of *V. arabica* has been described by Calman (*ibid.*) from specimens 3·1 mm. long from Suez Canal and Aden. In the shape of carapace, second peraeopod and uropods, the female in the present collection resembles the male specimen described by Calman. *V. nana* Hale was first described from an incomplete male specimen 1·9 mm. collected from South Australia. Hale (1944, p. 268) observes " it seems close to *arabica* Calman (Suez and Aden) but the carapace is of different shape, the basis of the first peraeopod is still shorter and stouter, also proportions of the joints of last pair of peraeopods seem to be distinctive " But, later (Hale 1949, pp. 118, 119) a few more specimens measuring 3·1 to 3·4 mm. were collected from western Australia, which makes him doubt whether the South Australian type described by him is after all a dwarf variety of *arabica*, in view of the fact that the first and second peraeopods and uropods described (Hale 1949, fig. 6) agree with the type *V. arabica* Calman.

The female specimen in the present collection agrees with *V nana* Hale, in the nature of the pseudo-rostrum, pleon, third maxilliped, first and second peraeopods and uropods. Considering the similarity of the two species described as *V arabica* Calman (male) and *V. nana* Hale (male) and the close resemblance of the Andaman specimen (female) with these two species, it may be presumed that all of them belong to the same species and since *V arabica* has precedence, *V nana* may be regarded as a synonym of the former.

Family DIASTYLIDAE.

Genus **Paradiastylis** Calman.

Paradiastylis culicoides Kemp.

1916. *Paradiastylis culicoides, Kemp, Mem. Ind. Mus.* V, PP. 398-402, figs. 3-5.

1951. *Paradiastylis culicoides,* Kurian, *Bull. Cent. Res. Inst.* II, C, pp. 106, 107.

Locality.—

" Waltair, station 5. 24-1-1921."	97 specimens, mostly ♀♀ ; adult ♀ 2·2 mm.; adult ♂ 2·1 mm. long.

Specimens closely resemble the type from Chilka Lake. Body in female stouter than in male. Lateral ridge on carapace distinct in female, faint or absent in male. Peduncle of uropod in female shorter, only a little more than double the length of last pleon somite ; in male about three times the length of telsonic somite.

P. culicoides was first recorded from the Chilka Lake from the surface of mud at a depth of 6-12 ft. It is stated that they are " a permanent inhabitant of the main area of the lake, living in water that varies in specific gravity from 1·000 to 1·015" and that when the salinity of the water increased to the same percentage as that of the sea water outside the lake no specimens were found. The present record of the species is therefore interesting, since the collection was taken from the open sea, 5 years later, not far away from the type locality.

Distribution.—Chilka Lake 1 to 2 fathoms, Trivandrum 15 fathoms.

Genus **Dimorphostylis** Zimmer.

Dimorphostylis horai, sp. nov.[1]

Locality.—

" From Nankauri Oct. 20:1922 ".	2 adult ♂♂ 5·0 mm. long (one damaged). 2 ovigerous ♀♀ 5·1 mm. long (one damaged).
Andamans, Ross channel, 2 to 9 fathoms. 1921.	1 damaged ♂ 4·4 mm. long.

Ovigerous female. (fig. 12). Integument thin and fragile. Carapace about one-third the total length of body, its height slightly less than half its own length, dorsal profile slightly serrated in the anterior region. A dorso-lateral fold runs backwards from the pseudo-rostrum around base of frontal lobe and extends beyond the middle of carapace. Side of carapace bears three obliquely curved carinae, of which the lowest, *i.e.* the one nearest the margin broken into two.

Pseudo-rostrum acute, meet in front of eye-lobe for about one-seventh the length of carapace. Ocular-lobe rounded, seen projecting above in side view.

TEXT-FIG. 12.—*Dimorphostylis horai*, sp. nov. Lateral view, female × 11.

Pedigerous somites 5 distinct, together about half as long as carapace.

Pleon smooth, shorter than cephalothorax. Telson (fig. 14*a*) long, cylindrical, more than double the length of last abdominal somite, reaches beyond peduncle of uropod with a narrow post-anal region. Dorsum in front of post-anal region of telson marked by a depression with a 'U' shaped raised margin, almost as in *D. australis* Foxon[1].

First antenna slender, first joint of peduncle longer than second and sub-equal to third, bears two flagella, outer one longer.

First peraeopod long, reaching beyond pseudorostrum by the last two joints and one third of carpus; second peraeopod with exopod; exopod absent on third peraeopod.

Peduncle of uropod (fig. 14*a*) narrow, about twice as long as last abdominal somite, bears 4 slender setae on inner margin. Endopod longer than peduncle three-jointed; first joint about as long as second and third combined, which are sub-equal. Spines on inner marign of the three joints of endopod, 8, 2, and 2 respectively and a long seta at the extremity of third joint. Exopod smaller than endopod, bears numerous spines on the margins and 2 long setae at extremity.

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[1] Named after Dr. S. L. Hora, Director, Zoological Survey of India.

[1] Foxon, *Great Barrier Reef Exped.* 1928-'29 *Sci. Rep.* IV, 2, pp. 387, figs. 5-10(1932).

Adult male.—Carapace slightly longer than in female, lowest pair of carinae faint. Antero-lateral angle of carapace rounded.

TEXT-FIG. 13.—*Dimorphostylis horai*, sp. nov.

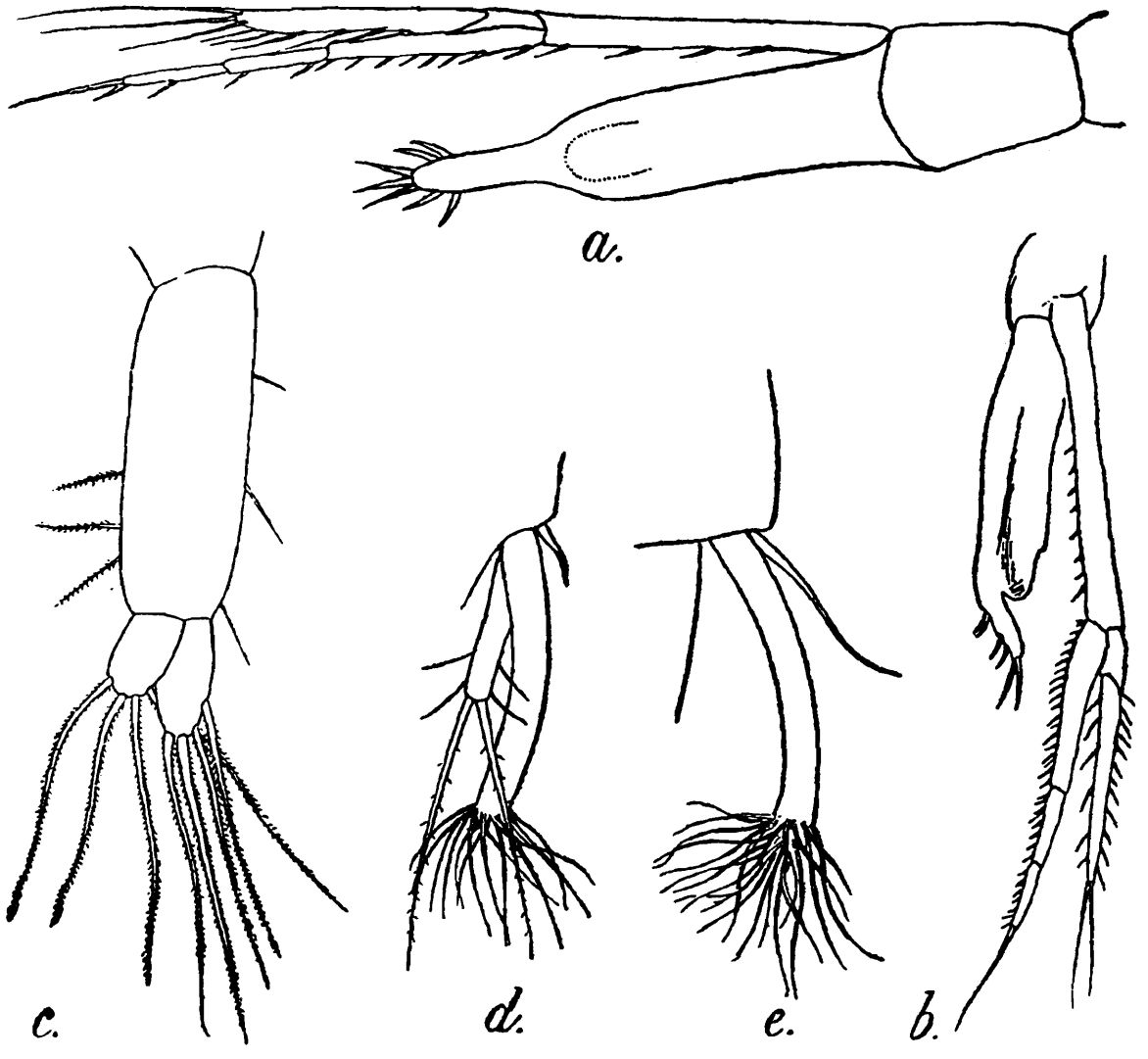
a. First antenna, male × 85; *b.* Third maxilliped, male × 85; *c.* First peraeopod, male × 47; *d.* Second peraeopod, male × 47; *e.* Fourth peraeopod, male × 85; *f.* Fourth peraeopod, female × 47; *g.* Fifth peraeopod, male × 85.

Cephalothorax about one and a half times as long as pleon. A stout curved tooth present on the ventral median margin of first pleon somite. Telson reaches beyond peduncle of uropod, but slightly smaller than in female, only six spines noticed on the post anal part of telson.

First antenna (fig. 13 *a*) with first joint longer than second; third shorter than second, bears two-jointed flagella and a tuft of setae at the tip.

Flagellum of second antenna reaches beyond extremity of uropod.

Third maxilliped (fig. 13 *b*) with a dialated basis, thrice as long as rest of limb, segments of which successively increase in length to propodus, which is twice as long as dactylus.



TEXT-FIG. 14.—*Dimorphostylis horai*, sp. nov.
a. Telson and uropod, female × 47; *b*. Telson and uropod, male × 47; *c*. First pleopod, male × 255; *d*. Third pleopod, male × 255; *e*. Fourth pleopod,male × 255.

First peraeopod (fig. 13 *c*) elongate, carpus reaching to level of pseudorostrum. Basis, half as long as rest of limb; ischium and merus small; propodus half as long again as carpus and twice as long as dactylus.

Second peraeopod (fig. 13 *d*) with basis almost half as long as rest of limb. Merus, carpus, and dactylus almost equal, propodus only one-third of dactylus.

Third and fourth peraeopods bear exopods. Basis broad, almost as long as rest of limb.

Fifth peraeopod without exopod, basis slender, only half as long as rest of limb.

Pleopods (fig. 14 *c, d, e*) present on the first four abdominal somites of which first two biramous, while the next two in the form of slender processes with terminal tuft of hairs.

Peduncle of uropod (fig. 14 *b*) slightly shorter than telson and bears 8 to 10 short spines on inner margin. Endopod with first joint about half as long again as second and third joints combined. Spines on inner margin 19, 8 and 8 on the three joints respectively. Exopod with about 20 setae fringing the sides and extremity.

Dimorphostylis horai, sp. nov. resembles *D. australis* Foxon in having four pairs of abdominal appendages in male, a pre-anal portion of telson much longer than the sixth pleon somite and in the possession of a 'U' shaped raised ridge on the dorsum of the telson. But, it differs from the latter in the absence of an exopod on the fifth peraeopod in male, in having a long post-anal region for the telson and in the nature of the thoracic appendages.

D. horai, sp. nov. resembles *D. subaculeata var. praecoxa* Hale,[1] in the absence of an exopod on the 5th peraeopod in male, and in the nature of the first peraeopod. But, it differs from the latter mainly in the possession of a long telson, in the proportionate lengths of the joints of the uropods and in the absence of a spinous carapace and pleon.

D. horai, sp, nov, could be distinguished from all other species of the genus, by the long, cylindrical telson divisible into a pre-anal and post-anal part, and which is much longer than the sixth pleon somite and extends backwards beyond the peduncle of uropod.

Genus **Gynodiastylis** Calman.

Gynodiastylis sp.

Locality.—

"Palk strait, Marine survey " hawls up to 12 fathoms. Reg. No. 9093.

6

1 damaged ♂ approximate length 4·9 mm.

Telson small, more or less as in *G. polita* Hale, bears two backwardly directed setae. Exopods present on the first four peraeopods. First peraeopod broken. No trace of pleopod on abdomen.

Peduncle of uropod slender, slightly longer than endopod, bears 12 spines on inner margin. Endopod of uropod two-jointed, first longer than second; bear 6 and 2 spines on inner margins of the two joints respectively. Exopod shorter than endopod, bears stout setae, those at the terminus being long.

[1] Hale, *Trans. Roy. Soc. S. Austral.* 69 (2) pp. 185-187 (1945).

Family NANNASTACIDAE.

Genus **Nannastacus** Bate.

Nannastacus johnstoni Hale.

1945. *Nannastacus johnstoni*, Hale, *Rec. S. Austral. Mus.* pp. 165-168, figs. 14, 15.

Locality.—

Kilakari. 12-ii-1913 . . . . 1 adult ♀ 1·6 mm.
1 (damaged) ♂ 2·6 mm. long.

Andamans, Ross channel, 2-9 fathoms, 1921. 1 adult ♂ 1·8 mm. long.

Specimens closely agree with the type description except that the hairs on carapace and abdomen are rather scarce.

Distribution.—New South Wales, Queensland.

Nannastacus gibbosus calman.

1911. *Nannastacus gibbosus*, Calman, *Trans. Zool. Soc. London* XVIII, pp. 355-356, pl. xxxiii, figs. 16-21.

1913. *Nannastacus gibbosus*, Stebbing, *Das Tierreich*, XXXIX, p. 170.

1945. *Nannastacus gibbosus*, Hale, *Rec. S. Austral. Mus.* VIII, 2, p. 148.

Locality.—

Andamans, Stream at Corbyn's Cove North. (station 9). One ♀ 1·8 mm. long.

Specimen agrees with the description of Calman (*loc. cit.*) except that peduncle and endopod of uropod are slightly shorter, and the body is covered with lesser number of setae.

Distribution.—Gulf of Siam, 5 fathoms.

Nannastacus inflatus Hale.

Nannastacus inflatus, Hale, *Rec. S. Austral. Mus.* VIII, 2, pp. 159-162, figs. 10, 11.

Locality.—

"Kilakarai, 0-2 fathoms, 12-ii-1920. s.w.k." 1 ♀ 1·8 mm. long.

Specimen slightly crushed in the third somite of pleon, agrees with Hale's type description. But peduncle of uropod slightly less than three-quarters as long as telsonic somite. Corneal lenses of paired eyes distinct. Inner margin of endopod with three stout spines and numerous smaller ones in between.

Distribution.—Australian Coasts.

Nannastacus sp.

Locality.—

"Kilakarai. Feb. 1913. S.W.K.", 1 damaged ♀ about 1·9 mm. long.

Identification of species is not possible since the specimen is badly crushed.

Family CAMPYLASPIDIDAE

Genus **Campylaspis** Sars.

Campylaspis maculata Zimmer.

1907. *Campylaspis maculata*, Zimmer, *Zool. Anz.* XXXI, p. 371.

1913. *Campylaspis maculata*, Stebbing, *Das Tierreich* XXXIX, *p.* 197.

1945. *Campylaspis maculata*, Hale, *Rec. S. Austral. Mus.* VIII, 2, p. 183.

Locality.—

Andamans, Off pier, Ross Island, in sand and a little weed; 2 ♀♀ 2·5 mm. long. 3-4 fathoms, 22/23--ii-1915.

Resemble the type except that dactylus of second peraeopod is longer than carpus and carapace bears prominent tuberculate ridges.

Distribution.—South Georgia 75 m.

CONTRIBUTION TO A KNOWLEDGE OF THE FAUNA OF MANIPUR STATE, ASSAM.

V. COLEOPTERA.

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CONTENTS

INTRODUCTION

The following account of the Coleoptera of Manipur State, Assam, is based mainly on a collection made by Dr. M. L. Roonwal, during a period of six months from July to December, 1945. The places of collection were situated mostly in the Imphal Valley and varied in

2 ZSI/54

altitude from 2,000 ft. to 3,750 ft. Further details of the environment and geography of the various places may be had of an introductory note to the series by Roonwal[1].

The material which is deposited in the Zoological Survey of India, contains 71 species belonging to 19 families. As the chief interest of the collection lies in the geographical distribution of the various species, additional materials belonging to such species in the Survey's collections were also examined so that a fuller account of the distribution could be given.

Geographical Distribution

North-East India, of which Manipur State forms a part butting upon Burma, is the meeting place of the Siberian and the Manchurian Sub-Regions[2] of the Palæarctic Region and of the Indo-Chinese and the Indian Sub-Regions of the Oriental Region. Species occurring in the Ceylonese and the Indo-Malayan Sub-Regions and to a lesser extent in the Ethiopean and the Australian Regions are also to be found in North-East India which is generally regarded as a part of the Indo-Chinese Sub-Region. Table I gives the distribution of various species under report. It will be observed that the number of species occurring in Burma, Assam and other hilly tracts of North India is practically the same. This is as one may expect to be the case, because conventionally all these areas constitute a part of the Indo-Chinese Sub-Region. However, the same is also true of the species occurring in the plains of India constituting the Indian Sub-Region. A possible explanation for this may be that the present material from Manipur comes from relatively lower altitudes of 2,000 ft. to 3,750 ft. Talbot[3] who studied Indian butterflies (a group better known than most other Indian insects) stated that the faunal boundaries were principally a question of altitude. Some of the hills in Manipur State go as high as 10,000 ft., and it seems that much more collecting and study of the Coleoptera from these parts will have to be made for a better understanding of the distribution of the Order and of the different faunal boundaries. Certain other points of interest regarding the geographical distribution of the various species are mentioned below :

(a) First records from India.—Countries from where the species have been known earlier are given in parenthesis.

1. *Anadastus ventralis* Gorham, Languriidæ (Burma).

2. *A. vicinus* Arrow (Burma).

3. *Oenopia luteopustulata* Mulsant, Coccinellidæ (Burma ; East Indies).

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(1) Roonwal, M.L. *Rec. Indian Mus.*, **46** : 123-126 (1949).

(2) The Zoogeographical Regions and Sub-Regions set out in *Atlas of Zoogeography* (Bartholmew's *Physical Atlas*, **5**, 1911) have been employed in this paper.

(3) Talbot, G. 1939 *Fauna British India*, ... Butterflies, **1** : 42 (2nd edition) London.

4. *Verania vincta* Gorham, Coccinellidæ (Burma).
5. *Monolepta picturata* Jacoby, Chrysomelidæ (Burma).
6. *Haltica foveicollis* Jacoby, Chrysomelidæ (Burma).
7. *Phytoscaphus nubilus* Faust, Curculionidæ (Burma).
8. *Alcides scenicus* Faust, Curculionidæ (Burma, Tonking, Japan).
9. *Athesapeuta vinculata* Faust, Curculionidæ (Burma).

(b) FIRST RECORDS FROM ASSAM.—Localities from which the species have been recorded earlier are given in parenthesis.

1. *Chlaenius ocellatus* Andrewes, Carabidæ (Madhya Pradesh).
2. *Diaphanes marginella* (Hope), Lampyridæ (Nepal ; Eastern Himalayas).
3. *Hemiops crassa* (Gyllenhal), Elateridæ (Bengal, Burma, Malacca, Sumatra, Borneo).
4. *Ceolophora bissellata* Mulsant, Coccinellidæ (Bengal, South India, Malacca, Sumatra, Java, Borneo, Philippine Islands, New Guinea).
5. *Gymnopleurus aethiops* Sharp. Scarabæidæ (Cochin, Nilgiri Hills, N. Kanra, Ceylon, Siam, Hongkong, Formosa).
6. *Aphodius costatulus* Schmidt, Scarabæidæ (Belgaum, Kulu).
7. *Adoretus compressus* (Weber), Scarabæidæ (Bihar, Madras, S. Ceylon).
8. *Aphrodisium cribricolle* Poll, Cerambycidæ (Sikkim).
9. *Galerucella placida* Baly, Chrysomelidæ (N. W India, Bihar, Bengal, South India).
10. *Monolepta lineata* Weise, Chrysomelidæ (Nilgiri Hills).
11. *M. maculosa* Allard (Bombay).
12. *Haltica cyanea* Weber, Chrysomelidæ (Punjab, Bombay, Bengal, Indo-China, China, Japan, Australia).
13. *Xanthochelus blumeæ* Marshall, Curculionidæ (Dehra Dun).
14. *Paracycnotrachelus cygneus* (Fabr.), Curculionidæ, (Bengal, Burma, Cambodia, Penang, Sumatra, Java).
15. *Gasterocercus anatinus* Chevrolet, Curculionidæ (Andaman Islands)

(c) FIRST RECORDS FROM SOUTH INDIA OF SPECIES ALREADY KNOWN FROM NORTH-EAST INDIA.

1. *Coilodera penicillata* Hope, Scarabæidæ. Now recorded from Nilgiri Hills , earlier records from Sikkim, Assam and Burma.
2. *Glenea pulchella* Thompson, Cerambycidæ. Now recorded from S. Mysore and Nilgiri Hills ; earlier records from Assam and Burma.

TABLE I.—SHOWING THE DISTRIBUTION OF VARIOUS SPECIES

No.	Name of species	Ethiopean Region (Malagasy Sub-Region)	Oriental Region									Australian Region	Palaearctic Region
			Ceylonese Sub-Region		Indian Sub-Region	Indo-Chinese Sub-Region					Indo-Malayan Sub-Region		
			Ceylon	India-South of Mysore		N.-E. India	Assam	Manipur	Burma	The rest of Sub-Region			
1	2	3	4	5	6	7	8	9	10	11	12	13	14
	CARABIDAE												
1	*Amblystomus fuscascens* (Mots.)			—	—	—	—	—	—				
2	*Amblystomus quadri-guttatus* (Mots.)		—	—	—	—	—	—			—		
3	*Chlaenius ocellatus* Andr.				—			—					
4	*Orthogonius duplicatus* (Weid.)				—	—	—	—	—	—	—		
	HYDROPHILIDAE												
5	*Hydrous indicus* Bedel			—	—	—	—	—					

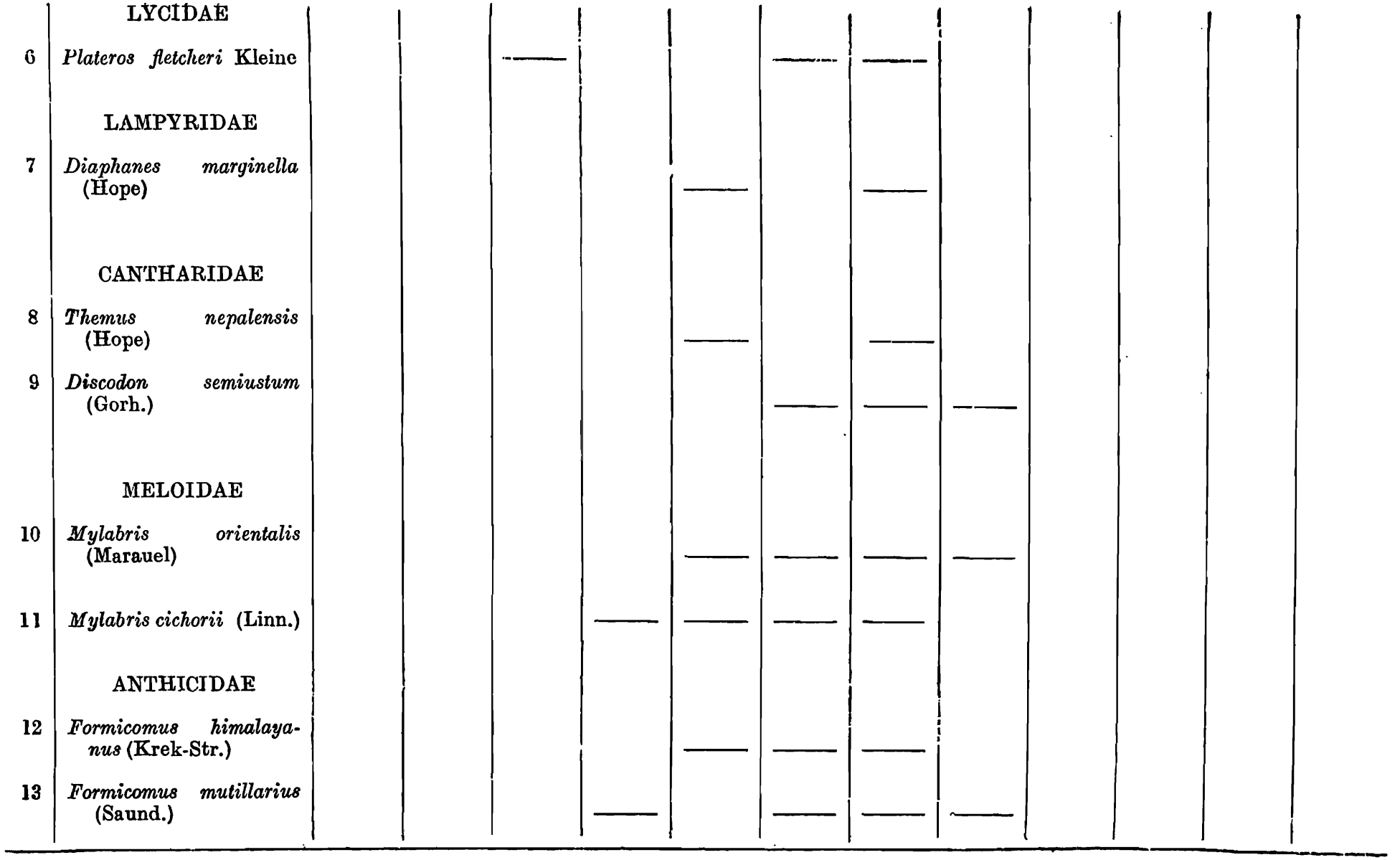

LYCIDAE
6 Plateros fletcheri Kleine
LAMPYRIDAE
7 Diaphanes marginella (Hope)
CANTHARIDAE
8 Themus nepalensis (Hope)
9 Discodon semiustum (Gorh.)
MELOIDAE
10 Mylabris orientalis (Marauel)
11 Mylabris cichorii (Linn.)
ANTHICIDAE
12 Formicomus himalayanus (Krek-Str.)
13 Formicomus mutillarius (Saund.)

TABLE I.—SHOWING THE DISTRIBUTION OF VARIOUS SPECIES—*contd.*

No.	Name of species	Ethiopean Region (Malagasy Sub-Region)	Oriental Region									Australian Region	Palaearctic Region
			Ceylonese Sub-Region		Indian Sub-Region	Indo-Chinese Sub-Region					Indo-Malayan Sub-Region		
			Ceylon	India-South of Mysore		N.-E. India.	Assam	Manipur	Burma	The rest of Sub-Region			
1	2	3	4	5	6	7	8	9	10	11	12	13	14
	ELATERIDAE												
14	*Hemiops crassa* (Gyllenh.)				———			———	———		———		
	BUPRESTIDAE												
15	*Sternocera aequisignata* (Saund.)				———	———		———	———				
	LANGURIIDAE												
16	*Anadastus ventralis* Gorh.							———	———				
17	*Anadastus dohertyi* Arrow						———	———					
18	*Anadastus vicinus* Arrow							———	———	———			

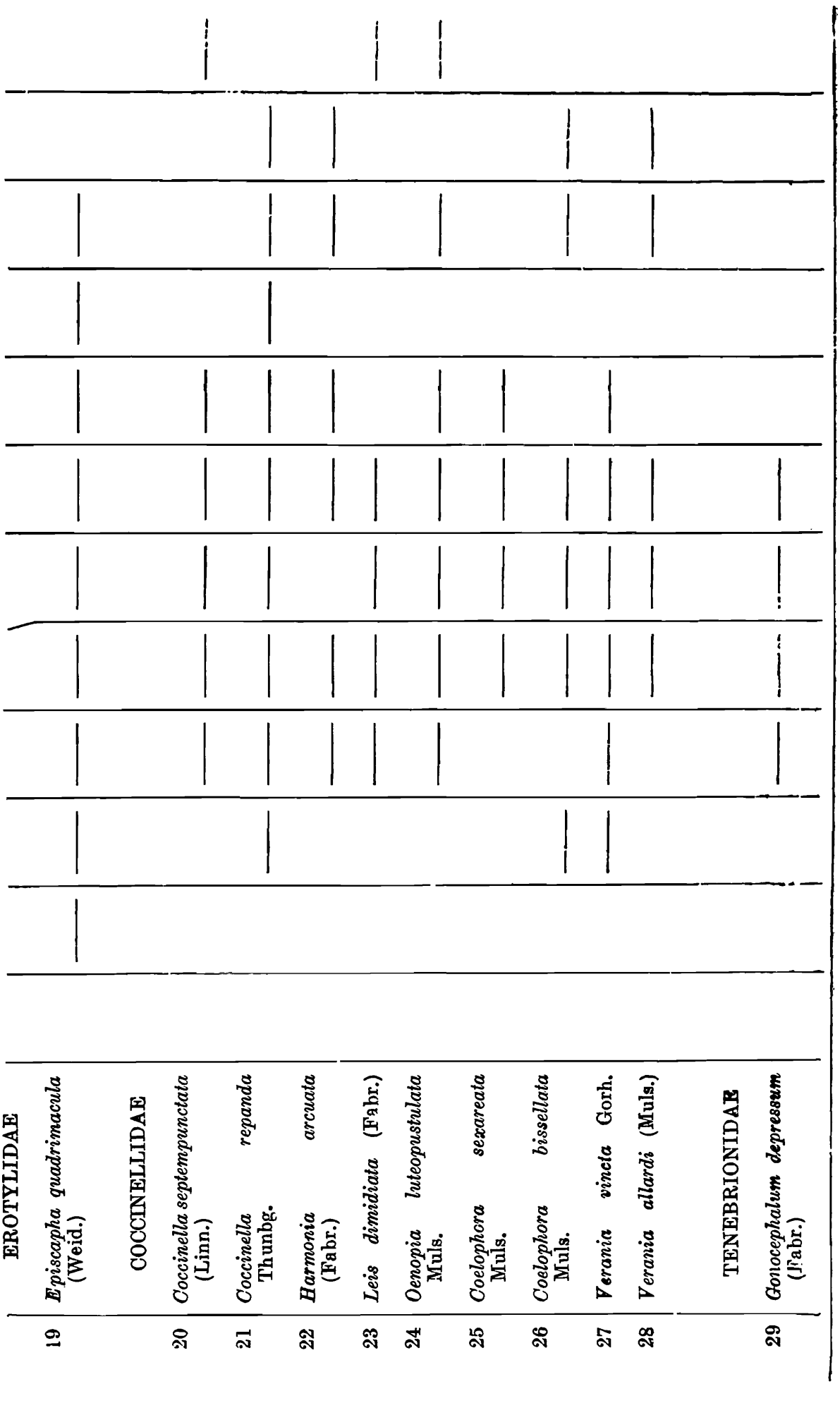

EROTYLIDAE
19 Episcapha quadrimacula (Weid.)
COCCINELLIDAE
20 Coccinella septempunctata (Linn.)
21 Coccinella repanda Thunbg.
22 Harmonia arcuata (Fabr.)
23 Leis dimidiata (Fabr.)
24 Oenopia luteopustulata Muls.
25 Coelophora sexareata Muls.
26 Coelophora bissellata Muls.
27 Verania vincta Gorh.
28 Verania allardi (Muls.)
TENEBRIONIDAE
29 Gonocephalum depressum (Fabr.)

TABLE I.—SHOWING THE DISTRIBUTION OF VARIOUS SPECIES—*contd.*

No.	Name of species	Ethiopean Region (Malagasy Sub-Region)	Oriental Region									Australian Region	Palaearctic Region
			Ceylonese Sub-Region		Indian Sub-Region	Indo-Chinese Sub-Region					Indo-Malayan Sub-Region		
			Ceylon	India-South of Mysore.		N.-E. India	Assam	Manipur	Burma	The rest of Sub-Region			
1	2	3	4	5	6	7	8	9	10	11	12	13	14
	BOSTRICHIDAE												
30	*Heterobostrychus aequalis* (Wat.)	———	———	———	———	———		———	———	———	———	———	———
31	*Xylothrips flavipes* (Ill.)	———	———	———	———	———	———	———					
	SCOLYTIDAE												
32	*Xyleborus minor* (Steb.)				———	———	———	———	———				
	SCARABAEIDAE												
33	*Gymnopleurus aethiops* Sharp		———	———	———			———	———	———	———		

34	*Catharsius molossus* (Linn.)		—	—	—	—	—	—						
35	*Onthophagus hystrix* (Bouc.)		—	—	—			—	—					
36	*Aphodius costatulus* (Schm.)				—			—						
37	*Anomala dimidiata* (Hope)				—	—	—	—						
38	*Adoretus compressus* (Weber.)		—	—	—			—	—	—	—			
39	*Alissonotum crassum* Arrow				—	—	—	—	—					
40	*Heteronychus lioderes* (Redt.)				—	—	—	—	—		—			
41	*Dynastes gideon* (Linn.)		—	—	—	—	—	—	—	—	—			
42	*Coilodera penicillata* (Hope)			—		—	—	—	—					
	CERAMBYCIDAE													
43	*Xystrocera globosa* (Oliv.)	—	—	—	—	—	—	—	—	—	—	—		
44	*Aphrodisium cribricolle* Poll					—		—						
45	*Batocera numitor* Newm.				—	—	—	—	—	—	—			
46	*Glenea pulchella* Thoms.			—	—	—	—	—	—					

TABLE I.—SHOWING THE DISTRIBUTION OF VARIOUS SPECIES—*contd.*

No.	Name of species	Ethiopean Region (Malagasy Sub-Region)	Oriental Region									Australian Region	Palaearctic Region
			Ceylonese Sub-Region		Indian Sub-Region	Indo-Chinese Sub-Region					Indo-Malayan Sub-Region		
			Ceylon	India-South of Mysore		N.-E. India	Assam	Manipur	Burma	The rest of Sub-Region			
1	2	3	4	5	6	7	8	9	10	11	12	13	14
	CHRYSOMELIDAE												
47	*Lema rufotestacea* Clark			—			—	—	—				
48	*Diapromorpha pallens* (Oliv.)				—	—	—	—		—			
49	*Aulacophora foveicellis* (Lucas)	—	—	—	—	—	—	—	—				—
50	*Galerucella placida* Baly			—	—	—		—	—	—			
51	*Gallerucida singularis* Harold,						—	—	—	—			

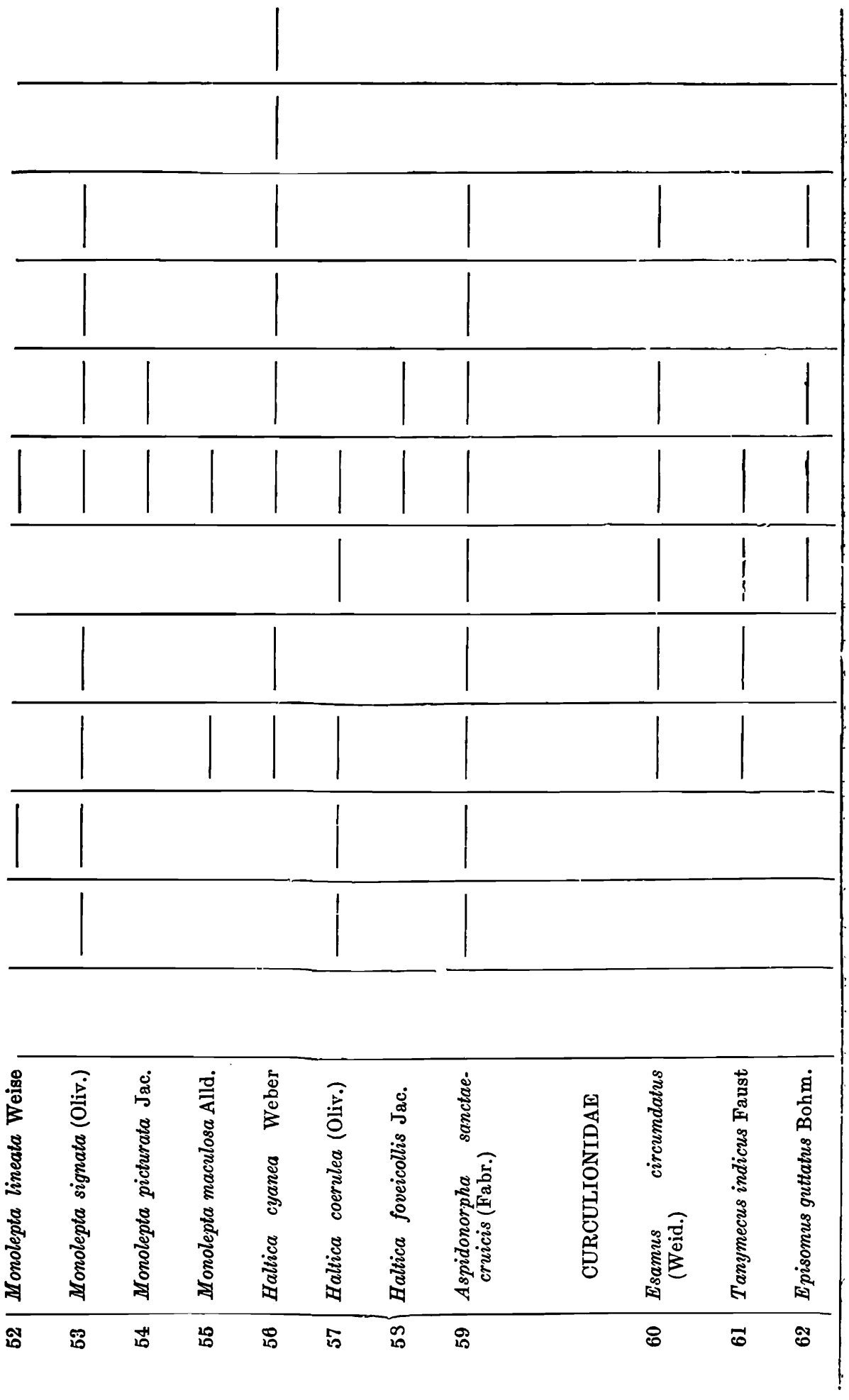

52 Monolepta lineata Weise
53 Monolepta signata (Oliv.)
54 Monolepta picturata Jac.
55 Monolepta maculosa Alld.
56 Haltica cyanea Weber
57 Haltica coerulea (Oliv.)
58 Haltica foveicollis Jac.
59 Aspidonorpha sanctae-cruicis (Fabr.)
CURCULIONIDAE
60 Esamus circumdatus (Weid.)
61 Tanymecus indicus Faust
62 Episomus guttatus Bohm.

TABLE I.—SHOWING THE DISTRIBUTION OF VARIOUS SPECIES—*concld.*

No.	Name of species	Ethiopean Region (Malagasy Sub-Region)	Oriental Region									Australian Region	Palaearctic Region
			Ceylonese Sub-Region		Indian Sub-Region	Indo-Chinese Sub-Region					Indo-Malayan Sub-Region		
			Ceylon	India-South of Mysore		N.-E. India	Assam	Manipur	Burma	The rest of Sub-Region			
1	2	3	4	5	6	7	8	9	10	11	12	13	14
	CURCULIONIDAE–*contd.*												
63	*Astycus lateralis* (Fabr.)				—	—	—	—	—	—	—		
64	*Phytoscaphus nubilus* Faust						—	—	—				
65	*Xanthochelus blumeae* Marshll					—		—					
66	*Paracycnotrachelus cygneus* (Fabr.)				—	—		—	—	—	—		
67	*Apoderus notatus* (Fabr.)						—	—	—	—	—		

68	*Alcides scenicus* Faust					—	—	—	—	—			—
69	*Gasterocercus anatinus* Chev.				—			—					
70	*Athesapeuta vinculata* Faust							—	—				
71	*Cyrtotrachelus buqueti* Var. *dux* Bohm.					—	—	—	—	—	—	—	—
	TOTAL (Column-wise)	4	14	25	45	47	46	71	46	22	25	9	9

Systematic Account

Order COLEOPTERA

Sub-Order ADEPHAGA

Family Carabidae

1. **Amblystomus fuscescens** (Motschulsky)

1858. *Hispalis fuscescens* Motschulsky, *Etud. Ent.* **7**: 23 (Type locality: Burma).

1864. *Hispalis fuscescens* Motschulsky, *Bull. Soc. Nat. Moscou*, **37**: 233.

1919. *Amblystomus fuscescens* (Mots.), Andrewes, *Trans. ent. Soc. Lond.* **1919**: 198.

1931. *Amblystomus fuscescens* (Mots.), Csiki, *Coleopt. Cat., Berl.* pt. 115, Carabidæ: 923.

Material.—1 example: Manipur, Imphal Valley, 2,000 ft., 10-13. X. 1945.

Remarks.—Csiki gives its distribution as British India; the type comes from Burma.

2. **Amblystomus quadriguttatus** (Motschulsky)

1858. *Hispalis quadriguttatus* Motschulsky, *Etud. Ent.* **7**: 23. (Type locality: Ceylon).

1931. *Amblystomus quadriguttatus* (Mots.), Csiki, *Coleopt. Cat., Berl.* pt. 115, Carabidæ: 1925.

Material.—1 example: Manipur, 16 miles N. of Imphal on Dimapur Road, *ca.* 3,500 ft., 8. VIII. 1945.

Remarks.—Recorded by Csiki from India, Ceylon and the Philippines.

3. **Chlaenius ocellatus** Andrewes

1923. *Chlaenius ocellatus* Andrewes, *Ann. Mag. nat. Hist.*, (9)**11**: 339 (Type locality: Nagpur).

1931. *Chlœnius ocellata* Andr., Csiki, *Coleopt. Cat. Berl.*, pt. 115, Carabidæ: 934.

Material.—1 example: Manipur, 16 miles N. of Imphal, on Dimapur Rd., *ca.* 3,500 ft., 24. X. 1945.

Remarks.—Hitherto known only from Nagpur and Jubbulpur in the Central Provinces (now known as Madhya Pradesh), the species is being recorded for the first time from Assam.

4. **Orthogonius duplicatus** (Wiedemann)

1819. *Carabus duplicatus* Wiedemann, *Zool.*, **1**(3): 166 (Type locality: East Indies).

1825. *Orthogonius duplicatus* (Wied.), Dejean, *Sp. gen. Coleopt.* **1**: 279.

1846. *Orthogonius puncticollis* Schmit—Goebel, *Faunula Coleopt. Burma*, 57 (Type loc.: Martaban).

1846. *Orthogonius profundestriatus* Schmidt-Goebel, *Faunula Coleopt. Burma* : 58 (Type loc. : Tenasserim).

1871. *Orthogonius puncticollis* Schmidt-Goebel, Chaudoir, *Ann. Soc. ent. Belg.* **14** : 113 (sinks *O. profuncestriatus*).

1921. *Orthogonius duplicatus* (Wied.), Andrewes, *Trans. ent. Soc. Lond.* **1921** : 165 (sinks *O. puncticollis*).

1923. *Orthogonius duplicatus* (Wied.), Andrewes, *Trans. ent. Soc. Lond.*, **1923** : 32 (synonomy discussed).

1932. *Orthogonius duplicatus* (Wied.), Csiki, *Coleopt. Cat., Berl.* pt. 124, Carabidæ : 1588.

Material.—1 example : Manipur, Imphal Valley, 2,000 ft., 3. IX. 1945.

Remarks.—Csiki gives its distribution as British India, Burma, Laos, Cochin-China, Malaya and Java. Exact locality from India is not mentioned by him. Besides the present and other material from Assam, the Zoological Survey of India (Z. S. I.) collections contain examples from Uttar Pradesh (Former United Provinces), Bihar, Orissa, Bengal and Bhutan.

Sub-Order POLYPHAGA

Family HYDROPHILIDAE

5. **Hydrous indicus** Bedel

1892. *Stethoxus indicus* Bedel, *Rev. Ent. Caen.*, **10** : 310, 316 (Type locality : N. India, Moradabad).

1928. *Hydrous indicus* (Bedel), d'Orchymount, *Cat. Indian Ins.*, pt. 14 : 127.

Material.—1 example : Manipur, Imphal Valley, 2,000 ft., —VII. 1945.

Remarks.—This species is widely distributed in India, examples being present in the Z. S. I. collections from the following parts of the country : Bengal, Bihar, Punjab and Madras State. It has also been recorded from Assam and Sind.

Family LYCIDAE

6. **Plateros fletcheri** Kleine

1930. *Plateros fletcheri* Kleine, *Stettin. ent. Ztg.*, **91** : 97 (Type locality : Nilgiri Hills).

1931. *Plateros fletcheri* Kleine, *Cat. Indian Ins.*, pt. 21 : 32.

Material.—1 example : Manipur, 16 miles N. of Imphal, on Dimapur Rd., *ca.* 3,500 ft., at light, 9. XI. 1945.

Remarks.—The species has been recorded from Nilgiri Hills in the South and Shillong (Assam) in the North-East.

Family LAMPYRIDAE

7. **Diaphanes marginella** (Hope)

1831. *Lampyris marginella* Hope, in Gray, *Zoological miscellany* : 26 (London) (Type locality : Nepal).

1854. *Lamprohiza* ? *marginella* (Hope), Motschulsky, *Etud, Ent.*, **3** : 22.

1880. *Lampyris* (*Diaphanes*) *marginella* (Hope), Gorham, *Trans. ent. Soc. Lond.*, **1880**: 96.

1910. *Diaphanes marginellus* (Hope), Olivier, *Coleopt. Cat., Berl.* pt. 9, Lampyridæ: 32.

Material.—1 example: Manipur, 16 miles N. of Imphal, on Dimapur Rd., *ca.* 3,500 ft., 5. XI. 1945.

Remarks.—This species has already been recorded from Eastern Himalayas although the present record is the first one from Assam. There is one example from Rajashahi (Bengal) also in the Z. S. I. collection.

Family Cantharidae

8. **Themus nepalensis** (Hope)

1831. *Telephorus nepalensis* Hope, in Gray, *Zoological miscellany*: 26 (London) (Type locality: Nepal).

1889. *Telephorus nepalensis* (Hope), Gorham, *Proc. zool. Soc. Lond.*, 1889.

1926. *Themus nepalensis* (Hope), Champion, *Ent. monthl. Mag.*, **62**: 127.

1929. *Themus nepalensis* (Hope), Pic., *Bull. Soc. ent., Fr.*, 1929: 196.

1939. *Themus nepalensis* (Hope), Delkeskamp, *Coleopt. Cat., Berl.* pt. 165, Cantharidæ: 164.

Material.—1 example: Manipur, below Modbung near Imphal, *ca.* 3,500 ft., —.XI. 1945.

Remarks.—Hitherto known from Nepal, the present record from Manipur is of interest.

9. **Discodon semiustum** (Gorham)

1899. *Telephorus semiustum* Gorham, *Proc. zool. Soc. Lond.*, 1899: 99 (Type locality: Sibsagar, Assam).

1926. *Discodon semiustum* (Gorh.), Champion, *Ent. monthl. Mag.*, **2**: 127, 202.

1939. *Discodon semiustum* (Gorh.), Delkeskamp, *Coleopt. Cat. Berl.*, pt. 165, Cantharidæ: 164.

Material.—3 examples: Manipur, 16 miles N. of Imphal on Dimapur Rd., *ca.* 3,500 ft., 7,22. X. 1945.

Remarks.—The species is already known from Assam and a variety of it (*basipenne* Pic) is also known from Burma.

Family Meloidae

10. **Mylabris orientalis** Marseul

1872. *Mylabris orientalis* Marseul, *Monograph Mylab.* (*Mem. Soc. Liege*) 451 (Reprint p. 91) (Type locality: East India).

1909. *Mylabris orientalis* var. *antefasciata* Pic, *Echange*, **25**: 175 (Type locality: Burma).

1909. *Mylabris orientalis* var. *birmanica* Pic, *Echange*, **25**: 175 (Type locality: Burma).

1917. *Mylabris orientalis* (Mars.), Borchmann, *Coleopt. Cat., Berl.* pt. 69, Meloidæ: 44.

Material.—11 examples as follows : Manipur, 16 miles N. of Imphal, on Dimapur Rd., *ca.* 3,500 ft., —.VIII. 1945 (1 ex.), 14-19. IX. 1945 (1 ex.), 20-30.IX.1945 (1 ex.), 8.X.1845 (1 ex.), —. XI.1945 (1 ex.), 5. XI. 1945 (6 ex.).

Remarks.—Already recorded from East India and Burma, the species is represented in the Z. S. I. collections by examples from Bengal (Darjeeling District), Assam (Sibsagar and Shillong), Nepal and Bhutan.

11. **Mylabris cichorii** (Linneaus)

1764. *Meloe cichorii* Linneaus, *Museum Ludovicae ulricae Reginae :* 103 (Type locality : Orient).

1775. *Mylabris cichorii* (Linn.), Fabricius, *Syst. Ent. :* 261 (China).

1917. *Mylabris cichorii* (Linn.), Borchmann, *Coleopt. Cat., Berl.* pt. 69. Meloidae : 29.

Material.—21 examples : Manipur, 16 miles N. of Imphal, on Dimapur Rd., *ca.* 3,500 ft., 2.X.1945 (1 ex.), 4.X.1945 (7 ex.), 7-8.X.1945 (2 ex.), 18.X.1945 (4 ex.), 1. XI. 1945 (7 ex.).

Remarks.—The species occurs in China, India and Australia. Besides the present and earlier material from Assam, examples are present in the Z. S. I. collections from the following localities : Gilgit, Murree, Lucknow and Dehra Dun, Calcutta, Darjeeling district, Sikkim and Mysore.

Family ANTHICIDAE

12. **Formicomus himalayanus** Krekich-Strassoldo

1914. *Formicomus himalayanus* Krekich-Strassoldo, *Verh. Zool.-Bot. Ges. Wien.* **64** : 109 (Type locality : Assam).

Material.—1 example : Manipur, 16 miles N. of Imphal, on Dimapur Rd., *ca.* 3,500 ft., 4.X.1945.

Remarks.—The species is already known from various parts of Assam and from Darjeeling district, Bengal.

13. **Formicomus mutillarius** (Saunders)

1836. *Anthelephila mutillaria* Saunder, *Trans. ent. Soc. Lond.* **1** : 66 (Type locality : Hooghly).

1911. *Formicomus mutillarius* (Saund.), Pic, *Coleopt. Cat., Berl.* pt. 36, Anthicidae : 19.

Material.—1 example : Manipur, 16 miles N. of Imphal, on Dimapur Rd., *ca.* 3,500 ft., 8.X.1945.

Remarks.—Pic records it from India, Burma and Tonking. Besides other material from Assam, examples from Pusa, Bihar, are also present in the Z.S.I. collections.

Family ELATERIDAE

14. **Hemiops crassa** (Gyllenhal)

1817. *Elater crassa* Gyllenhal, in Schonher, *Synonymia Insectorum*, **3**: append. 135 (Type locality: East Indies).

1927. *Hemiops crassa* (Gyll.), *Coleopt. Cat., Berl.* pt. 88, Elateridae: 503.

Material.—1 example: Manipur, Imphal Valley, 2,000 ft., 19.IX.1945.

Remarks.—The species, reported here for the first time from Assam, has already been recorded from Bengal, Burma, Malacca, Sumatra and Borneo. In the Z.S.I. collection several examples from Sikkim, and Assam (Cachar, North Khasi Hills, Shillong, etc.), are present.

Family BUPRESTIDAE

15. **Sternocera aequisignata** Saunders

1866. *Sternocera aequisignata* Saunders, *Trans. ent. Soc. Lond.* (3) **5**: 298 (Type locality: Pachbon, Sima).

1926. *Sternocera aequisignata* Saund., Obenberger, *Coleopt. Cat., Berl.* pt. 84: Buprestidae: 6.

Material.—4 examples: Manipur, Imphal Valley, 2,000 ft., 10.IX.1945 (2 ex.), 23.X.1945 (1 ex.), —.XII.1945 (1 ex.).

Remarks.—The species is distributed in N. India, Burma and Siam. It is represented in the Z.S.I. collections from Bihar (Sahibgunj), Bengal (Malda, Berhampur and Darjeeling district), Assam (Manipur) and Burma.

Family LANGURIIDAE

16. **Anadastus ventralis** Gorham

1896. *Anadastus ventralis* Gorham, *Ann. Mus. Civ. Genova*, **36**: 273 (Type locality: Burma).

1925. *Anadastus ventralis* Gorh., Arrow, *Fauna British India*..Clavicornia, Erotylidae, Languriidae and Endomychidae: 215 (London).

Material.—1 example: Manipur, 16 miles N. of Imphal, on Dimapur Rd., *ca.* 3,500 ft., 8.X.1945.

Remarks.—Previously known from the Karen Hills, Burma, the species is being recorded here for the first time from India.

17. **Anadastus dohertyi** Arrow

1925. *Anadastus dohertyi* Arrow, *Fauna British India*..Clavicornia, Erotylidae, Languriidae and Endomychidae: 216 (London). (Type locality: Patkai Mountains, Assam).

Material.—3 examples: Manipur, 16 miles N. of Imphal, on Dimapur Rd., *ca.* 3,500 ft., on grass, 7.X.1945 (1 ex.), 8.X.1945 (1 ex.). Below Modbung near Imphal, *ca.* 3,500 ft., 1.XI.1945 (1 ex.).

Remarks.—The fore-mentioned examples differ from the typical form in that their abdomens are rather reddish towards the apices instead of being black or piecous.

18. **Anadastus vicinus** Arrow

1925. *Anadastus vicinus* Arrow, *Fauna British India*..Clavicornia, Erotylidae, Languriidae and Endomychidae : 226 (London). (Type locality : Burma ; Siam).

Material.—1 example : 16 miles N. of Imphal, on Dimapur Rd., *ca.* 3,500 ft., 1.X.1945.

Remarks.—This is the first record of the species from India.

Family EROTYLIDAE

19. **Episcapha quadrimacula** (Wiedemann)

1823. *Engis quadrimacula* Wiedemann, *Zool. Mag. Altona*, (2) 1 : 132(Type locality : Java).

1825. *Dacne quadrimacula* (Wied.), Macleay, *Annulosa Javanica* ; 41.

1842. *Episcapha quadrimacula* (Wied.),'Lacordaire, *Monograph Erotylidae :* 53.

1925. *Episcapha quadrimacula* (Wied.), Arrow, *Fauna British India*..Clavicornia, Erotylidae, Languriidae and Endomychidae : 39 (London).

Material.—1 example : Manipur, 16 miles N. of Imphal, on Dimapur Rd., *ca.* 3,500 ft., 1.X.1945.

Remarks.—This species has been regarded as perhaps the most abundant and widely distributed of all the oriental Erotylidae. Arrow gives its distribution as follows : Ceylon, South India (Nilgiri Hills), Uttar Pradesh (Kumaon Hills), Assam (Garo Hills, Syllet), Sikkim, Bengal (Berhampur), Burma (Tenasserim), Indo-China, Malaya Peninsula, Sumatra, Java, Borneo and the Philippine Islands. The Z.S.I collections contain examples from other parts of Assam, Bengal and U.P and also a few specimens from Delhi.

Family COCCINELLIDAE

20. **Coccinella septempunctata** Linneaus

1758. *Coccinella 7-punctata* Linneaus, *Systema Naturae*, (ed. X) 365 (Type locality : Europe).

1909. *Coccinella septempunctata* L., Lefroy, *Indian Insect Life* :306 (Calcutta).

1932. *Coccinella septempunctata* L., Korschefsky, *Coleopt. Cat., Berl.* pt. 120. Coccinellidae, 2 : 486-494.

Material.—3 examples : Manipur, near Modbung, *ca.* 3,500 ft., 1.XI.1945 (2 ex.), 7.XI.1945 (1 ex.).

Remarks.—The markings on the three examples mentioned above are constant and identical with the typical pattern of the species. Though of palaearctic origin, the species extends beyond the limits of that Region. In India it is more common in the north than in the south.

21. **Coccinella repanda** Thunberg

1781. *Coccinella repanda* Thunberg, *Nov. Ins. Spec.*, **1** : 18 (Type locality : 'Cape of Good Hope'. This record is probably due to an error).

1909. *Coccinella repanda* Thunb., Lefroy, *Indian Insect Life :* 306 (Calcutta).

1932. *Coccinella repanda* Thunb., Korschefsky, *Coleopt. Cat., Berl.* pt. 120, Coccinellidae, **2** : 483-485.

Material.—1 example : Manipur, near Modbung, *ca.* 3,500 ft., 1.XI.1945.

Remarks.—The example mentioned above has the typical pattern of the species which is widely distributed in the plains of India and is also recorded from central China, Sunda Islands, Molucca Islands, New Guinea, Australia, New Zealand, etc. In the Z.S.I. the species is represented by examples from Java, Burma, Andamans, Assam, Bengal, Bihar, Orissa, South India (Eastern Ghats), Bombay, Rajasthan, Madhya Pradesh and Uttar Pradesh, as far as Lucknow. It would be of interest to find out its exact western limits of distribution.

22. **Harmonia arcuata** (Fabricius)

1787. *Coccinella arcuata* Fabricius, *Mantissa Insectorum*, etc. **1** : 55 (Type locality : China).

1850. *Harmonia arcuata* (Fabr.), Mulsant., *Ann. Soc. Agric. Lyon* (2) **2** : 77.

1874. *Coccinella arcuata* Fabr., Crotch, *Revision of the coleopterous family, Coccinellidae* : 110 (London).

1932. *Coccinella* (sub-gen. *Harmonia*) *arcuata* Fabr., Korschefsky, *Coleopt. Cat., Berl.* pt. 120, Coccinellide : 440.

Material.—64 examples : Manipur, Imphal Valley, 2,000 ft.,—.VII. 1945 (35 ex.), 31.VII.1945, at light (1 ex.), 1.IX.1945 (1 ex.), 3.IX.1945 (1 ex.), 5-9.IX.1945 (4 ex.), 10-13.IX.1945 (22 ex.).

Remarks.—The species is very variable as regards its pronotal and elytral patterns. In the 64 examples mentioned above this fact is very well demonstrated. Certain specimens have been given separate varietal names by certain authors but in view of the fact that very few examples would look exactly alike, there is hardly any practical use of such names. Some of the variations in the pattern are illustrated in text-figure 1. It will also be noted that an example of this species has been collected at light.

The species occurs mostly in peninsular and N.-E. India, many examples being present from these parts in the Z.S.I. collections. Outside India the species is reported from Burma, China, Formosa, the Philippine and Sunda Islands, New Guinea, Australia, New Caledonia and doubtfully so from South Africa.

23. **Leis dimidiata** (Fabricius)

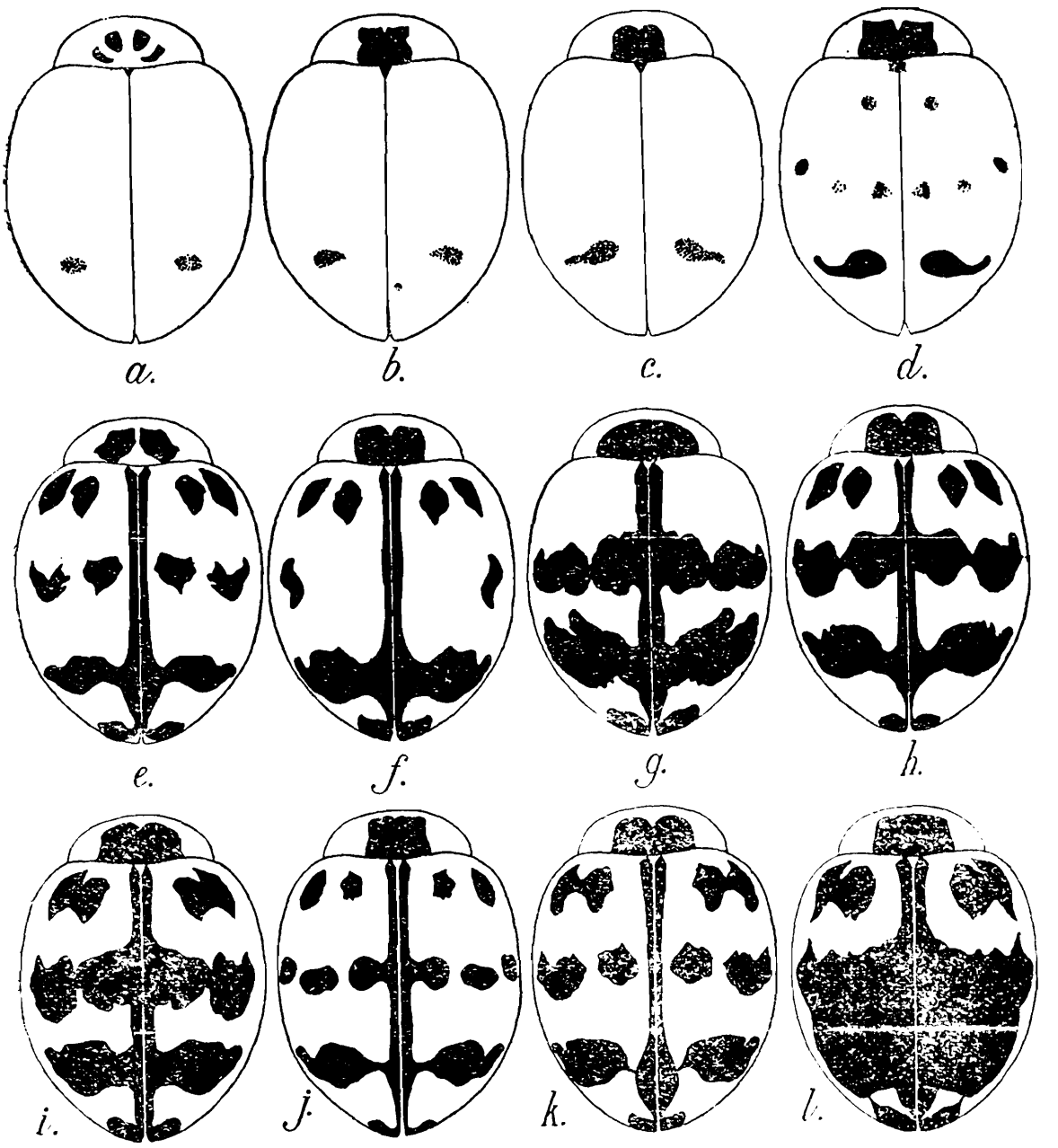
1781. *Coccinella dimidiata* Fabricius, *Species Insectorum :* 94 (Type locality : India).

1850. *Leis dimidiata* (Fabr.), Mulsant, *Ann. Soc. Agric. Lyon* (2) **2** : 242.

1932. *Leis dimidiata* (Fabr.), Korschefsky, *Coleopt. Cat., Berl.* pt. 120, Coccinellidae, **2** : 273.

Material.—1 example : Manipur, 16 miles N. of Imphal, on Dimapur Rd., *ca.* 3,500 ft., 6.X.1945.

Remarks.—The humeral black spot is present in the above-mentioned example. The species has hitherto been recorded from Kashmir to Nepal along the Himalayas and also from China and Japan. There are examples from the following localities in the Z.S.I. collection : Kashmir ; Kulu, Gurdaspur and Palampur in the Punjab ; Sikkim ; Nepal ; Assam and Bengal (Calcutta).



TEXT-FIG. 1, *a-l*. Colour variation in *Harmonia arcuata* (Fabr.).

24. **Oenopia luteopustulata** Mulsant

1850. *Oenopia luteopustulata* Mulsant, *Ann. Soc. Agric. Lyon* (2) **2** : 421 (Type locality : Assam).

1853. *Anatis thibetiana* Mulsant, *Anno Soc. linn. Lyon*, **1** : 148 (Type locality : Tibet).

1874. *Coelophora luteopustulata* (Muls.), Crotch, *Revision of the coleopterous family Coccinellidae :* 156 (London).

1932. *Oenopia luteopustulata* (Muls.), Korschefsky, *Coleopt. Cat., Berl.* pt. 120, Coccinellidae : 288.

Material.—5 examples : Manipur, Imphal Valley, 2,000 ft., 3.IX.1945 (2 ex.), 10-13.IX.1945 (2 ex.). Near Modbung, *ca.* 3,500 ft., 1.XI.1945 (1 ex.).

Remarks.—This is another very variable species. Ordinarily, as described originally by Mulsant, each elytron has five pale-orange spots (2, 2, 1) separated by a network of black pigment. The latter is often absent on the external margin and when the marking is further reduced it seems as if only two irregular transverse bands are present. Three of the five examples mentioned above exhibit this pattern. In the other two examples the post-median band is obliterated and only the very narrow sutural and the broad sub-basal bands are present. The sub-basal band on an elytron extends at its outer end towards the base so as to mark out a scutellar spot which is paler than the rest of the elytron.

Described originally from Assam, the species has also been recorded from Chamba (N.W India), Tibet and Burma. In the Z.S.I. collections examples are present from Simla, Kumaon, Lucknow, Sikkim, Darjeeling, Kurseong and the Andaman Islands. A few examples from Nepal in the British Museum collection have also been seen by the author.

O. Luteopustulata var. pedicata (Mulsant)

1853. *Coelophora pedicata* Mulsant, *Ann. Soc. linn. Lyan.*, **1** : 180 (Type locality : East Indies).

1912. *Coelophora luteopustulata* var. *pedicata* (Muls.), Sicard, *Ann. Soc. ent. Fr.* **71** : 500.

1932. *Oenopia luteopustulata* var. *pedicata* (Muls.), Korschefsky, *Coleopt. Cat., Berl.* pt. 120, Coccinellidae **2** : 288.

Material.—3 examples : Manipur, 16 miles N. of Imphal, on Dimapur Rd., *ca.* 3,500 ft., 4.X.1945 (1 ex.), 22.X.1945 (2 ex.).

Remarks.—While one (4.X.1945) of the three examples mentioned above has four cells on an elytron as described for the typical *pedicata*, the other two have only three cells, *i.e.*, two basal and one apical.

The type locality is East Indies ; Sicard recorded it also from Burma. The present record is the first one from India. In the Z.S.I. collection examples from Shillong are also present.

25. Coelophora sexareata Mulsant

1853. *Coelophora sexareata* Mulsant, *Ann. Soc. linn. Lyon*, **1** : 181 (Type locality : North India).

1932. *Coelophora sexareata* (Muls.), Korschefsky, *Coleopt. Cat., Berl.* pt. 120, Coccinellidae **2** : 296.

Material.—1 example : Manipur, 16 miles N. of Imphal, on Dimapur Rd., *ca.* 3,500 ft., 18.X.1945.

Remarks.—Recorded earlier from North India and Burma, the species is represented in Z.S.I. collection by examples from Darjeeling, Kalimpong, Kurseong and Sikkim.

C. sexareata var. lacerata Sicard

1912. *Coelophora sexareata* Muls. var. *lacerata* Sicard, *Ann. Soc. ent. Fr.* **81** : 500 (Type locality : Burma).

Material.—2 examples : Manipur, near Modbung, *ca.* 3,500 ft., 1.XII. 1945 (1 ex.); 16 miles N. of Imphal, on Dimapur Rd., *ca.* 3,500 ft., 1.XII.1945 (1 ex.).

Remarks.—The variety *lacerata* is distinguished by its interrupted black lines on the elytra and has hitherto been known only from Burma.

26. **Coelophora bissellata** Mulsant

1850. *Coelophora bissellata* Mulsant, *Ann. Soc. Agric. Lyon* (2) **2** : 400 (Type locality : Bengal ; Java).

1932. *Coelophora bissellata* (Muls.), Korschefsky, *Coleopt. Cat., Berl.* pt. 120, Coccinellidae 2 : 291.

Material.—3 examples : Manipur, 16 miles N. of Imphal, on Dimapur Rd., *ca.* 3,500 ft., 18.X.1945 (2 ex.). Near Modbung, *ca.* 3,500 ft., 1.XI. 1945 (1 ex.).

Remarks.—In one example (1.XI.1945) the sutural spot (situated posterior to the apex of scutellum) is confluent with the sub-basal spot and the external margin of the elytron is also having a black border. Mulsant noted a tendency for the union between the said spots in certain of the examples seen by him. Originally described from Bengal and Java, the species has since been recorded from Malacca, Sumatra, Java, Borneo, the Philippine Islands and New Guinea. The Z.S.I. collections contain examples from Kumaon Hills, Sikkim, Assam, Darjeeling and the Eastern Ghats (Kiliyur, *ca.* 2 miles from Yercaud, *ca.* 4,000 ft., Shevaroy Hills, Salem district, 8.VI.1929, *H. S. Pruthi*).

27. **Verania vincta** Gorham

1895. *Verania vincta* Gorham, *Ann. Mus. Civ. Genova* (2) **34** : 686 (Type locality : Burma).

Material.—6 examples : Manipur, Imphal Valley, 2,000 ft., 3.IX.1945 (2 ex.), 10-13.IX.1945 (4 ex.).

Remarks.—Hitherto known only from Burma, the species is being recorded for the first time from India. Other material in the Z.S.I. comes from Nepal, Assam-Bhutan Frontier, Assam (Siliguri), Bihar (Purnea district) and South India (Palni Hills, 6,500-7,000 ft., 28.VIII. 1922, *S. Kemp ;* Waltair,—.I.1941, *H. A. Hafiz*).

28. **Verania allardi** (Mulsant)

1866. *Lemnia Allardi* Mulsant, *Monograph Coccinellidae :* 249 (*Mem. Acad. Lyon* (1869-1870) **16** : 23) (Type locality : Northern India).

1874. *Verania Allardi* (Muls.), Crotch, *Revision of the coleopterous family, Coccinellidae :* 177 (London).

1932. *Verania Allardi* (Muls.), Korschefsky, *Coleopt. Cat., Berl.* pt. 120, Coccinellidae, **2** : 307.

Material.—1 example : Manipur, near Modbung, *ca.* 3,500 ft., 1.XI.1945.

Remarks.—This example resembles the typical *Verania allardi* in all respects (including the male genitalia) except that the pair of elytral spots present in typical *allardi* are absent. The sutural black line and the two black spots on the pronotum are in the same positions as in typical *allardi*.

Originally recorded from N. India, the species *allardi* has since been reported from Sumatra, Java and Borneo. A variety *malaccensis* Crotch has also been recorded from Malacca, New Guinea, the Philippines and China.

Family TENEBRIONIDAE

29. **Gonocephalum depressum** (Fabricius)

1798. *Opatrum depressum* Fabricius, *Supplementum Entomologiae Systematicae*, (Suppl.). 41 (Type locality : India).

1906. *Gonocephalum depressum* (Fabr.), Gebien, *Dtsch. ent., Z.* **2** (1906) : 213.

1911. *Gonocephalum depressum* (Fabr.), Gebien, *Coleopt. Cat., Berl.* pt. 22, Tenebrionidae : 323.

Material.—8 examples : Manipur, 16 miles N. of Imphal, on Dimapur Rd., *ca.* 3,500 ft., 20-30.IX.1945 (1 ex.), 11.X.1945 (1 ex.), 4.XI.1945 (1 ex.), 1.XII.1945 (1 ex.), 3.XII.1945, in soil (1 ex.), 9.XII.1945 (2 ex.), 14.XII.1945, common on ground (1 ex.).

Remarks.—Gebien who examined the Fabrician type states that it comes from Bengal. The species is, however, stated to be widely distributed in India.

Family BOSTRICHIDAE

30. **Heterobostrychus aequalis** (Waterhouse)

1884. *Bostrichus aequalis* Waterhouse, *Proc. zool. Soc. Lond.* **1884** : 215 (Type locality : Maroe, Timor-Laut Island).

1898. *Heterobostrychus aequalis* (Waterh.), Lesne, *Ann. Soc. ent. Fr.* **67** : 555, 557, 560.

1938. *Heterobostrychus aequalis* (Waterh.), Lesne, *Coleopt. Cat., Berl.* pt. 161, Bostrychidae : 37.

1941. *Heterobostrychus aequalis* (Waterh.), Beeson, *The ecology and control of forest insects*. : 64 (Dehra Dun).

Material.—1 example : Manipur, 16 miles N. of Imphal, on Dimapur Rd., *ca.* 3,500 ft., 20-30.IX.1945.

Remarks.—The species is widely distributed throughout the Oriental Region and extends to Madagascar in the west and New Guinea in the east. In the Z.S.I. collections examples from Malabar, Kashmir, Bengal, Assam and Burma are present.

31. **Xylothrips flavipes** (Illiger)

1801. *Apte flavipes* Illiger, *Mag. Insectenk.* (Illiger) **1** : 171 (Type locality : Africa).

1900. *Xylothrips flavipes* (Illig.), Lesne, *Ann. Soc. ent. Fr.* **69** : 621.

1938. *Xylothrips flavipes* (Illig.), Lesne, *Coleopt. Cat., Berl.* pt. 161, Bostrychidae : 67.

1941. *Xylothrips flavipes* (Illig.), Beeson, *The ecology and control of forest insects* .: 97 (Dehra Dun).

Material.—1 example : Manipur, 16 miles N. of Imphal, on Dimapur Rd., *ca.* 3,500 ft., 8.X.1945.

Remarks.—Beeson states this species to be frequent in tropical and moist subtropical parts of India but not common in the dry regions. He also states that it does not ascend to high elevations. In the Z.S.I collections examples from the Andaman Islands, Bengal, Assam and Ceylon are present. It occurs in Madagascar, besides several parts of the Oriental Region.

Family SCOLYTIDAE

32. **Xyleborus minor** (Stebbing)

1907. *Phloesinus minor* Stebbing, *Indian For. Bull.* **11** : 37.

1909. *Phloesinus minor* Stebbing, *Indian For. Mem.* **1**(2) : 20.

1914. *Dryocoetes minor* (Stebbing), *Indian forest insects* : 549 (London).

1930. *Xyleborus minor* (Stb.), Beeson, *Indian For. Rec.* **14** : (10) : 70-73.

Material.—4 examples : Manipur, 16 miles N. of Imphal, on Dimapur Rd., *ca.* 3,500 ft., 18.X.1945.

Remarks.—Beeson gives a detailed account of the distribution and biology of this species which is of importance to forestry in India. The species is widely distributed in India, having been recorded from several places in Uttar Pradesh, Madhya Pradesh, Bombay, Bengal and Assam. It is also known from Magayi Reserve in Burma.

Family SCARABAEIDAE

33. **Gymnopleurus aethiops** Sharp

1875. *Gymnopleurus aethiops* Sharp, *Coleopterologische Hefte*, Munchen, **13** : 34 (Type locality : Burma).

1931. *Gymnopleurus aethiops* Sharp, Arrow, *Fauna British India*..Coleopt. Lamellicornia, **3** : 62 (London).

Material.—10 examples : Manipur, mile-stone 34, Palel, on Imphal-Palel-Tamu Rd., *ca.* 3,750 ft., in foeces, 4.IX.1945.

Remarks.—Originally described from Burma, the species has since been recorded from Ceylon, India, Siam, Hongkong and Formosa. Within the boundaries of India it is known from Cochin and Nilgiri Hill, N. Kanara, Nedungayam and Nilumbur (Bombay State). The present record from Assam is, therefore, of interest.

34. **Catharsius molossus** Linneaus

1758. *Scarabaeus molossus* Linneaus, *Systema Naturae*, (ed. X) : 347 (Type locality : India).

1931. *Catharsius molossus* (Linn.), Arrow, *Fauna British India*..Coleopt. Lamellicornia, **3** : 94.

Material.—5 examples : Manipur, Imphal Valley, 2,000 ft., —.VI. 1945 (1 ex.), —.VII.1945 (1 ex.), 30.VIII.1945 (1 ex.), —.XI.1945 (1 ex.), 16 miles N. of Imphal, on Dimapur Rd., 14-19.IX.1945 (1 ex.).

Remarks.—The species is distributed in Ceylon, Andaman Islands, Sikkim, and India. In the latter country it is known from the Punjab (Simla), Uttar Pradesh (Nainital District), Bihar, Assam, Bengal, Orissa, Bombay State, Mysore and South Malabar.

35. **Onthophagus hystrix** Boucomont

1914. *Onthophagus hystrix* Boucomont, *Ann. Mus. Civ. Genova*, **46**: 238 (Type locality : Malabar, Coromondol).

1931. *Onthophagus hystrix* Bouc. Arrow, *Fauna British India*..Coleopt. Lamellicornia, **3**: 164.

Material.—1 example : Manipur, Imphal Valley, 2,000 ft.,—VIII. 1945.

Remarks.—The species is distributed in Ceylon, India and Burma. It is reported to be common in India and has been recorded by Arrow from Bihar, Uttar Pradesh, Madhya Pradesh, Bombay and Madras States. In the Z S.I. collection, besides the material from some of these localities, examples from Barkuda Island (Chilka lake), Orissa are also present.

36. **Aphodius costatulus** Schmidt

1908. *Aphodius costatulus* Schmidt, *Entomol. Wochenbl.* : 47 (Type locality : India).

1910. *Aphodius costatulus* Schmidt, *Coleopt. Cat., Berl.* pt. 20 : Scarabaeidae, Aphodinae : 18.

Material.—1 example : Manipur, 66 miles N. of Imphal, on Dimapur Rd., *ca.* 3,500 ft., 14.X.1945.

Remarks.—Schmidt records this species from Belgaum (Bombay State) and Kulu (Punjab). The present record from N.-E. India is, therefore, of interest.

37. **Anomala dimidiata** (Hope)

1831. *Euchlora dimidiata* Hope, in Gray, *Zoological miscellany* : 23 (London) (Type locality : Nepal).

1917. *Anomala dimidiata* (Hope), Arrow, *Fauna British India*..Coleopt. Lamellicornia, **2** : 232 (London).

Material.—9 examples : Manipur, Imphal Valley, 2,000 ft., —. VII.1945 (4 ex.), —.X.1945 (2 ex.), —.XI.1945 (1 ex.) ; 16 miles N. of Imphal, on Dimapur Rd., *ca.* 3,500 ft., 8.X.1945 (1 ex.), 4.XI.1945 (1 ex.).

Remarks.—Originally described from Nepal, the species has since been recorded from Kashmir, Punjab (Kulu and Simla Hills), Uttar Pradesh (Chawi, Nainital), Bihar (Pusa), Bengal (Sarda, Calcutta), Sikkim and Assam (Shillong, Manipur, Khasi Hills).

38. **Adoretus compressus** (Weber)

1801. *Melolontha compressus* Weber, *Observationes Entomologicae*. 72 (Type locality : Sumatra).

1844. *Adoretus umbrosus* Burmeister, *Handbuch der Entomologie*, **4**: 475.

1912. *Lepadretus compressus* (Weber), Ohaus, *Eng. Blatt.*, **8**: 224.

1917. *Adoretus compressus* (Weber), Arrow, *Fauna British India*..Coleopt. Lamellicornia, **2**: 311 (London).

Material.—1 example : Manipur, Imphal Valley, 2,000 ft., 25. VIII. 1945.

Remarks.—This is a widely distributed species which has been recorded from India, Burma, Indo-China, Malaya Peninsula, Sumatra, Java, Borneo and Mauritius. In India it has been recorded from Purnea. Ohaus (*l. c.*) recorded it from Madras and South Ceylon but about these records Arrow (*l. c.*) expresses doubt in the following words: " .it seems likely that *A.* (*Adoretus*) *bivaudatus* or another of the closely similar forms may have been mistaken for it. It is essentially a Malayan insect although its presence in Mauritius indicates its capability of extending its range. If incidently introduced into fresh regions it is probably capable of becoming a serious pest, as a race or very closely related species (*A. sinicus*) introduced into Hawaiian Islands has proved very destructive to sugarcane, its larvae feeding upon the roots." It is now well known that there is a certain amount of Malayan element in the fauna of South India and Ceylon. In view of this and in the absence of a re-examination of Ohaus' material, it would be more appropriate to accept the distribution of the species as given by Ohaus.

39. **Alissonotum crassum** Arrow

1908. *Alissonotum crassum* Arrow, *Trans. ent. Soc. Lond.* **1908** : 323 (Type locality : Assam ; Burma).

1910. *Alissonotum crassum* Arrow, *Fauna British India*..Coleopt. Lamellicornia, **1** : 302 (London).

Material.—1 example : Manipur, Palel, Imphal-Tamu Rd., 4.IX. 1945.

Remarks.—The species has already been recorded from Bengal (Rajmahal), Assam (Sylhet) and Burma. In the Z.S.I. collections examples from Sikkim are also present.

40. **Heteronychus lioderes** Redtenbacher

1867. *Heteronychus lioderes* Redtenbacher, *Reise der*..*'Novara'. Wien Zoologischer Theil Coleopteren :* 75 (Type locality : Java).

1891. *Heteronychus poropygus*, Bates, *Entomologist*, **1891** Suppl. : 19 (London).

1910. *Heteronychus lioderes* (Redt.), Arrow, *Fauna British India* Coleopt. Lamellicornia, **1** : 295 (London).

Material.—2 examples : Manipur, 16 miles N. of Imphal, on Dimapur Rd., *ca.* 3,500 ft., 1, 5.X.1945.

Remarks.—The species is distributed in India, Nepal, Burma, Malaya Peninsula, Java and Celebes. In India it has been recorded from Bengal and Assam. In the Z.S.I. collection examples from Bihar are also present.

41. **Dynastes gideon** (Linneaus)

1767. *Scarbaeus Gideon* Linneaus, *Systemae Naturae*, (12th Ed.) 1 (2) : 541.

1910. *Xylotrupes gideon* (Linn.), Arrow, *Fauna British India* Coleopt. Lamellicornia, **1** : 262 (London).

1937. *Dynastes gideon* (Linn.), Arrow, *Coleopt. Cat., Berl.* pt. 156 : 96.

Material.—1 example : Manipur, 16 miles N. of Imphal, on Dimapur Rd., *ca.* 3,500 ft., 20-30 IX.1945.

Remarks.—The species is distributed in Ceylon, India, Sikkim, Burma, Siam, South China, Malacca, Borneo, etc. In India it has been recorded

from various parts including Assam (Shillong, Sibsagar, Cachar), Bengal (Calcutta), Bombay State and Travancore.

42. **Coilodera penicillata** Hope

1831. *Coilodera penicillata* Hope, in Gray, *Zoological miscellany :* 25 (London) (Type locality : Nepal).

1842. *Macronota penicellata* (Hope), Burn.., *Handb. ent.*, **3** : 371.

1910. *Macronota penicillata* (Hope), Arrow, *Fauna British India*..Coleopt. Lamellicornia, **1** : 44 (London).

1921. *Coilodera penicillata* Hope, Schenkling, *Coleopt. Cat., Berl.* pt. 72, Scarabaeidae, Cetoninae : 133.

Material.—1 example : Manipur, 16 miles N. of Imphal, on Dimapur Rd., *ca* 3,500 ft., —.XI.1945.

Remarks.—Recorded earlier from Sikkim, Khasi Hills (Assam) and Burma, this species is represented in the Z.S.I. collections by examples from Darjeeling and Nilgiri Hills.

Family CERAMBYCIDAE

43. **Xystrocera globosa** (Olivier)

1795. *Cerambise globosus* Olivier, *Entomologie* **4** : 27 (Type locality : Batavia, Java).

1906. *Xystrocera globosa* (Oliv.), Gahan, *Fauna British India* Coleopt. Cerambycidae : 106 (London).

1912. *Xystrocera globosa* (Oliv.), Aurivillius, *Coleopt. Cat., Berl.* pt. 39, Cerambycidae : 37.

Material.—3 examples : Manipur, 16 miles N. of Imphal, on Dimapur Road, *ca.* 3,500 ft. (2 ex.). Near Modbung, *ca.* 3,500 ft.,—.XI.1945 (1 ex.).

Remarks.—This Austral-Asian species is widely distributed and has been recorded by Aurivilius from Scychell Island, Egypt, Mauritius, Ceylon, India, Burma, Siam, Malaya Peninsula, Java, Celebes, Philippine and Hawaiian Islands. In India it has been recorded by Gahan from Madras, Mysore, Bombay, Bengal and Assam. Examples from Bihar and the Punjab are also present in the Z.S.I.

44. **Aphrodisium cribricolle** Poll

1890. *Aphrodisium cribricolle* Poll, *Notes Leyd. Mus.*, **12** : 157 (Type locality : Sikkim).

1906. *Aphrodisium cribricolle* Poll, Gahan, *Fauna British India* .. Coleopt. Cerambycidae : 207 (London).

Material.—2 examples : Manipur, 16 miles N. of Imphal, on Dimapur Road, *ca.* 3,500 ft., 9.XI.1945.

Remarks.—Hitherto known from Sikkim only, the present record from Manipur is of interest.

45. **Batocera numitor** Newman

1842. *Batocera numitor* Newman, *Entomologist*, **1** : 275 (London).

1922. *Batocera numitor* Newm., Aurivillius, *Coleopt. Cat., Berl.* pt. 73, Cerambycidae, Lamaiini : 125.

1941. *Batocera numitor* Newm., Beeson, *Ecology and control of forest insects* : 147 (Dehra Dun).

Material.—1 example : Manipur, near Modbung, *ca.* 3,500 ft., 1. XI.1945.

Remarks.—This is a wide-spread species which has been recorded from Nepal, India (Bengal, Assam), Burma, Siam, Sumatra, Java, Celebes and Philippines.

46. **Glena pulchella** Thomson

1860. *Glena pulchella* Thomson, *Essai D'une classification de la family Cerambycidae* : 58.

1923. *Glena pulchella* Thomson, *Aurivilliu, Coleopt. Cat., Berl.* pt. 74, Cerambycidae, Lamaiini : 499.

Material.—1 example : Manipur, Imphal Valley, 2,000 ft.,—VII.1945.

Remarks.—Previously known from Burma and Assam, the species is represented in the Z. S. I. collections by examples from Sikkim ; Darjeeling and Kurseong, Bengal ; Khasi Hills, Assam ; Sahibgunj, Bihar ; South Mysore (*H. L. Andrewes*, 6.II.1912) and Nilgiri Hills (*H. L. Andrewes*).

Family CHRYSOMELIDAE

47 **Lema rufotestacea** Clark

1866. *Lema rufotestacea* Clark, *Cat. Phyt. Appl.* : 29.

1908. *Lema rufotestacea* Clear Jacoby, *Fauna British India* Coleopt. Chrysomelidae : 36 (London).

Material.—1 example : Manipur, 16 miles N. of Imphal, on Dimapur Road, *ca.* 3,500 ft., 8.X.1945.

Remarks.—This species occurs in Deccan, Malabar, Mahe, Assam (Patkai Mountains) and Burma.

48. **Diamorpha pallens** (Olivier)

1808. *Clytra pallens* Olivier, *Entomologie*, **4** : 836 (Type locality : Bengal).

1848. *Diamorpha melanopus* Lacordaire, *Mon. Phyt.* **2** : 238.

1908. *Diamorpha melanopus* Lac., Jacoby, *Fauna British India* Coleopt. Chrysomelidae : 168 (London) (Synonymy discussed).

1913. *Diamorpha pallens* (Lac.), Clavareau, *Coleopt. Cat., Berl.* pt. 53, Chrysomelidae : 41.

Material.—5 examples : Manipur, 16 miles N. of Imphal, on Dimapur Road, *ca.* 3,500 ft., 1, 2.X.1945 (2 ex.), 18.X.1945 (3 ex.).

Remarks.—Jacoby regards it as one of the commonest species of the genus. It has been recorded earlier from East India and Siam. Examples from Bengal (Darjeeling District, Chittagong), Orissa (Puri district) and Bihar (Sripur, Saran) are also present in the Z. S. I. collections.

49. **Aulacophora foveicollis** (Lucas)

1849. *Galeruca foveicollis* Lucas, *Explor. Alger Ent.* : 42 (Type locality : Algier).

1879. *Aulacophora foveicollis* (Luc.), Baly *Cistula Entomologica*, **2** : 445 (London).

1936. *Aulacophora foveicollis* (Luc.), Maulik, *Fauna British India* .... Coleopt. Chrysomelidae (Galerucinae) : 173 (London).

Material.—1 example : Manipur, 16 miles N. of Imphal, on Dimapur Road, *ca.* 3,500 ft., 18.X.1945.

Remarks.—The species which is pest of cucurbits is distributed throughout India and is also known from Greece, South Europe, North Africa, Cyprus, Aden, Persia, Pakistan, Ceylon, Andaman Islands and Burma. Essentially a Palaearctic species it has spread extensively into this part of the Oriental Region.

50. **Galerucella placida** Baly

1878. *Galerucella placida* Baly, *Cistula Entomologica*, **2** : 381 (London) (Type locality : Jhelum Valley, India).

1936. *Galerucella placida* Baly, Maulik, *Fauna British India* Coleopt. Chrysomelidae (Galerucinae) : 217 (London).

Material.—1 example : Manipur, Imphal Valley, 2,000 ft., 1.IX.1945.

Remarks.—The species is widely distributed in India, and has been recorded from Kashmir, Punjab, U. P., Bihar, Bengal and South India. It is also known from Burma and the present report from Assam fills up a gap in record of its distribution.

51. **Galerucida singularis** Harold

1880. *Galerucida singularis* Harold, *Stettin. ent. Ztg.*, 41 : 146.

1936. *Galerucida singularis* Harold, Maulik, *Fauna British India* Coleopt. Chrysomelidae (Galerucinae) : 551 (London).

Material.—1 example : Manipur, 16 miles N. of Imphal, on Dimapur Road, *ca.* 3,500 ft., 15.X.1945.

Remarks.—The species has previously been recorded from Assam (Sadiya), Burma (Ruby Mines) and Indo-China (Tonking).

52. **Monolepta lineata** Weise

1904. *Monoloepta duvivieri* Jacoby, *Ann. Soc. ent. Belg.*, **48** : 404 (name preoccupied). (Type locality : Nilgiri Hills, South India).

1915. *Monolepta lineata*, Weise, *Dtsch. ent. Z., Afr. Exp. Zool.* **1**, (1915) : 177.

1936. *Monolepta lineata* Weise, Maulik, *Fauna British India* Coleopt. Chrysomelidae (Galerucinae) : 398 (London).

Material.—2 examples : Manipur, 16 miles N. of Imphal, on Dimapur Road, *ca.* 3,500 ft., on grass, 8.X.1945.

Remarks.—Hitherto known from Nilgiri Hills, South India, the present record from Manipur is of special interest because of the affinity of the fauna of Nilgiri Hills with that of Assam.

53. **Monolepta signata** (Olivier)

1808. *Galeruca signata* Olivier, *Entomologie*, **6** : 665. (Type locality : Bengal).

1889. *Monolepta signata* Oliv., Jacoby, *Ann. Mus. Civ. Genova*, **26** : 229.

1936. *Monolepta signata* (Oliv.), Maulik, *Fauna British India* Coleopt. Chrysomelidae (Galerucinae) : 410 (London).

Material.—10 examples : Manipur, 16 miles north of Imphal, on Dimapur Road, *ca.* 3,500 ft., 8.X.1945 (5 ex.) 18.X.1945 (1 ex.), 22.X.1945 (2 ex.). Near Modbung, *ca.* 3,500 ft., 1.XI.1945 (2 ex.).

Remarks.—Hitherto recorded from Deccan, Malabar, Bengal and Assam (Sadyia) in India, the species occurs in Siam and Hongkong also. A variety from Ceylon has also been described by Maulik. In the Z. S. I. collections examples from the following additional localities are present : Bihar (Katihar, Rajmahal) ; Bengal (Berhampur, Calcutta, Darjeeling) ; Sikkim ; Upper Burma (Mandalay).

54. **Monolepta picturata** Jacoby

1896. *Monolepta picturata* Jacoby, *Ann. Soc. ent. Belg.* **40** ; 292 (Type locality : Burma).

1936. *Monolepta picturata* Jacoby, Maulik, *Fauna British India* .. Coleopt. Chrysomelidae (Galerucinae) : 412 (London).

Material.—7 examples : Manipur, 16 miles north of Imphal, on Dimapur Road, *ca.* 3,500 ft., 3.X.1945 (1 ex.), 22.X.1945 (6 ex.).

Remarks.—Previously recorded from Burma only, the species is for the first time being recorded from India.

55. **Monolepta maculosa** Allard

1890. *Monolepta maculosa* Allard, *Comptes-Rendus Soc. ent. Belg.* (1890) ; **82** (Type locality : Belgaum and Kanara).

1936. *Monolepta maculosa* Alld., Maulik, *Fauna British India* Coleopt. Chrysomelidae (Galerucinae) : 444 (London).

Material.—2 examples : Manipur, Imphal Valley, 2,000 ft., 5.IX.1945 (1 ex.), 10-13.IX.1945 (1 ex.).

Remarks.—Hitherto known from Bombay State, the species is for the first time being recorded from North-East India.

56. **Haltica cyanea** Weber

1801. *Haltica cyanea* Weber, *Observationes Entomologiae, Kiliae,* **1** : 57 (Type locality : Sumatra).

1807. *Haltica janthina* Illiger, *Mag. Inskde.*, **6** : 115 (Type locality : Sumatra).

1889. *Haltica australis* Blackburn, *Proc. linn. Soc. N. S. Wales* (2) **3** : 1943 (Type locality : South Australia).

1896. *Haltica birmanensis* Jacoby, *Ann. Soc. ent. Belg.* **40** : 254 (Type locality : Burma).

1923. *Haltica coerulea* Weise (not *coerulea* Olivier), *Ark. Zool.* **15**(12) : 109 (Type locality : Queensland).

1926. *Haltica cyanea* Weber, Maulik, *Fauna British India* . Coleopt. Chrysomelidae (Chrysomelinae and Halticinae), 442 (London).

1933. *Haltica cyanea* Weber, Chen, *Peking nat. Hist. Bull.* **8** (1) : 51.

1940. *Haltica cyanea* Weber, Heikertinger and Csiki, *Coleopt. Cat., Berl.* pt. 166, Chrysomelidae : Halticinae : 277 (Synonymy).

Material.—15 examples : Manipur, 16 miles North of Imphal, on Dimapur Road, *ca.* 3,500 ft., 25.IX.1945 (1 ex.), on shrub, in copula 2.X.1945 (2 ex.), 18.X.1945 (11 ex.), 22.X.1945 (1 ex.).

Remarks.—Distributed in India, Burma, Indo-China, China, Japan, Sumatra, Java and Australia. In India it is recorded from various parts of the Punjab, Bombay and Bengal. In the Z.S.I. collections

examples from Sikkim, Ranchi and Bangalore are also preset. It would be interesting to know its exact southern limits in peninsular India.

57. **Haltica coerulea** (Olivier)

1791. *Galeruca coerulea* Olivier, *Encyclopedic Methodicue*, **6** : 590 (Paris) (Type locality : East Indies).

1926. *Haltica coerulea* (Oliv.), Maulik, *Fauna British India* .. . Coleopt. Chrysomelidae (Chrysomelinae and Halticinae) : 423 (London).

Material.—5 examples : Manipur, near Modbung, 3,500 ft., 1.XII.1945.

Remarks.—The species has been recorded from Ceylon, Madras State (Coromondal Coast, Nilgiri Hills), and Assam (Sadiya). Examples from Calcutta and Gosaba in Bengal are also present in the Z. S. I. collection.

58. **Haltica foveicollis** Jacoby

1889. *Haltica* (*Graptodera*) *foveicollis* Jacoby, *Ann. Mus. Civ. Genova*, **27** : 190 (Type locality : Burma).

1926. *Haltica foveicollis* Jacoby, Maulik, *Fauna British India* .. . Coleopt. Chrysomelidae (Chrysomelinae and Halticinae) : 419 (London).

Material.—1 example : Manipur, near Modbung, *ca.* 3,500 ft., 1.XI. 1945.

Remarks.—This species has hitherto been recorded from Burma (Rangoon, Toungoo, Tharawady and Tenasserim). The present example compares very well with the material from Burma in the Z. S. I. collection.

59. **Aspidomorpha sanctae-crucis** (Fabricius)

1794. *Cassida sanctae-crucis* Fabricius, *Entomologiae systematicae*, **4** : 446 (Type locality : Central America).

1854. *Aspidomorpha sanctae-crucis* (Fabr.), Boheman, *Mon. Cassid.* **2** : 288.

1919. *Aspidomorpha sanctae-crucis* (Fabr.), Maulik, *Fauna British India*. .. Coleopt., Chrysomelidae (Hispinae and Cassidinae) : 329 (London).

Material.—3 examples : Manipur, near Imphal, at mile stone 130 on Imphal-Dimapur Road, 17 VIII.1945 (2 ex.) ; Imphal Valley, 2,000 ft., 22.VIII.1945 (1 ex.).

Remarks.—The species when alive has golden colour. The following description has been given on the label by the collector. " Elytra : dorsally bright golden with copper tinge, outer half transparent, two dots golden dorsally, dark ventrally ; ventrally only translucent, with golden tinge of dorsal surface. Pronotum : like elytra dorsally. Abdomen dorsally dirty yellow, ventrally metallic gold, with green tinge, legs similar but not golden. Eyes and mouth-parts black. "

The species is widely distributed in India being recorded from Madras, Bombay, Bengal and Assam. It is also known from Sikkim. Examples from Bihar are also present in the Z. S. I. collections. Outside India it is known from Burma, Ceylon, Indo-China, West China, Sunda Islands, Sumatra and Borneo.

Family CURCULIONIDAE

60. **Esamus circumdatus** (Wiedemann)

1821. *Curculio circumadatus* Wiedemann, *Mag. Entom.* (Germar) **4**: 156 (Type locality : Bengal).

1863. *Tanymecus circumdatus* (Wied.), Maklin, *Act. Soc. Fenn.* **7** : 129.

1919. *Tanymecus circumdatus* (Wied.), Marshall, *Fauna British India* .... Coleopt. Curculionidae : 90-91 (London).

1933. *Esamus circumdatus* (Wied.), Gunther and Zumpt., *Coleopt. Cat., Berl.* pt. 131, Curculionidae : 95.

Material.—2 examples : Manipur, 16 miles North of Imphal on Dimapur Road, *ca.* 3,500 ft., IX.1945 (1 ex.) ; near Modbung, *ca.* 3,500 ft. 1.XI.1945 (1 ex.).

Remarks.—The species is distributed in the Punjab, Bengal, Assam, Nepal, Burma and Formosa.

61. **Tanymecus indicus** Faust

1894. *Tanymecus indicus* Faust, *Ann. Mus. Civ. Genova*, **34** : 177 (Type locality ; Calcutta, East India).

1916. *Tanymecus indicus* Faust, Marshall, *Fauna British India* .... Coleopt. Curculionidae : 99 (London).

1933. *Tanymecus indicus* Faust, Gunther and Zumpt, *Coleopt, Cat., Berl.* pt. 131, Curculionidae : 92.

Material.—5 examples : Manipur, Imphal Valley, 2,000 ft., 10-13.IX. 1945 (2 ex.), 26.IX.1945 (1 ex.) ; 16 miles North of Imphal, on Dimapur Road, *ca.* 3,500 ft., 22.X.1945 (2 ex.).

Remarks.—The species is widely distributed in India, being known from the Punjab, Uttar Pradesh, Bihar, Bengal and Assam. It is stated to be a pest of seedling of various crops.

62. **Episomus guttatus** Boheman

1845. *Episomus guttatus* Boheman, in Schonher, *Synonymia Insectorum* (*Gen. et. Spec. Curculion.*), **8** : 435 (Type locality : Assam).

1916. *Episomus guttatus* Boh., Marshall, *Fauna British India* ..*Coleopt.* Curculionidae : 217 (London).

1937. *Episomus guttatus* Boh., Loha, *Coleopt. Cat. Berl.* pt. 160, Curculionidae : 367.

Material.—1 example : Manipur, Imphal Valley, 2,000 ft., 31.VIII. 1945.

Remarks.—The species has already been recorded from Assam (Naga Hills and Khasi Hills), Burma and Malaya.

63. **Astycus lateralis** (Fabricius)

1792. *Curculio lateralis* Fabricius, *Entomologi Systematicae* **1**: 454 (Type locality : East Indies).

1892. *Astycus lateralis* (Fabr.), Faust, *Ann. Soc. ent. Fr.*, **61** : 505 (Indo-China).

1916. *Astycus lateralis* (Fabr.), Marshall, *Fauna British India* .... Coleopt. Curculionidae : 139 (London).

Material.—2 examples : Manipur, 16 miles north of Imphal, on Dimapur Road, *ca.* 3,500 ft., 1.X.1945 (1 ex.) ; Near Modbung, 3,500 ft., 1.XI.1945 (1 ex.).

Remarks.—The species is distributed in India, Burma, Siam and Malaya Peninsula. It attacks tea plants in Assam and mulberry bushes in Rangoon (Burma). In the Z. S. I. collections examples from various parts of Bengal, Bihar, Nepal and Burma are present.

64. **Phytoscaphus nubilus** Faust

1894. *Phytoscaphus nubilus* Faust, *Ann. Mus. Civ. Genova*, **34**: 218 (Type locality : Burma).

Material.—6 examples : Manipur, 16 miles North of Imphal, on Dimapur Road, *ca.* 3,500 ft., 18.X.1945 (1 ex.), 22.X.1945 (1 ex.) ; Near Modbung *ca.* 3,500 ft., 1.XI.1945 (4 ex.).

Remarks.—Known earlier from Burma, the present record is the first one from India. Examples from Shillong and Khasi Hills, Assam, are also present in the Z. S. I. collections.

65. **Xanthochelus blumeae** Marshall

1938. *Xanthochelus blumeae* Marshall, *India For. Rec.* (*N. S.*) *Ent.* **3**: *159*, (Type locality : Dehra Dun).

Material.—1 example : Manipur, Imphal Valley, 2,000 ft., 13.X.1945.

Remarks.—Already known from Dehra Dun, U. P., the present record appears to be a new one for North-East India.

66. **Paracycnotrachelus cygneus** (Fabricius)

1801. *Attelabus cygneus* Fabricius, *Systema Eleutheratorum*, **2**: 417 (Type locality : Sumatra).

1833. *Apoderus cygneus* (Fabr.), Gyllenhall, in Schonher, *Synonumia insectorum* (*Gen. et. Spec. Curculion.*), **1** : 190.

1860. *Apoderus* (sub-gen. *Cycnotrachelus*) *cygneus* (Fabr.), Jekel, *Ins. Saunders*, **2** : 160.

1929. *Paracycnotrachelus cygneus* (Fabr.), VõB, *Stettin. ent. Ztg.* **90** : 131, 135.

1930. *Paracycnotrachelus cygneus* (Fabr.), Torre and VõB, *Coleopt. Cat., Berl.* pt. 110, Curculionidae ; Aphodrinae : 31.

Material.—1 example : Manipur, Imphal Valley, 2,000 ft., 10-13.IX. 1945.

Remarks.—Though not previously known from Assam, the species has been recorded from Bengal, Burma, Cambodia, Laos, Penang, Sumatra, Java and Borneo.

67. **Apoderus notatus** (Fabricius)

1792. *Attelabus notatus* Fabricius, *Entomologiae Systematicae*, **1**: 385 (Type locality : India).

1860. *Apoderus notatus* (Fabr.), Jekel, *Ins. Saunders.*, **2** : 170.

1930. *Apoderus notatus* (Fabr.), Torre and VõB, *Coleopt. Cat., Berl.* pt. 110, Curculionidae ; Apoderinae : 21.

Material.—1 example : Manipur, 16 miles North of Imphal, on Dimapur Road, *ca.* 3,500 ft., 25.IX.1945.

Remarks.—The species is distributed in India, Burma, Tonking and China. Besides the present example from Assam, material from Shillong is also present in the Z. S. I. collections.

68. **Alcides scenicus** Faust

1894. *Alcides scenicus* Faust, *Ann. Mus. Stor. nat. Genova*, **34** : 256, 260 (Type locality : Burma).

1934. *Alcides scenicus* Faust, Klima, *Coleopt. Cat., Berl.* pt. 135, Curculionidae ; Gymnetrinae : 59.

Material.—1 example : Manipur, 16 miles North of Imphal, on Dimapur Road, *ca.* 3,500 ft., 4.X.1945.

Remarks.—The species has hitherto been recorded from Burma, Tonking (subspecies *instrusomimus* Heller[1] and Japan). Other examples from Garo Hills, Assam, Mungphu and Kallimpong, Darjeeling District, Bengal, are also present in the Z. S. I. collections.

69. **Gasterocercus anatinus** Chevrolet

1880. *Gasterocercus anatinus* Chevrolet, *Naturaliste*, Paris, **2** (4) : 94 (Type locality : Andaman Islands).

1936. *Gasterocercus anatinus* Chev., Hustache, *Coleopt. Cat., Berl.* pt. 151, Curculionidae ; Cryptorrhynchinae : 186.

Material.—1 example : Manipur, Imphal Valley, 31.VIII.1945.

Remarks.—Hitherto known from Andaman Islands, the species is now being recorded from the mainland of India for the first time.

70. **Athesapeuta vinculata** Faust

1894. *Athesapeuta vinculata* Faust., *Ann. Mus. Civ. Genova*, **34** : 315 (Type locality : Burma).

1938. *Athesapeuta vinculata* Faust, Hustache, *Coleopt. Cat., Berl.* pt. 163, Curculionidae ; Barinae : 169.

Material.—9 examples : Manipur, 16 miles North of Imphal, on Dimapur Road, *ca.* 3,500 ft., common on grass, 8.X.1945 (8 ex.) ; Near Modbung *ca.* 3,500 ft., 1.XI.1945 (1 ex.).

Remarks.—Previously known only from Burma, the present record is the first one from India.

71. **Cyrtotrachelus buqueti** Guerin, var. DUX Boheman

1844. *Cyrtotrachelus buqueti* Guerin-M, *Ichonographie Regne Anim.* Ins. : 176 (Type locality : Bombay).

1845. *Cyrtotrachelus dux* Boheman, in Schonher, *Synonymia Insectorum* (*Gen. et. Spec. Curc.*), **8**(2) : 221 (Type loc. : Assam).

1866. *Cyrtotrachelus buqueti* var. *dux*. Boh., Lacordire, *Gen. Coleopt.* **7** : 272.

1936. *Cyrtorachelus buqueti* var. *dux* Boh., Csiki, *Coleopt. Cat., Berl.* pt. 149, Curculionidae ; Rhynchophorinae : 9.

Material.—1 example : Manipur, Imphal Valley, 2,000 ft., 4.IX.1945.

Remarks.—The variety *dux* has been recorded from Assam, Bengal, Sikkim and Burma ; *buqueti* is also known from Tonking besides India and Burma. Two of its other varieties, *viz. nigrocinctus* Faust and *borealis* Jordon, are known from Burma and China and China and Japan respectively.

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[1] Heller, *Dtsch. ent. Zt.*, 1922 ; 19.

IV. Acknowledgments

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ON A NEW ACANTHOCEPHALA, *PALLISENTIS COLISAI*, FROM THE FISH *COLISA FASCIATUS* (BLOCH AND SCHN.), WITH A NOTE ON *ACANTHOGYRUS ACANTHOGYRUS* THAPAR, FROM THE FISH *LABEO ROHITA* (HAMILTON).

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In order to study the occurrence of Acanthocephala from the fishes of Delhi State, the alimentary canal of a number of species of fishes were examined at different times of the year from July, 1952 to May, 1953. All the fishes were collected from the local fish market near Juma Masjid or from fish hawkers. Care was taken to select only the species of fishes which are found in the Jumna river and the ponds of the Delhi State proper. The collection was made at irregular intervals according to the availability of fresh specimens. Altogether 101 fishes, belonging to 16 species, were examined, the details of which are given in the Table I.

The majority of the fishes examined were adult in size. Out of 16 species only in two, namely *Colisa fasciatus* collected on 31-8-52 and *Labeo rohita* on 18-9-52 the acanthocephalan worms were found. In *C. fasciatus* altogether 9 worms, 6 male and 3 female, were found. The parasites belong to a single species in the genus *Pallisentis* and since it cannot be assigned to any of the known species it is described here as a new species. A single male specimen of acanthocephala was found from *L. rohita*, which has been identified as *Acanthogyrus acanthogyrus* Thapar.

TABLE I.—*Details of the Fishes Examined.*

Names of fishes.	Number.	Measurement.	Date of collection.	Locality.	Whether infected or not.
Family Cyprinidae Sub-Fam. Cyprininae.					
1. *Labeo rohita* . .	1	2′6″	18-9-52	Juma Masjid	Yes
	1	2′4″	3-4-53	,,	No
	1	2′3″	10-4-53	,,	,,
2. *Labeo calbasu* .	1	1′	3-4-53	,,	,,
	1	1′1″	9-4-53	,,	,,
3. *Cirrhina mrigala* .	2	2′; 2′1″	30-7-52	Fish hawker.	,,
	1	1′9″	20-9-52	,,	,,

TABLE I.—*Details of the Fishes Examined*—contd.

Names of fishes.	Number.	Measurement.	Date of collection.	Locality.	Whether infected or not.
Family Cyprinidae—*contd.* Sub-Fam. Cyprininae—*contd.*					
4. *Cirrhina reba* .	4	6″ to 7″	5-8-52	Fish hawker.	No
	10	3½″ to 4½″	13-4-53	,,	,,
5. *Puntius sarana* .	1	10″	5-8-52	,,	,,
	7	4″ to 5″	12-4-53	Juma Masjid.	,,
6. *Puntius ticto* .	12	2″ to 2¼″	20-7-52	,,	,,
7. *Aspidoparia morar*	6	3″ to 4″	12-4-53	,,	,,
	15	5″ to 6″	13-4-53	Fish hawker.	,,
Family Notopteridae					
8. *Notopterus notopterus.*	4	9″ to 12″	10-8-52	Juma Masjid.	,,
Family Siluridae					
9. *Wallago attu* . .	6	6″ to 7″	18-9-52	,,	,,
Family Bagridae					
10. *Mystus seenghala*	6	6″ to 10″	27-7-52	,,	,,
	1	2′	23-9-52	Fish hawker.	,,
	2	2′6″ ; 3′3″	24-9-52	Juma Masjid.	,,
Family Schilbeidae					
11. *Eutropiichthys vacha*	2	1′ ; 1′2″	20-7-52	,,	,,
Family Sisoridae					
12. *Bagarius bagairus*	2	7″ ; 9″	23-9-52	Fish hawker.	,,
Family Channidae					
13. *Channa marulius*	3	6″ ; 7½″ ; 12″	27-9-52	,,	,,
14. *Channa striatus*	3	9″ ; 10″ 12″	6-4-53	Juma Masjid.	,,
Family Anabantidae					
15. *Colisa fasciatus* .	6	2½″ to 3″	31-8-52	Fish hawker.	Yes
Family Gobiidae					
16. *Glossogobius giuris*	3	4″ ; 4¾ ; 5″	27-9-52	,,	No

Pallisentis colisai, sp. nov.

The body (Text fig. b) is long and cylindrical with a globular proboscis at the anterior end. The males are generally smaller than the females. The body is covered with spines. Maximum diameter is in the region of the anterior rows of hooks.

The proboscis is with a long neck and is devoid of spines. It is covered with four equidistant circles of 10—12 curved hooks in each circle. Hooks of the anterior circle are stouter and longer than those of the posterior ones. The proboscis sheath is a thin, ovoid, single-layered, muscular sac. It originates from the posterior end of the neck region and hangs down freely in the body cavity. Retractor and protractor muscles are present and are attached slightly above the free end of the proboscis sheath. A big oval nerve ganglion is embedded at the posterior end of the proboscis sheath. The ganglion forms the central nervous system of the worm, with a few nerve fibres which go out to supply the body wall. The lacunar system cannot be seen very clearly.

At the anterior part of the body, immediately below the neck region, 15—17 circular, equidistant rows, each with 18—20 close set collar spines, are present. This is followed by a short spineless region. The portion of the body behind this is covered with 21—67 regular spinose circles varying in numbers according to sex, separated from one another by wide spineless spaces. Each circle has 16—20 small arrow-shaped spines.

Sexual dimorphism is distinct in respect of the number of circles of spines over the body. In the male the range of variation of the number of circles is very little which is 21—22, while in the female it is fixed, the number being 67, in all the worms examined. Again in the former nearly half the body is covered with the circles of the body spines while in the female nearly five-sixth of the body is covered by the body spines.

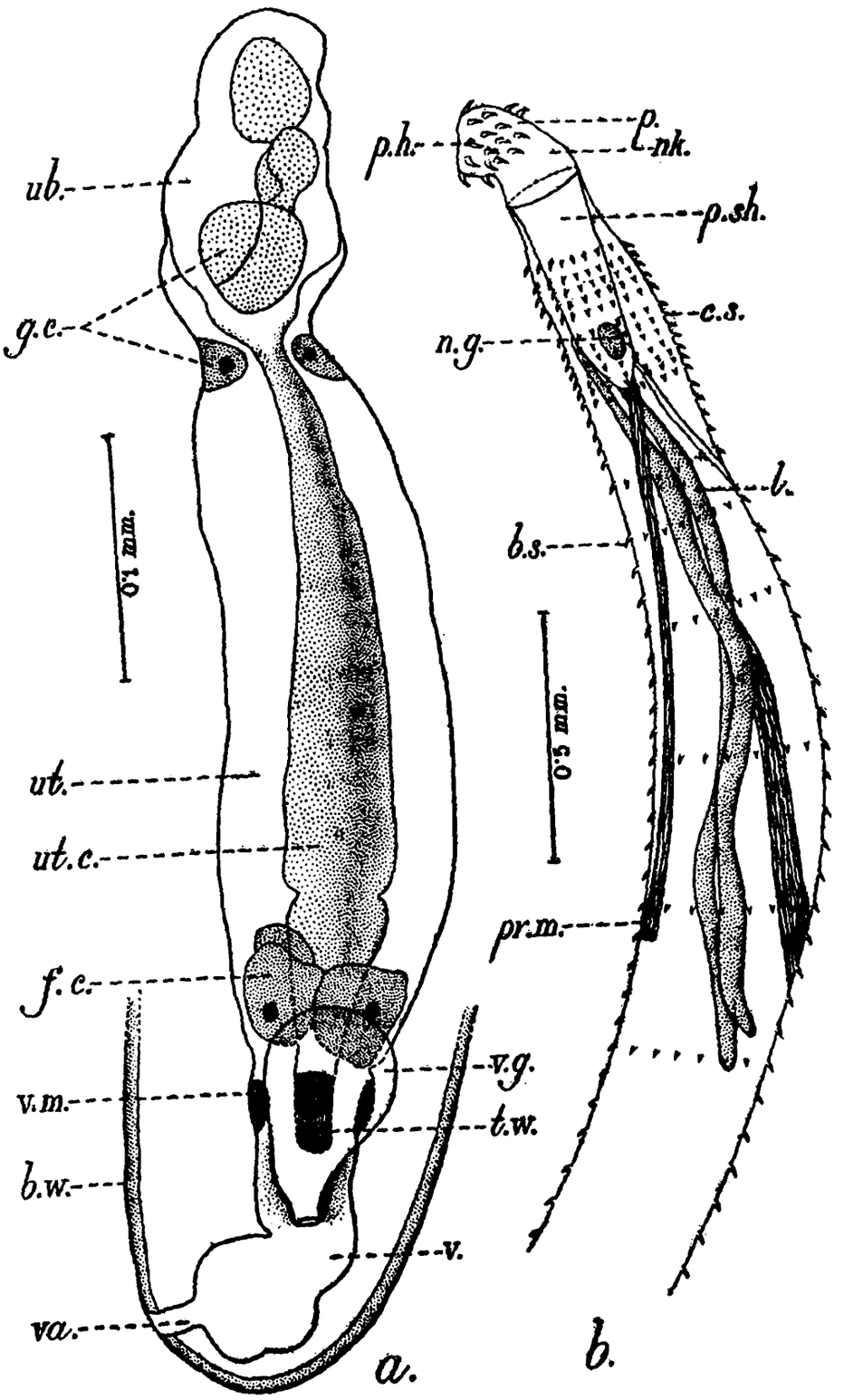
The two elongated lemniscii are situated on either side of the proboscis sheath and are nearly equal in length.

The body nucleus has not been observed.

The male genitalia consists of a pair of elongated elliptical testes lying one behind the other. Both the testes are almost equal in length and are cylindrical with both the ends blunt. The vas efferens runs downward from each testis. The single vas deferens opens at the base of the seminal vesicle, which is a large thin walled sac. The prostate gland is a single elongated structure and is situated immediately behind the posterior testis. It consists of 12—14 nuclei. The prostate gland opens into the prostatic reservoir. It is conspicuous and is a pyriform sac. The penis with the ducts opens in the bursa.

The female genitalia (Text fig. a) consists of a uterine bell, uterus, vaginal gland, vagina, vaginal muscles and vulva. The uterine bell is an elongated oval structure with two constrictions, one in the anterior end, the other in the middle region. The guard cells are seen inside and below the uterine bell. The uterus is a long flabby tube and

begins from the end of the uterine bell. The maximum diameter of the uterine cavity is towards the posterior part and near this region a distinct constriction is also noticed. The posterior portion of the uterus has a prominent tubular structure coming inside the elongated vaginal chamber. It is provided with thick frilled longitudinal muscles with a



TEXT FIG. 1.—(*a*) Posterior portion of *Pallisentis colisai*, female, showing the reproductive organ; b.w.—Body wall; f.c.—Flask cells; g.c.—Guard cells; t.w.—Tubular vaginal wall; u.b.—Uterine bell; ut.—Uterus; ut.c.—Uterine cavity; v.—Vagina; v.g.—Vaginal gland; v.m.—Vaginal muscle; va.—Vulva.

(*b*) Anterior region of *Pallisentis colisai*, male. b.s.—Body spine; c.s.—Collar spine; l.—Lemniscus; n.g.—Nerve ganglion; nk—Neck; p.—Proboscis; p.h.—Proboscis hook; p.sh.—Proboscis sheath; pr. m.,—Protractor muscle.

transverse muscular band. Four flask cells lie at the posterior end of the uterus, below which the uterus passes in to the vagina. The tubular vaginal wall has two sets of strong muscular bands, known as vaginal muscles or vaginal sphincters. A pyriform sac, *i.e* , the vaginal gland is situated over the vaginal wall and opens in the vagina below the uterine portion. The vulva is a small tubular structure placed more or less postero-laterally.

In the mature worms the ovary bursts liberating the ova in the body cavity in the various stages of development.

TABLE II.—*Measurements of* Pallisentis colisai *in millimeters.*

		Holotype.	Paratypes.
LENGTH	male	4·2×0·36	3·5—8·5×0·34—0·36
	female		5·4—12·9×0·61—0·62
PROBOSCIS (fully extended)		0·12×0·15	0·12—0·19 × 0·15—0·28
PROBOSCIS HOOKS	first circle	0·08	0·08
	second circle	0·07	0·07
	third circle	0·05	0·05
	fourth circle	0·04	0·04
PROBOSCIS SHEATH		0·34×0·14	0·28—0·68 × 0·14—0·28
COLLAR SPINE		0·02	0·02
BODY SPINE		0·02	0·02
LEMNISCII		1·06×·04	1·06—2·4 × 0·04—0·07
TESTES	anterior	0·38×0·15	0·34—0·38×0·11—0·15
	posterior	0·35×0·18	0·31—0·35×0·12—0·18

TABLE II.—*Measurements of* Pallisentis colisai *in millimeters*—contd.

	Holotype.	Paratypes.
PROSTATE GLAND	0·42×0·17	0·28—0·42 × 0·12—0·17
PROSTATIC RESERVOIR . .	0·25×0·12	0·25—0·45 × 0·11—0·12
SEMINAL VESICLE . .	0·29×0·12	0·29—0·45 × 0·08—0·12
BURSA	0·21×0·9	0·18—0·21×0·09

Name. *Pallisentis colisai*, sp. nov.

Host. *Colisa fasciatus* (Bloch and Schn.)

Location. Alimentary canal

Locality. *Delhi*

Holotype. Adult male ; collected by H. L. Sarkar ; 31st August, 1952.

Specimens on slide number (W 3855/1) preserved in the collection of the Zoological Survey of India, Calcutta.

Paratypes. Adult 5 males, 3 females ; collected by H. L. Sarkar ; 31st August 1952.

Specimens on slide retained by the author, Department of Zoology, University of Delhi.

Sarkar (1953), while describing the new species of *Pallisentis nandai* discussed the existing species of the genus *Pallisentis*. At present two species in addition to the above mentioned one are included in this genus. Van Cleave (1920) described *Pallisentis umbellatus*. Datta and Poddar (1935) transferred *Farzandia nagpurensis* Bhalerao to the present genus.

The present species *P. colisai* differs from the above mentioned three species on the following points.

The range of variations in length in both the male and female of *P. colisai* is very wide and is greater than that in *P. nandai*. The range of

the width of the body of both the sexes of *P. colisai* is very little while it is very prominent as compared with *P. umbellatus* and *P. nandai.*

The proboscis of *P. colisai* is smaller in size than that of *P. nandai.* The number of hooks in each circle of the proboscis of *P. colisai,* which is 10 to 12, differs from that of *P. umbellatus, P. nagpurensis* and *P. nandai* which are six and eight to ten respectively.

The proboscis sheath of *P. colisai* is smaller in size than that of *P. nandai.*

The number of circles of collar spines and the body spines of *P. colisai* differs from that of *P. umbellatus* and *P. nandai.* In *P. umbellatus* the number is 9 and 20 to 24 and in *P. nandai* it is 13 to 14 and 28 to 55 respectively, whereas in *P. colisai* it is 15 to 17 and 21 to 67 respectively. In *P. nagpurensis* the number of the collar spines is 14 and thus is different from that of the present species but nothing is known about the number of circles of body spines.

A distinct sexual dimorphism has been observed in *P. colisai* in regard to the length and breadth of the body as well as the number of circles of spines on the body. The length of the female is almost 1·5 times longer than that of the male, while the width is nearly double. In *P. nandai* difference of such magnitude has not been observed.

The number of body spine in *P. colisai* varies from 21 to 67 whereas in *P. nandai* it ranges from 28 to 55. In the male of *P. colisai* this number ranges from 21 to 22, whereas in *P. nandai* it ranges from 28 to 34. In the female of *P. colisai* the number is fixed being 67, whereas in *P. nandai* it ranges from 44 to 55.

Nothing is recorded about the sexual dimorphism in *P. umbellatus* and in *P. nagpurensis.*

In *P. colisai* the lemniscii are nearly equal in length whereas in *P. nandai* one of the lemniscus is two thirds of the length of the other. Nothing has been mentioned about the lemniscii in *P. umbellatus.* Regarding the proportion of lemniscii in *P. nagpurensis* nothing has been mentioned ; only the measurement of one lemniscus has been given.

The male genitalia of *P. colisai* agrees with that of *P. nandai* in respect of the arrangement of the structures but differs in the size of the testes. The anterior and posterior testes of *P. colisai* are more or less equal in length while the anterior testis of *P. nandai* is slightly longer than the posterior one. Like *P. nandai, P. colisai* differs from *P. nagpurensis* in respect of genitalia.

The size of the prostate gland of *P. colisai* is nearly half in size when compared with *P. nandai.* The number of nuclei of the prostate gland, which is 12 to 14 in *P. colisai,* differs from that in all the other species. In *P. nandai* it is 23 to 25, in *P. nagpurensis* it is 15 or more and in *P. umbellatus* it is 16.

TABLE III.—*Measurements (in millimeters) and hosts of the different species of* Pallisentis.

	Pallisentis umbellatus Van Cleave	*Pallisentis nagpurensis* (Bhalerao)	*Pallisentis nandai* Sarkar	*Pallisentis colisai* sp. nov.
DIMENSIONS OF THE BODY	6—10×0·3—0·5	♂: 14×0·45 ♀: 17·5×6·56	♂: 5·6—9·9×0·37—0·63 ♀: 6·3—10·4×0·35—0·56	♂:3·5—8·5×0·34—0·36 ♀:5·4—12·9×0·61—0·62
MEASUREMENTS OF PROBOSCIS	0·2 (diameter)	0·2×0·23	0·17—0·48×0·19—0·32	0·12—0·19 × 0·15—0·28
PROBOSCIS HOOKS :—				
Number of circles	4	4	4	4
Number of hooks in each circle	6	8—10	8—10	10—12
Measurements of hooks in each circle	(i) 0·089—0·119 (ii) 0·083—0·1 (iii) 0·053—0·065 (iv) 0·035—0·041		(i) 0·093 (ii) 0·08 (iii) 0·06 (iv) 0·033	(i) 0·08 (ii) 0·07 (iii) 0·05 (iv) 0·04
MEASUREMENTS OF PROBOSCIS SHEATH	In fully extended specimen, reaching slightly beyond the first series of body spines.	0·88×0·28	0·46—0·84×0·12—0·25	0·28—0·68 × 0·14—0·28

TABLE III.—*Measurements (in millimeters) and hosts of the different species of* Pallisentis—*contd.*

	Pallisentis umbellatus Van Cleave	*Pallisentis nagupensis* (Bhalerao)	*Pallisentis nandai* Sarkar	*Pallisentis colisai* sp. nov.
COLLAR SPINES :—				
Number of circles	9	14	13—14	15—17
Number of spines in each circle			18—20	18—20
Length of spine	0·018		0·029	0·02
BODY SPINES :—				
Number of circles	20—24		28—55	21—67
Number of spines in each circle			16—20	16—18
Length of spine	0·024		0·018	0·02
LEMNISCI		2·43×0·09	(i) 1·1—1·9×0·04 (ii) 0·72—1·3×0·004	1·06—2·4 × 0·04—0·07
TESTES :—				
anterior		1·04×0·23	0·43—0·56×0·14—0·16	0·34—0·38×0·11—0·15
posterior		0·74×0·23	0·37—0·53×0·14—0·16	0·31—0·35×0·12—0·18
PROSTATE GLAND :—				
size		2·65×0·2	0·77—1·4×0·14—0·22	0·28—0·42×0·12—0·17
number of nuclei	16	16 or more	23—25	12—14

TABLE III.—*Measurements (in millimeters) and hosts of the different species of* Pallisentis—*contd.*

	Pallisentis umbellatus Van Cleave	*Pallisentis nagupensis* (Bhalerao)	*Pallisentis nandai* Sarkar	*Pallisentis colisai* sp. nov.
PROSTATIC RESERVOIR			0·29×0·48×0·12—0·21	0·25—0·45 0·11—0·12
SEMINAL VESICLE		0·85×0·13	0·24—0·89×0·13—0·9	0·29—0·45 0·08—0·12
BURSA			0·43—0·51	0·18—0·21×0·09
BODY NUCLEI (number)			2	
HOST	*Ophicephalus argus*	*Ophicephalus striatus*	*Nandus nandus*	*Cotisa fasciatus*

The female genitalia of *P. colisai* differs from that of other species of *Pallisentis*. The uterine bell in *P. colisai* is an elongated oval structure whereas in *P. nagpurensis* and *P. nandai* it is a funnel shaped structure. In *P. nagpurensis* nothing has been mentioned about the presence of flask cells, whereas four of them are present in *P. nandai* and in the present specimens. A prominent vaginal gland is present in *P. colisai* which has not been observed in any other species of *Pallisentis*.

No body nucleus, like *P. umbellatus* and *P. nagpurensis*, has been observed in *P. colisai*, while two distinct body nuclei have been noticed in *P. nandai*.

In Table III the measurements and hosts of different species of *Pallisentis* have been given to facilitate comparison.

Acanthogyrus acanthogyrus Thapar

A single specimen of acanthocephala has been found from the intestine of *Labeo rohita* (Ham.). The worm has been identified as *Acanthogyrus acanthogyrus* Thapar (1927). Datta and Poddar (1935) also found the same species of worms from the fish *Catla catla* (Ham.) from Calcutta, Diamond Harbour and Port Canning and from *Labeo rohita*, Calcutta.

The present specimen was a male one measuring 8·3 m.m. in length. Only minor variations in the characters of this specimen from those obtained from different hosts and localities are observed.

Thapar in his original description has not mentioned the locality of the occurrence of the parasite.

From the dimension of the body of the worms of the different host and localities it will be observed that the female is nearly double the male in length. Datta and Poddar observed 6 probosis hooks in the worms found from the host *L. rohita* which differs from that of Thapar's observation. Regarding the number of the circles of the body spines, the present specimen does not correspond with the worm described by Thapar as well as by Datta and Poddar. The length of the lemniscii observed by Datta and Poddar is twice more than that of the worms observed by Thapar. The testis of the present specimen is nearly two and half times greater in length than that of the specimen described by Thapar. No nucleus has been observed in the prostate gland of the present worm. Thapar has pointed out that the opening of the male genitalia is guarded by spines which has not been observed by Datta and Poddar as well as by me.

TABLE IV.—Comparison of *Acanthogyrus acanthogyrus* from different hosts and localities as observed by Thapar, Datta and Poddar, and Sarkar.

	Thapar	Datta and Poddar		Sarkar
HOST .	*Labeo rohita*	*Catla catla*	*Labeo rohita*	*Labeo rohita*
LOCALITY	not mentioned	Calcutta ; Diamond Harbour ; Port Canning	Calcutta	Delhi State
DIMENSIONS OF THE BODY	♂ 2·0—3·0 × 0·45—0·55 ♀ 6·0 × 0·9	♂ 3·49 × 0·68 (largest) ♀ 7·0 × 1·45 (largest)	♂ 2·8—8·0 × 0·6—1·1 ♀ 3·0—15·0 × 0·7—1·7	♂ 8·3 × 1·4
MEASUREMENTS OF PROBOSCIS	0·09—0·11 fully expanded	0·10 × 0·09	—	0·14 × 0·1·1
PROBOSCIS HOOKS :—				
Number of circles . . .	3	—	3	3
Number of hooks in each circle .	8		6	8
Measurements of hooks :				
in the first circle	60 μ ; 50 μ ;	—	—	0·07
in the last circle	40 μ.			
PROBOSCIS SHEATH	0·13 length thick walled	single walled	..	thick walled

TABLE IV.—Comparison of *Acanthogyrus acanthogyrus* from different hosts and localities as observed by Thapar, Datta and Poddar, and Sarkar—*contd.*

	Thapar	Datta and Poddar		Sarkar
BODY SPINES :—				
Number of circles . . .	19—20 (anteriorly)	..	23 (anteriorly complete	22 (anteriorly)
Number of spines in each circle	20—21 (posteriorly)		rings) ; 4 (incomplete rings)	23 (posteriorly)
Length of spine	paired, 25μ		several (posteriorly with 2 hooks in each.)	..
LEMNISCII—				
Size	pear shaped, 2 in nos. 0·35 long	2, filamentous, few large nuclei, 0·86×0·14	..	2, long and narrow, each with a large nucleus.
TESTES—				
Measurements : anterior	0·17	..	ovoid	0·42
posterior	0·14			0·39
PROSTATE GLAND—				
Size	spherical	..	bilobed	bilobed
Number of nuclei	2 or more		2 or more	..
BURSA	protrusible	..	..	..
GENITAL OPENING	guarded by spines	..	..	..

In Table IV comparison of *A. acanthogyrus* observed by Thapar Datta and Poddar, and the author has been given.

I am indebted to the Director, Zoological Survey of India, for the facilities given to me to consult the library and the reserve collections and to Mr. M. N. Datta, Assistant Superintendent, Zoological Survey of India, for helping me to identify the specimens and going through the manuscript. Thanks are due to Dr. M. L. Bhatia, Delhi University, for kindly giving me help and facilities for my work and to Mr. J. N. Rudra, Department of Zoology, Presidency College, for helping me in the preparation of the manuscript. I must also record my thanks to Mr. R. C. Bagchi, Artist, Zoological Survey of India, who finished the figures for this paper.

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ON A NEW SPECIES OF *ACANTHOSENTIS* VERMA AND DATTA FROM *GLOSSOGOBIUS GIURIS* (HAMILTON).

By T. D. SOOTA, *M.Sc., Zoological Assistant* and J. K. SEN, *M.Sc., Gallery Assistant, Zoological Survey of India, Calcutta.*

We have studied six specimens of *Acanthosentis* Verma and Datta (1929) which were lying in the unnamed collection of the Zoological Survey of India, collected from a Gobioid fish *Glossogobius giuris* (Ham.) from Pulta Water Works.

Verma and Datta[1] (1929) created the genus *Acanthosentis* to accommodate *A. antispinus* from a cat fish *Mystus gulio* [=*Aoria* (*Macrones*) *gulio*] from Calcutta. Subsequently, the following species have been added:—

A. holospinus by Sen[2] (1938) from a carp *Barbus sophore*[=*Barbus stigma*] from Calcutta;

A. dattai by Poddar[3](1938) from carps *Barbus ticto* and *Barbus sophore*; from Calcutta;

A. sarkari also by Poddar[4] (1941) from a carp *Rasbora elanga*, from Calcutta; and

A. tilapiae by Baylis[5] (1947) from a percoid fish *Tilapia lidole* from E. Africa.

It is noteworthy that all these species have been reported only from fishes. We have added now one more species to the above list, also from a fish from Calcutta. The description of the same appears below. New species is named after the host fish *Glossogobius giuris* (Hamilton).

Acanthosentis giuris, sp. nov.

Male.—Out of three males only one is in a well preserved condition. It measures 4·35 mm. in length and 0·48 mm. in width in the anterior region. The body proper is somewhat cylindrical. It gradually expands from the front to the middle and narrows down from there to the posterior end. The anterior half of the body is studded with approximately 23 rows of spines. These spines make their appearance leaving anteriorly a small spineless area approximately 0·03 mm. in length. Sub-cuticular nuclei are present.

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[2] Sen, P. *Proc. Ind. Acad. Sci.*, VII, Sec. B., pp. 41-46 (1938).

[3] Poddar, T. N. *Parasitology*, XXX, pp. 171-175 (1938).

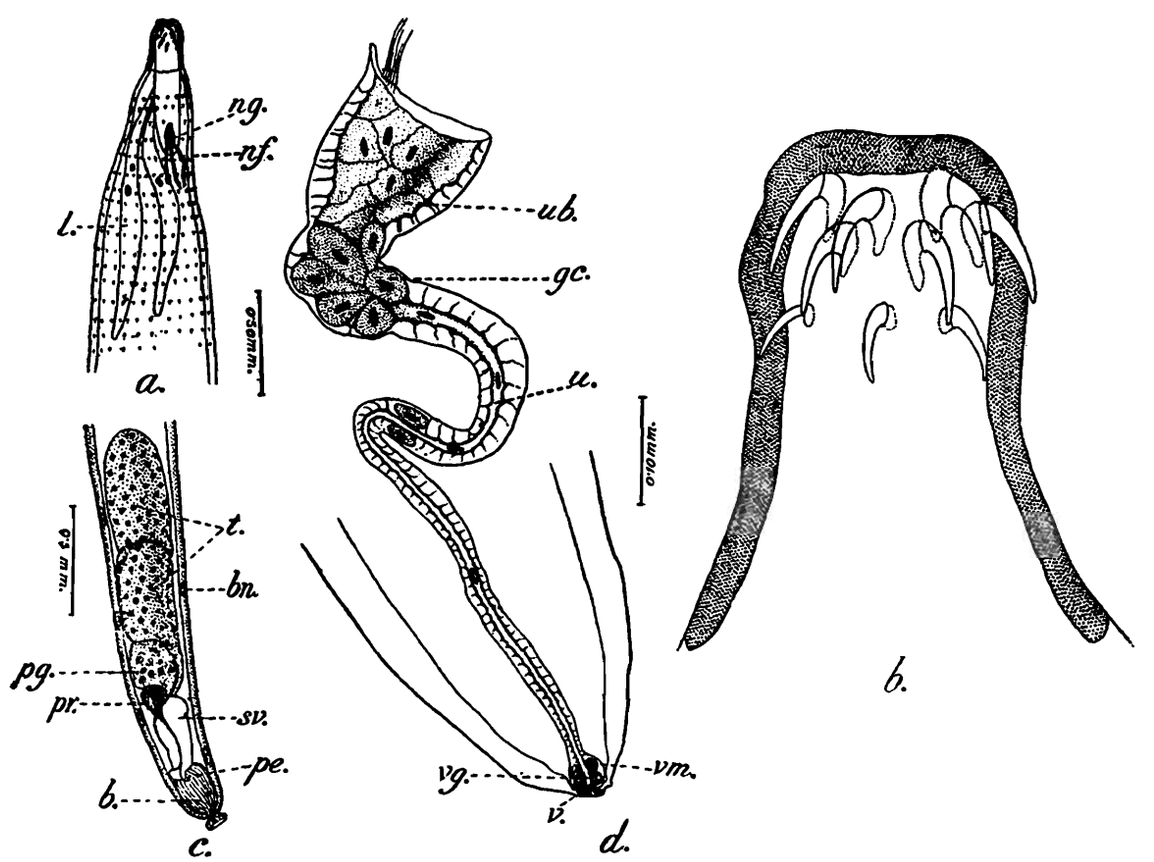
[4] Poddar, T. N. *Rec. Ind. Mus.*, XLIII, pp. 137-142 (1941).

[5] Baylis, H. A. *Ann. Mag. Nat. Hist.*, XIV, II, pp. 861-868 (1947).

The proboscis is globular. It measures 0·07 mm. in length and 0·10 mm. in width. It is armed with three rows of hooks with six hooks in each circle. The hooks are of three different sizes; the largest being in the top-most circle, the intermediate in the middle and the smallest in the lower-most; each hook in the respective circle measuring 0·04, 0·03 and 0·02 mm. in length. The proboscis is followed by a neck like region, which widens gradually to the base, measuring approximately 0·10 mm. in length and 0·14 mm. in width at the base. It is lined with a thick layer of cuticle. This region appears to be the most distinctive feature of this species.

The proboscis sheath is 0·43 mm. long. The nerve ganglion is in the posterior region of the proboscis sheath, being 0·39 mm. from the anterior end. The two lemnisci are unequal and bigger than the proboscis sheath. The bigger lemniscus contains two nuclei while the smaller a single nucleus.

The testes (text-fig. 1 *c*) are situated in the posterior half of the body. They are unequal in size, the anterior bigger measures 0·53 × 0·29 while the posterior smaller 0·50 × 0·27 mm. The former lies 2·35 mm. from the anterior end. The prostate gland measures 0·26 × 0·21 mm. and contains eight nuclei. Vesicula seminalis is 0·38 mm. long. Bursa measures 0·32 mm. in length.



TEXT-FIG. 1.—*Acanthosentis giuris*, sp. nov.

a., Females; ant. region; *b*. proboscis with neck-like region; *c*. Male genital organs; *d*., Female genital organs;

b., bursa; *bn*., body nuclei; *gc*., guard cells; *l*., lemnisci; *nf*.; nerve fibres; *ng*., nerve ganglion; *pe*., penis; *pg*., prostate gland; *pr*., prostatic reservoir; *sv*., seminal vesicle; *t*., testis; *u*, uterus; *ub*., uterine bell; *v*., vulva; *vg*. vagina; *vm*.., vaginal muscles.

Female.—Only two specimens of the three females are in a good state of preservation. The length ranges from 5·22—6·5 mm. and the width from 0·55—0·63 mm. The shape of the body is similar to that of the male. The spines appear 0·07—0·10 mm. posterior to the place where the body proper begins.

The proboscis is 0·07—0·09 mm. long and 0·09—0·13 mm. wide. The length of the hooks in the top-most circle ranges from 0·04—0·05 ; in the middle circle from 0·03—0·04 and in the lowermost circle 0·03. mm. The neck-like region following the proboscis is similar to that of the male and measures 0·09—0·13 mm. in length and 0·15—0·17 mm. in width at the base.

The proboscis sheath is 0·39—0·59 mm. long. The nerve ganglion is 0·35—0·51 mm. from the anterior end.

The uterine bell (text-fig. 1 *d*) is 0·24—0·26 mm. long. The uterus along with the vagina is 0·48—0·75 mm. long. Guard cells are six in number.

The eggs measure, 0·03—0·10×0·03—0·08 mm.

Specific diagnosis.—A neck-like region intervening between the proboscis and the body proper; the proboscis armed with three rows of hooks.

Regd. No.—W 3834/1, Zoological Survey of India.

Host.—*Glossogobius giuris* (Hamilton).

Locality.—Pulta Water Works, 24, Parganas, West Bengal, India.

Remarks.—The new species corresponds with, *A. antispinus* Verma and Datta (1929), and *A. sarkari* Poddar (1941), in having the body spines confined to the anterior half. Further, with the latter it agrees also in having a small area without spines before the region where spines make their appearance. But it differs from all the known species of the genus in having a neck-like region lined with cuticle, immediately behind the proboscis. It is noteworthy that such a structure has not been observed in any of the species known so far under this genus.

Acknowledgment.

We are thankful to Shri M. N. Datta, Assistant Superintendent, Zoological Survey of India, for his helpful guidance in the preparation of this paper.

II. A LIST OF REFERENCES RELATING TO INDIAN ZOOLOGY (DEALING WITH GENERAL PARASITOLOGY, EXCLUDING HELMINTHOLOGY) PUBLISHED DURING THE YEARS 1938-1950.

By B. S. CHAUHAN, MSc, PhD, FZS, FASc, FZSI, FHS, FAZ,
Zoological Survey of India, Calcutta.

INTRODUCTION.

In an earlier part—A list of references relating to Indian Zoology (excluding Insecta, Fishes and Helminths) published in the *Records of the Indian Museum*, Vol. **51** (3) 1953, it was stated on page 428 that references relating to general Parasitology (excluding Helminthology) will be published in due course. The list presented herewith fulfils that promise. References generally important from zoological point of view only are included in the list. Papers dealing with entirely a medical or veterinary stand point (clinical, therapeutic, etc.) are generally omitted. It is needless to mention that in a work of this type it is almost impossible to present a fully complete list. Therefore, the author will feel grateful if omissions are brought to his notice for publication either as a supplement or for inclusion in future lists.

My best thanks are due to Shri G. Ramakrishna, Shri A. K. Bose and Shri S. Ghoshal, Librarian, Zoological Survey of India, for their kind help and cooperation in the matter, in various ways.

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SHIPWORMS FROM INDIA.

1. Report on Ten Species of Shipworms from the Madras Coast.

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Introduction.

More than two hundred papers have been published by different authors on the Teredines of Britain, Europe, Australia, the Pacific islands and the New World. Of these, the papers of Atwood and Johnson (1924), Bartsch (1922), Edmondson (1941), Hill and Kofoid (1927), Iredale *et al* (1932), Jeffreys (1860-61), Lamy (1926), Miller (1924), Moll (1936), Moll and Roch (1937), Sivickis (1928), and Wright (1866) are purely taxonomic, Bartsch (1922) giving the most acceptable scheme of classification which has since been adopted by many workers in the field. Though Teredines have been extensively studied in the various countries, our knowledge of the tropical forms is very meagre. Except for a short account by Erlanson (1936) of the forms she found at Cochin Harbour, no paper has been published so far about the shipworms of India. The present study was undertaken as a preliminary to the investigations of the anatomy, life history, and physiology of these tropical forms which cause serious damage to timber structures along the sea front.

The present account deals with ten species, of which seven, on consultation with Dr. Edmondson, are found to be new to science. The remaining three which have already been recorded, *Bankia* (*Bankia*) *bipalmulata* Lamarck, *Teredo* (*Teredora*) *clava* Gmelin, *Teredo* (*Teredora*) *gregoryi* Dall *et al* are also described fully since the available descriptions are incomplete and since these tropical forms show slight differences from their type specimens. In the treatment of the species the classification given by Bartsch (1922) has been followed and an attempt has been made to consider both hard and soft parts for the exact determination of relationships of species.

Nearly eight hundred entire specimens of shipworms of different sizes, collected from country log-rafts, dragged ashore as not seaworthy; from timber floats used in fishing, and driftwood which were washed ashore, formed the material for the present study. About hundred forms were obtained with the help of test-planks. It may be inferred therefore, that many more species may yet be found if the wooden crafts and timber structures all over the Indian coast are examined.

All drawings were made by the author with the aid of a camera lucida.

SYSTEMATIC TREATMENT OF THE GROUP.

Genus *Bankia* Gray.

Subgenus *Bankia* s. str.

1. *Bankia* (*Bankia*) *bengalensis*, sp. nov.
2. *Bankia* (*Bankia*) *bipalmulata* Lamarck.

Subgenus *Bankiella* Bartsch.

3. *Bankia* (*Bankiella*) *indica*, sp. nov.
4. *Bankia* (*Bankiella*) *edmondsoni*, sp. nov.

Subgenus *Nausitora* Wright.

5. *Bankia* (*Nausitora*) *madrasensis*, sp. nov.

Genus *Teredo* Linnœus.

Subgenus *Teredo* Linnœus.

6. *Teredo* (*Teredo*) *madrasensis*, sp. nov.

Subgenus *Teredora* Bartsch.

7. *Teredo* (*Teredora*) *gregoryi* Dall, Bartsch & Rehder.
8. *Teredo* (*Teredora*) *clava* Gmelin.
9. *Teredo* (*Teredora*) *rehderi*, sp. nov.

Subgenus *Zopoteredo* Bartsch.

10. *Teredo* (*Zopoteredo*) *bengalensis*, sp. nov.

Genus **Bankia** Gray, 1840.

1840. *Bankia*, Gray, *Synop. Brit. mus.*, p. 76.

The pallet consists of a series of cone-in-cone structures.

Genotype.—*Teredo bipalmulata* Lamarck.

Subgenus **Bankia** s. str.

1840. *Bankia*, Gray, *Synop. Brit. mus.*, p. 76.

The distal edges of the cones terminate in a thin membrane, which is fimbriated at the free margin. The lateral fimbriations form long awn-like projections.

Type.—*Teredo bipalmulata* Lamarck.

Bankia (Bankia) bengalensis, sp. nov.

(Fig. 1 *a-c*,)

Occurrence.—During January, 1954, five specimens were obtained from a log of red-cedar 4′×6″×3″ used as a float for pomfret fishing in Mylapore, 4 miles off shore, which was in water for 3 months.

Size.—Shell height 6·3 mm., length 5·6 mm. ; pallet's length 15 mm., stalk 6·5 mm., maximum diameter of blade—2·25 mm. ; length of burrow—5·0 cms.

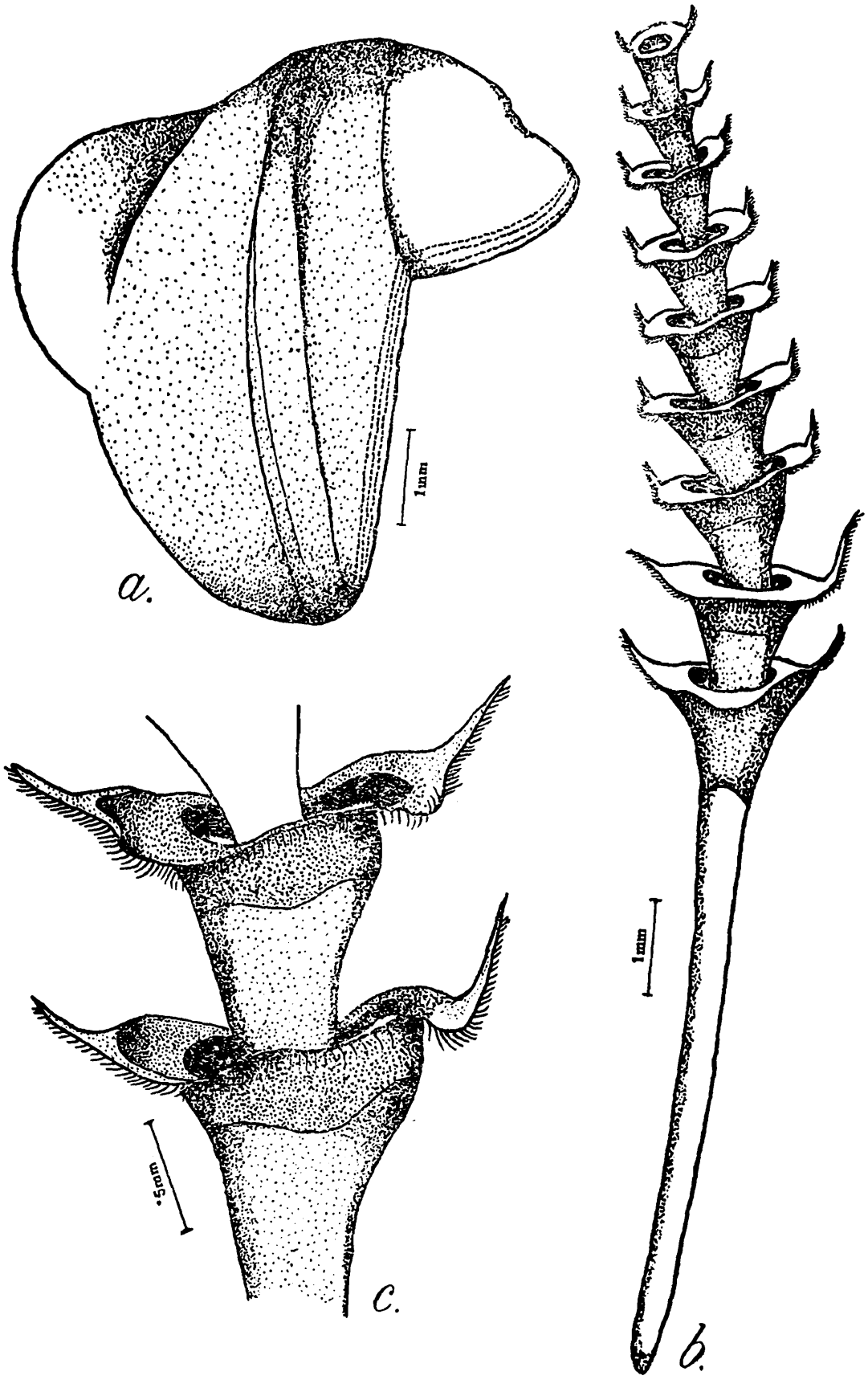

FIGURE 1.—*Bankia* (*Bankia*) *bengalensis*, sp. nov.
(*a*) Outer surface of shell, (*b*) Other face of pallet, (*c*) Two cups of the pallet enlarged to show the fimbriations of the distal margin.

Shell.—White and globose. The anterior part with strong sinus and thick reflected callus. The anterior part is marked by fortyeight denticulated ridges. These expand slightly fanwise from the anterior to the posterior part. The anterior median part is marked by closely arranged rows of stout denticles. These dental ridges meet the bases of those of the anterior in slightly more than a right angle. The middle median is a depressed area extending from the umbo to the ventral knob through the centre of which a shallow furrow extends for the whole length. This area is crossed by nondenticulated extensions of the dental ridges of the anterior median area. The posterior portion of the median area is almost as wide as the anterior and median part combined and is crossed by feeble extensions of a few ridges from the median portion and faint lines of growth. The auricle is well developed, thin, expanded and slightly reflected at the margin.

Interior white, with a strong umbonal knob from the base of which a slightly curved narrow flat blade, the apophysis, extends for more than half the distance from the umbone towards the ventral knob. The posterior part (auricle) projects over the posterior median part forming a narrow shelf. The lines of growth over the auricle are clearer when viewed from the inside.

Pallets.—(Fig. 1, *b-c.*)—Long with widely spaced cone-in-cone structures forming the blade, with a cylindrical stalk shorter than the length of the blade. The joints of the blade are bell-shaped with their distal margin reflected forming a broad rim. Each joint is covered by a periostracum which is finely fimbricated on the outer free margin and projects as spinous structures at the lateral margins. The spines of one side are slightly longer than those of the other side. The distal 1/3 of the joints is coloured dark brown.

Siphons.—The inhalant siphon is longer and larger than the exhalant siphon and is coloured brown. In preserved specimens the inhalant siphon is twice the length of the exhalant siphon.

Collar.—A little enlarged.

Burrow.—They enter the wood cutting against the grain and after boring for about 2 cms. proceed along with the grain. The burrow is lined with a calcareous material which is thin and adherent to the wood.

Bionomics.—A nereid polychaete and a turbellarian were found in association with the present form. These were recovered from empty burrows. Edmondson (1942) has also recorded the presence of the turbellarian along with shipworms in Hawaii.

Remarks.—Though the present form clearly belongs to the subgenus *Bankia,* by virtue of the fimbriated membranes at the distal edges of the pallet joints, it does not approximate to any of the fourteen species described under this subgenus. It resembles (1) *Bankia anechoensis* Roch, (2) *B. Stutchburyi* Blainville, (3) *B. kingyokuensis* Roch, (4) *B. brevis* Deshayes in having long widely separated funnel-shaped pallet joints; but, differs from the first three species in having the outer

distal margin of the joints broad (2·25 mm.) clearly fimbriate and reflected to form a broad rim (which is almost in a level with its inner margin) ; and in having a stalk shorter than the blade and in having the auricle of the shell well developed. The information regarding *B. brevis* is incomplete but it is described as having a pallet 13 mm. long with few joints in which it differs from the present form. In the possession of a well developed auricle it approaches (5) *B. setacea* Tryon, (6) *B. capensis* Calman, (7) *B. bipennata* Turton, (8) *B. australis* Calman but does not belong to these species because its pallet is different from the plume-like pallet of 5, the very broad pallet of 6, and the very long one of 7, and the slender stalked pallet with close 'V-shaped' joints of 8. (9) *Bankia cucullata* Jeffreys, (10) *B. kuronunnii* Roch, (11) *B. thielei* Roch, and (12) *B. bagidaensis* Roch differ from the present form in the possession of a pallet with thick joints. The auricles of 9 and 10 are small whereas there is no information regarding this feature for 11, and the shell of 12 is unknown. (13) *B. fimbriata* Jeffreys is described as having a pallet with the joints deeply angled on the outside which is distinct from the present form and (14) *B. bipalmulata* Lamarck is different from the present form in the size of the pallet, the proportion of the stalk and blade especially in the nature of the distal border of the joints.

A detailed comparison of the present form with many of the already recorded species becomes difficult as the description available is far from complete and in many cases the shells are unknown (*B. anechoensis*, *B. bagidaensis*) or not described at all (*B. thielei*) giving no clues as to the nature of these features on which taxonomy can be properly based even for subgeneric determination. However, the present form appears unique in having a clearly distinguishable type of pallet, with widely separated bell-shaped joints with reflected and fimbriated rim ; a characteristic brown colour for the distal $\frac{1}{3}$ of the joints and in having a cylindrical stalk slightly smaller than the blade. Therefore, the present form is treated as a new species *Bankia* (*Bankia*) *bengalensis* and can be defined as follows :—

Pallet with an overall length of 15 mm. of which 6·5 mm. belongs to the stalk which is cylindrical and opaque, with eleven widely separated bell-shaped joints the outer reflected rim of which is finely fimbriated and the extreme lateral margins pulled out into pointed processes.

Types.—The type shall be deposited in the Zoological Survey of India (Indian Museum), Calcutta and the paratypes will be in the Zoology Laboratory, Madras.

Bankia (Bankia) bipalmulata Lamarck, (Fig. *2, a-d.*)

1835. *T. palmulata*, Lamarck, *Historie naturelle*, 6, p. 38.
1923. *T. bipalmulata*, Bartsch, *A Monograph of American Shipworms*, p. 7.
1931. *B. bipalmulata*, Roch & Moll, *Mitt. Zool. Staatsmst. zool. Mus. Hamburg*, 44, p. 20.

Occurrence.—This form has been recorded from Pondicherry by Roch (1931) and 25 specimens were collected at Madras from a log of wood (Indian red-cedar) used as a fishing float which was in water 4

miles off shore from October 17th, 1953 to January 30th, 1954 and shells and pallets from a log of wood (undetermined) washed ashore at Kovilam 20 miles South of Madras.

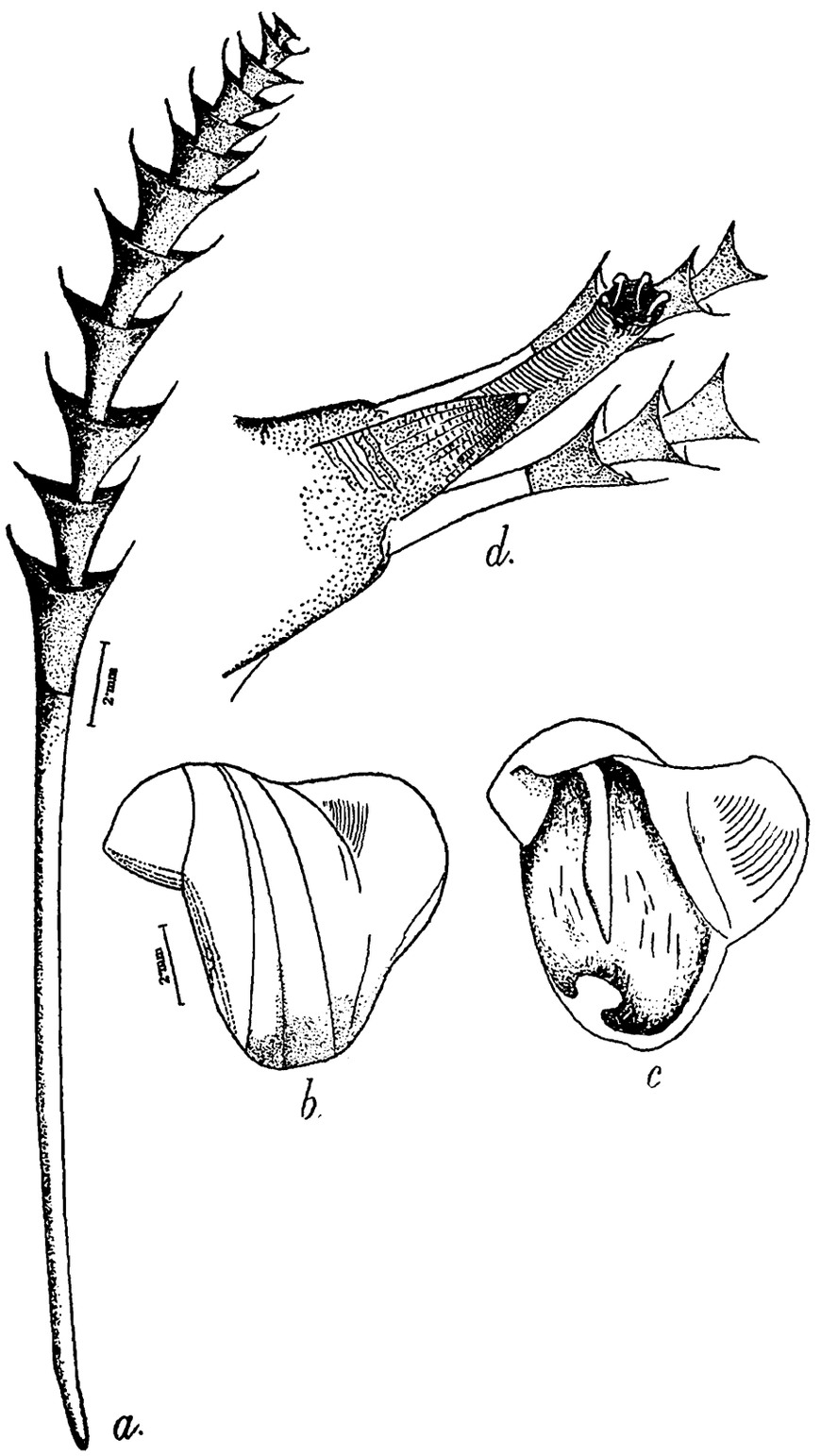

FIGURE 2.—*Bankia* (*Bankia*) *bipalmulata*, Lamarck.—
(*a*) Outer face of pallet, (*b-c*) Outer and inner faces of shell, (*d*) Posterior part of the body showing the siphons.

Size.—The largest specimen measured 19 cms. (length of burrow). Shell height—8·5 mm., Shell length—8·3 mm., Pallet length—4·5 cms., stalk—2·1 cms.

Shell.—(Fig. 2, *b-c.*)—Sub-globular white, anterior part with usual sinus and reflected callus. The dental ridges start from this area and spread fanwise posteriorily. Fifty-five dental ridges are present with finely denticulated free margins. Anterior median broad and well defined marked by dental ridges which join those of anterior part at a little more than a right angle. The junction of anterior part with the median is a well impressed line. Middle median is shallow almost as broad as the widest part of the anterior median crossed by a number of lines of growth. The posterior median is as wide as the anterior median and is smooth and convex. Auricle is well developed, broad and high. The outer surface is not smooth and concentric lines of growth are not so well developed as on its inner surface.

Interior white, the auricle is reflected over the posterior median as a narrow strong shelf. The umbo forms a strong knob from the basal portion of which the flat blade extends about 2/3 across the inside of the shell. The ventral margin of the median part bears a strong knob.

Pallets.—(Fig. 2, *a.*) –Long, provided with twelve well formred widely spaced, cone-in-cone elements or cups. The cones are covered with a thin layer of yellowish brown periostracum. The outer margins of cups are more concave than the inner margins. Lateral borders of cups are drawn out into long processes.

Siphons.—(Fig. 2, *d.*)—Inhalant, wide and coloured dark brown especially its interior, with six longitudinal, white, thickened patches. The rim of the siphon is reflected resembling a tulip. The exhalant is shorter, narrower, and free.

Collar.—A little enlarged and its rim is slightly thickened.

Burrow.—Lined with a thin shelly material which is not very brittle due to traces of a horny material, with transverse septa near the opening of the burrow.

Their presence inside the wood is easily detected by the protruding pallets.

Remarks.—The information regarding the shell characters of this form is incomplete. A close scrutiny of the figure of the pallet given by Roch and Moll (1931) and a comparison of the descriptions available show that this form is identical with *Bankia bipalmulata* Lamarck.

Subgenus **Bankiella** Bartsch, 1921.

1921. *Bankiella,* Bartsch. *Proc. Biol. Soc. Washington,* 34, p. 26.

Pallets consisting of a series of cone-in-cone elements covered by a thin membrane which is neither fimbriated nor denticulated at the free margin, but entire.

Type.—Bankia (*Bankiella*) *mexicana* Bartsch.

Bankia (Bankiella) indica, sp. nov. (Fig. 3, *a-d*).

Occurrence.—Nearly six hundred individuals of this species were collected from wooden buoys employed in pomfret fishing along the Madras coast. They were also obtained from drift logs cast ashore and

from old country rafts discarded as not seaworthy. Test blocks of red cedar that have been submerged off Mylapore also were heavily attacked by this species. This species is one of the dominant species of shipworms in Madras. Timber blocks exposed to sea water for more than two months get heavily riddled by this shipworm and are thoroughly honeycombed in about six months.

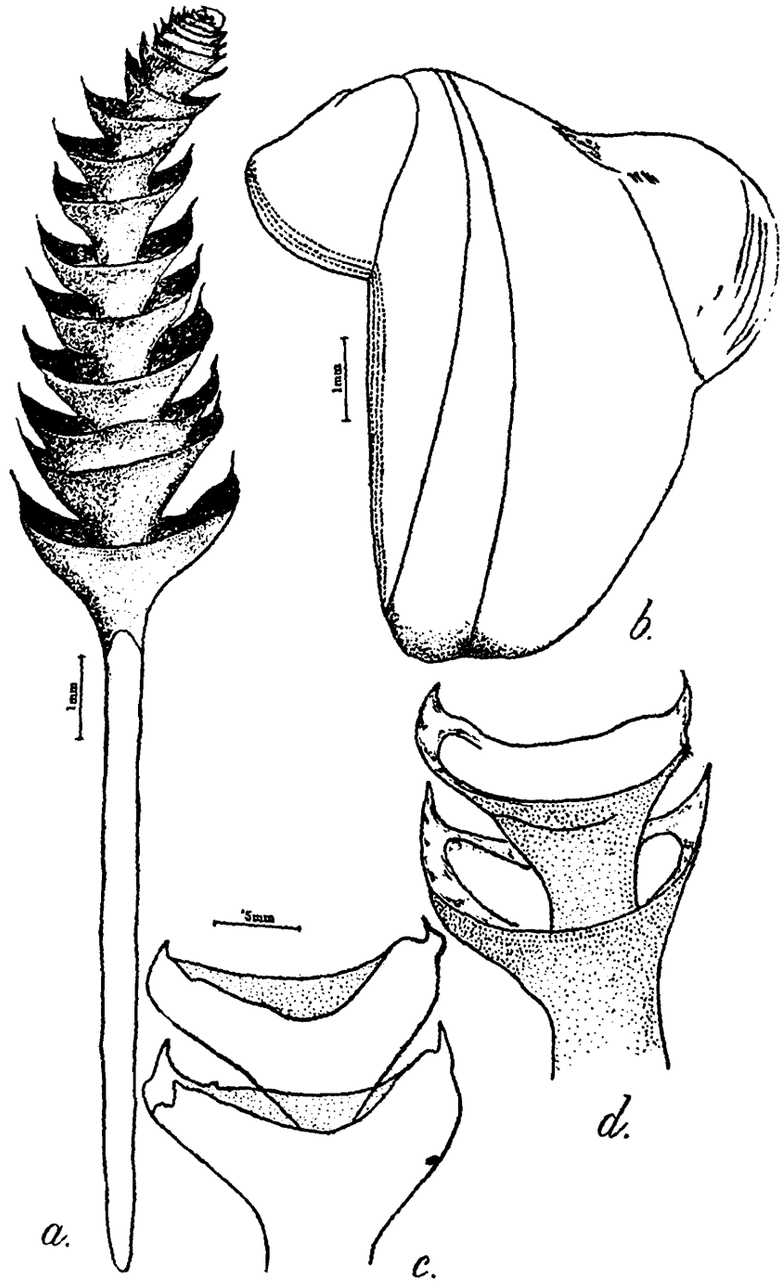

FIGURE 3.—*Bankia* (*Bankiella*) *indica*, sp. nov.
(*a-b*) Outer faces of pallet and Shell respectively, (*c-d*) Inner and outer faces of two 'cups' of the pallet enlarged.

Size.—The maximum size of a specimen I have recovered from a timber block was 28 cms. Shell length 6·6 mm., height 7·6 mm. Pallet length—16·8 mm., stalk length 8·3 mm.

Shell.—(Fig. 3, *b.*)—Globular in natural contact. Shell except for the auricle and posterior median part, has a light rosy flush. The extreme anterior portion with a deep sinus from which a smooth callus is reflected

over the anterior dental ridges. The height of anterior part is more than its width. Forty dental ridges with fine denticles at their free margin are present in the anterior region which are separated by spaces twice as wide as the dental ridges. The junction of the anterior portion with the anterior median is a well defined groove. The anterior median is marked by very closely set and regularly arranged dental ridges bearing denticles which are stouter and stronger than those of the anterior area. They meet those of the latter in a little more than a right angle. About fortythree dental ridges are present but some have been eroded at the umbonal end. The middle median part is smooth, bearing a few non-denticulated upturned extensions of the dental ridges of the anterior median area towards its ventral side. The posterior median portion is broader than the anterior median and middle median taken together. This region is thick, convex, and marked by feeble oblique lines of growth. This region slopes steeply down before forming the well developed auricle. In outline the auricle joins the posterior median portion in an even concave curve and is marked by curved lines of growth. The auricle is thin at the edges and slightly reflected outwards at the margin.

Internally the shell shows a tumid area at the junction of the anterior and median parts. The umbo marks a very strong knob from the underside of which a broad sickle shaped apophysis projects into the cavity of the shell parallel to the middle median part in such a way that the plane of the blade is at right angles to that of the shell. The extreme ventral part of the median part is provided with a strong knob. The inside of the auricle shows translucent chord-like lines. The posterior part projects as a shelf into the cavity of the median part at the junction of the auricle.

Pallets.—(Fig. 3, *a*, *b*, *c.*)—Cone-in-cone type joints, plainly funnel shaped and clearly separated, distal margin completely free and entire. The blade in the type consists of sixteen well spaced funnels or cups the rims of which are covered by a thin, light brown, periostracum which is drawn out into pointed processes laterally. Outer margin of the funnel more concave than inner. The outer side of blade is convex and inner side flat. The stalk is long and cylindrical.

Siphons.—In formalin preserved specimens the inhalant siphon is wider and longer with brownish spots. The exhalant siphon extends upto about 3/4th of the length of the inhalant siphon. Their rims are beset with small tentacles.

Collar.—Slightly developed.

Burrow.—With fairly thick calcareous tubing, which fall off easily from the wood when dry.

Bionomics.—The young ones were found to be invariably males. These pass into a female phase through a brief hermaphrodite stage. Gonads of many forms were infested with dicyemids in different stages of development. A polychaete worm and a turbellarian are frequently found in association with these shipworms.

Remarks.—The subgenus *Bankiella* which is distinguished from other subgenera by the margins of the pallet joints being entire, includes ten species. A comparative study of the descriptions of these suggests that the present form does not belong to any one of them. It resembles (1) *Bankia gouldi* Bartsch, (2) *B. segaruensis* Roch, (3) *B. mexicana* Bartsch, (4) *B. odhneri* Roch, in the possession of a well developed auricle, but differs from (1) in the relative proportions of the posterior median part with middle median and anterior median. In the present form the posterior median is more than anterior median and middle median combined, whereas in *Bankia gouldi* it is equal to the other two parts put together. Again the pallet is described as plumose in that form, with a horny film bridging the gap between the free ends of one cone to the body of the next, unlike the present form. The inner side of the pallet is deeply concave in *B. segaruensis*, while the shell length is more than shell height in *B. mexicana*. *B. odhneri* is distinguishable in having a lanceolate blade covered with strong film and long thorus on the sides. In having clearly separated joints with short thorns it approaches *B. brevis* Deshayes, *B. carinata* Gray and *B. oryzaformis* Sivickis but does not belong to these species because of the presence of nineteen joints for the blade when the length is 8·5 mm. and an overall pallet length of 16·8 mm. Again in *B. oryzaformis* the auricle is small. *B. companellata* Roch, is clearly different in having only six to eight bell shaped joints for the pallet. *B. minima* Balinville which has a pallet 10 mm. long with 12 to 20 joints and *B. pennaanseris* which has 'goose-quill'-like pallet with outer side 'V shaped' and inner side scaly are different from the present form. In view of these differences, the present form is treated as a species new to science : *Bankia* (*Bankiella*) *indica* and can be defined as follows :—shell length less than shell height, with width of posterior median greater than anterior median and middle median put together, with well developed auricle, 40-45 ridges on shells of length 6·6 mm. and height 7·6 mm. (average of seven specimens). The pallet on an average, with nineteen units for the blade with a length of 8·5 mm. with the stalk measuring 8·3 mm. and an overall length of 16·8 mm. with joints of the pallet blade well spaced and funnel-like, with yellowish-brown periostracum forming a smooth entire margin, which is drawn out into short pointed processes at the lateral margins.

Bankia (Bankiella) edmondsoni, sp. nov.

(Fig. 4, *a-e.*)

Occurrence.—Thirteen specimens were taken from a drift log of *Bamboosa* cast ashore on Madras Beach on December 17, 1953. Another lot of six specimens was recovered from a small teak (*Tectona* sp.) plank. A third lot of 5 specimens from a drifting palm leaf (*Borassus* sp.). All were alive and their pallets visibly protruding through the minute openings. A specimen of 4 cms. long with ripe gonadial contents has been selected as the type of the species.

Size.—Shell length—4·0 mm., height—4·3 mm., Pallet length—4 mm., stalk—2·3 mm.

Shell.—Subglobular, thin, height more than length, anterior portion large, broader than the middle and posterior area (auricle) taken together, bearing about 70 dental ridges which bear fine denticles at their free margin. This part is considerably wider than high, projecting fairly deep into the median portion. The dental ridges start from the callus and take a smooth curve and pass posteriorly parallel to the ventral margin of the anterior lobe. They are of regular width and spacing. The dental ridges of the anterior and median part meet at an acute angle, especially at the ventral side. Towards the umbo they meet almost at right angles. The anterior median part is broad bearing dental ridges arranged

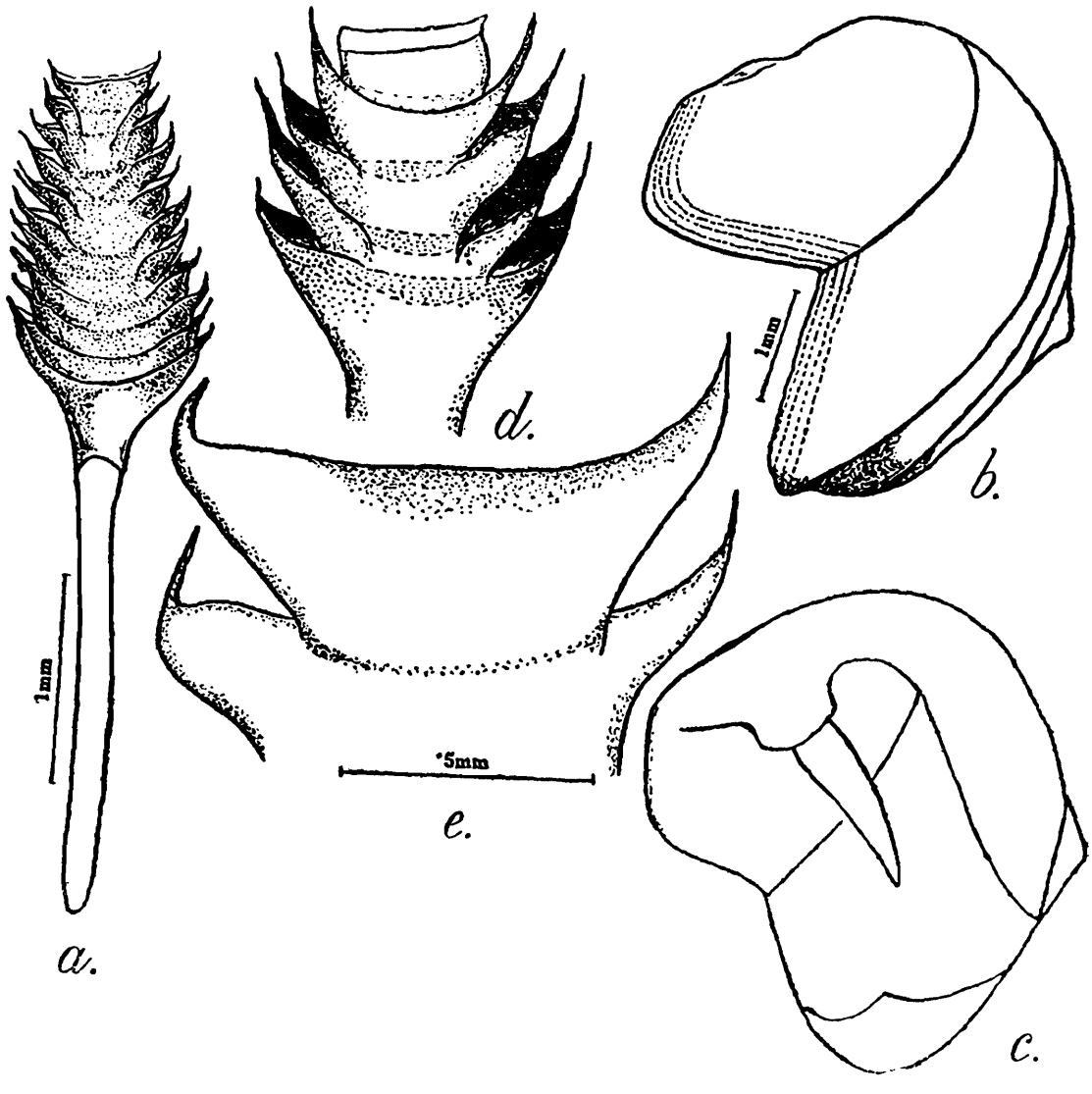

FIGURE 4.—*Bankia* (*Bankiella*) *edmondsoni* sp. nov.
(*a-b*) Outer faces of pallet and shell respectively, (*c*) Inner face of shell, (*d*) Outer face of the distal end of the pallet showing the first formed cups, (*e*) Inner face of two basal cups.

very closely, with denticles stronger than those of the anterior portion. This region, in addition to the dental ridges, show transverse wrinkles. The dental ridges extend into the middle median as non-denticulated strong curved lines, and proceed backwards into the posterior median. A shallow groove extends from the umbo to the ventral articulating knob in the middle median area. The posterior median is narrow, and is produced into a short auricle, having the shape of an equilateral triangle (Fig. 4, *b-c*).

Viewed from within, the impressions of the dental ridges are visible due to thinness of the valves, especially with transmitted light. From the base of the umbonal knob is pendant the apophysis, which is broad and flexed into the cavity of the shell.

Pallets.—(Fig. 4, *a*, *d*, *e.*)—Cone-in-cone type. Cones, arranged compactly overlapping one another, with the lateral margin drawn out into spinous projections. The stalk is cylindrical, long and opaque, the blade is broadest at the proximal part tapering distally. Pallet of the type specimen, 4 mm. long (dist. end of blade slightly imperfect), with a blade of 1·7 mm. provided with 11 joints closely arranged. Each joint of the blade has its distal part covered by a light-yellow periostracum which is entire.

Siphons.—In living specimens, exhalant and inhalant siphons are of equal length, the latter wider with a trumpet-like tip. It measures 7 mm. in a specimen 38 mm. long.

Burrow.—With calcareous lining.

Remarks.—The anterior and anterior median lobes combined of the shell of this form is so large as to constitute nearly 86 per cent of the total length of the shell, of which the anterior lobe alone constitutes 60 per cent. In this feature, it is clearly distinct from all the other eight species described or figured under the subgenus *Bankiella* so far,* whose dimensions are available or determinable from figures drawn to scale. In *Bankia triangularis* Sivickis the anterior, and anterior median lobes are wide, the latter being about 1·5 times the rest of the median and auricle combined, and the posterior median is very narrow with an auricle small or lacking. In these features the form resembles *B. triangularis,* though it differs in the outline of the shell. The description of the pallet of *B. triangularis* is incomplete and gives no clue as to the nature of the features on which taxonomy could be properly based. However, a scrutiny of the photograph shows the following differences:—(1) Joints of the blade are more compactly packed in *B. triangularis*, (2) Length of stalk is less than the length of the blade. Therefore the present form is treated as a new species: *Bankia* (*Bankiella*) *edmondsoni* and can be defined as follows: Thin shell with height more than its width, having broad anterior and anterior median lobes, which form nearly 86 per cent of the total length, and with an auricle which is very small like an equilateral triangle, and pallet with a stalk longer than the blade, the latter having eleven joints when it is 1·7 mm. long. (*edmondsoni*, to Dr. Charles Howard Edmondson for his work on shipworms).

Subgenus **Nausitora** Wright, 1865.

1865. *Nausitora*, Wright, *Trans. Linn. Soc.* Vol. 24, p. 51, pl. 46.

Pallets consisting of a series of cone-in-cone elements which are not entirely free at their distal ends but fused on the exterior surface, where some shelly material and a thick periostracum cover the entire pallet.

Type.—*Bankia* (*Nausitora*) *dunlopei* Wright.

* 'The Teredinidae of the Soviet Union' (Roch, F. 1934) was not available to the author who, therefore, has not been able to discuss the similarities and differences of form he has described, with the Soviet Teredines.

Bankia (Nausitora) madrasensis, sp. nov.

(Fig. 5, *a-d.*)

Occurrence.—Two specimens have been collected from an exposed Catamaran* of Maruthu† timber at Royapuram beach on 10th July, 1953. One of these has been selected as the type. A second lot of 4

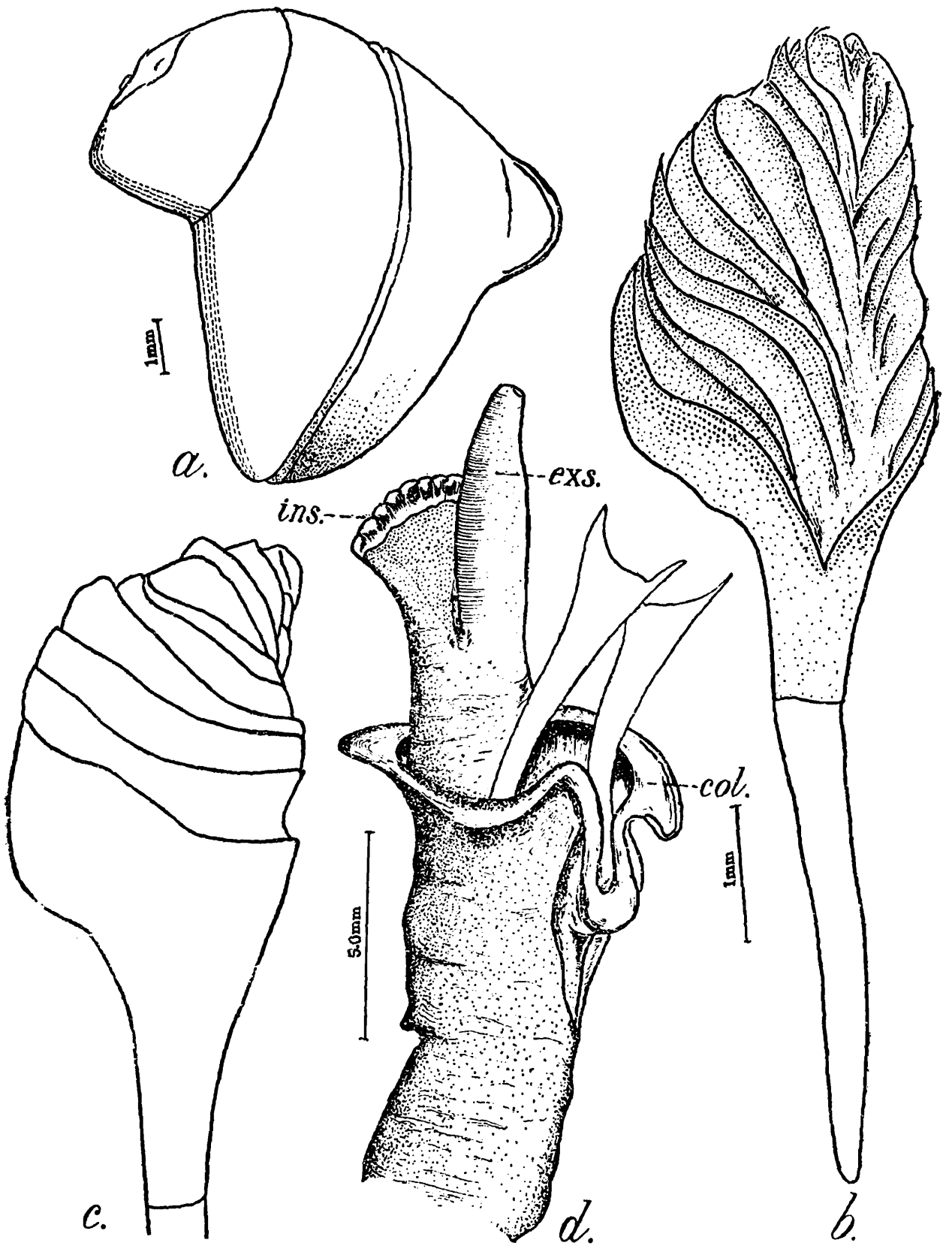

FIGURE 5.—*Bankia* (*Nausitora*) *madrasensis*, sp. nov.
(*a*) Outer face of shell, (*b*) Outer face of entire pallet, (*c*) Inner face of the blade of pallet, (*d*) Posterior part of the body showing collar and siphons.
Col—Collar. Ins—Inhalant siphon. *Ex. S.*—Exhalant siphon. *P.*—pallet. (Blade not fully shown).

* Country log raft.
† *Terminalia* Sp.

specimens was obtained from another Catamaran of the same timber from Triplicane beach.

Size.—Length of specimen—12 cms. Shell height—9 mm., length—9 mm., Pallet length —8·5 mm., stalk—4·5 mm. Maximum diameter of blade—2·3 mm.

Shell.—Subglobular with light brownish flush. The anterior part with about 100 closely spaced finely denticulated ridges. The line of junction between anterior and anterior median is a well marked concave line. Anterior median portion broad and is marked by more than hundred strongly denticulated closely packed dental ridges which join the dental ridges of the anterior part at a little more than a right angle. Curved nondenticulated ridges which are extensions of the dental ridges of the anterior median area cross the surfaces of the middle and posterior median areas. The anterior median area is broader than the middle and posterior parts taken together.

The middle median area is narrow, shallow and coloured dirty brown and its central part is marked by a groove. The extreme ventral part of the median part bears the usual knob. The posterior median area forms a small auricle at its posterior part, which is considerably eroded and the surface of which is crossed by feeble lines of growth. There is a deep furrow internal to the margin parallel to the outline of the auricle.

Internally the auricle forms a very narrow shelf. The apophysis is flat and broad at the middle.

Pallets.—(Fig. 5, *b-c.*)—Ovate, with a cylindrical stalk which is longer than the blade. The base of the blade is solid, the distal $\frac{2}{3}$ consists of cone-in-cone elements closely packed, covered by a periostracum of brownish hue. The inner side of the solid portion is slightly concave, and that of the distal part is marked by cross lines marking the joints of the blade.

Siphons.—(Fig, 5, *d.*)—The inhalant siphon is wider but shorter than the exhalant siphon, being nearly $\frac{1}{2}$ its length. Its rim is wavy. The siphons and pallets emerge out through a prominent muscular collar, (a cup-like growth of the mantle) the rim of which is rolled out (Fig. 5, *d*, Col.).

Burrow.—The calcareous tubing very thin and in the specimens collected on 10th July 1953 there was no trace of it.

NOTE.—Three specimens, when brought alive to the laboratory and kept in a bowl of sea water ejected gonadial elements.

Remarks.—In the possession of a pallet which is ovate and an auricle which is narrow it resembles *B.* (*N.*) *braziliensis* Bartsch, *Bankia globosa* Sivickis, *B. quadrangularis* Sivickis, but differs from the first, in that the

anterior median part of the shell is considerably wider than the middle median and post-median combined, and in having a shell, whose height is equal to its width, unlike that form in which the shell height is more than shell width (6 : 5·8) and in having a pallet blade whose length is more than its diameter, without a thin calcareous deposit. It differs from 2nd and 3rd in the relative proportions of the anterior median with the middle and post-median combined, and in the details of the pallet structure. Further, the present form approaches closely *Nausitora mcsseli* Iredale, in having a shell the height of which equals its length, with a broad anterior median area and an eroded small auricle, but differs from it in having 100 denticulated ridges on anterior lobe instead of 30 as in that form. These differences are further augmented when the pallets are compared. In *Nausitora messeli* the pallet is 21 mm. long, of which only 1·6 mm. belongs to the stalk and the blade is narrower (width 1·2 mm.) and elongate and not ovate as in the present form.

A detailed comparative study of the present form with the other seventeen forms, assignable to the subgenus *Nausitora* by virtue of the fused nature of the pallet joints, shows that the present form is different, and does not correspond to any described so far, and hence is treated as a new species *Bankia* (*Nausitora*) *madrasensis* and can be defined as follows :

Shell height, equivalent to shell width, with anterior median much more wider than the middle median and posterior median combined, with a small auricle and having a pallet with a long stalk and ovate blade, whose length is more than its diameter, formed of closely packed units covered over by a brownish periostracum.

Types.—The holotype will be deposited in the Indian Museum and the paratypes will be in the Zoology Laboratory, Madras.

Genus **Teredo** Linnæus, 1758.

1758. *Teredo*, Linnæus, *Syst. Nat. ed. 10, p. 651.*

Pallets are either paddle or spoon shaped. They may be distally cupped or not, or they may even bear a calcareous knob at the terminal portion.

Genotype.—Teredo navalis Linnæus.

Subgenus **Teredo** Linnæus.

1758. *Teredo*, Linnæus, *Syst. Nat., ed 10, p. 651.*

Teredo has the pallets paddle-shaped, with a decidedly cup-shaped depression at the distal end. The distal portion is covered with a dark periostracum, which terminates in the shape of two lateral horns.

Type.—Teredo navalis Linnæus.

Teredo (Teredo) madrasensis, sp. nov.

(Fig. 6, *a-c.*)

Occurrence.—Two specimens were obtained from a fish float of red cedar from Mylapore coast on 14th January 1954. One of these has been selected for the type specimen. Another lot of seven specimens

was obtained from a plank of *Mangifera* species from Kayankulam backwaters in Travancore on 20th January, 1954, and sent to me by Shrimati Gomati Nair.

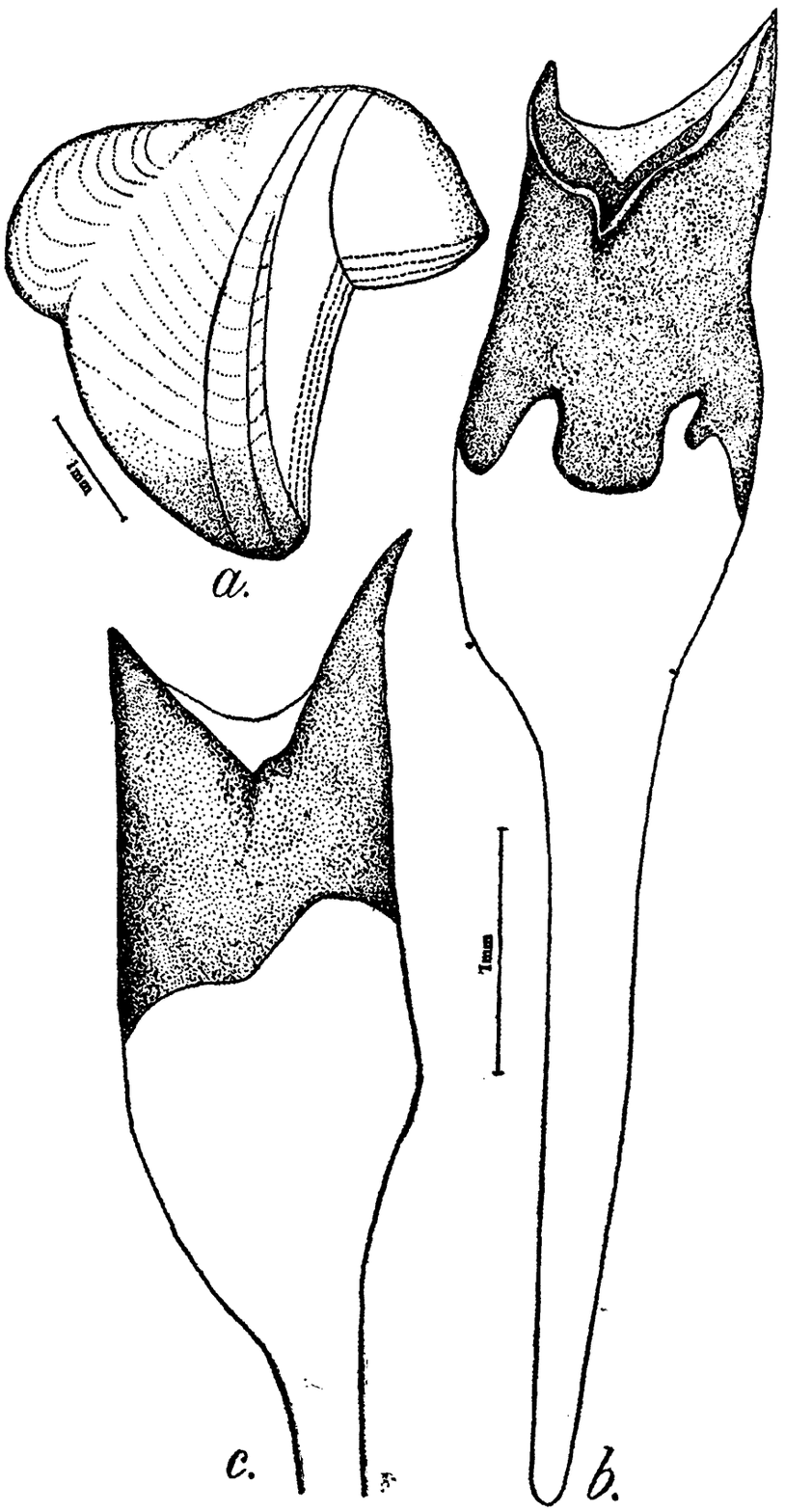

FIGURE 6.—*Teredo* (*Teredo*) *madrasensis*, sp. nov.

(*a-b*) Outer faces of shell and pallet respectively, (*c*) Inner face of the blade of pallet.

Size.—5·5 cms. long. Shell-height—4 m.m., Length—4 mm., Pallet length—6·3 mm., stalk—3·3 mm., Maximum diameter of blade—1·3 mm.

Shell.—(Fig. 6, *a.*) Sub-globular, white. The anterior part with a deep sinus, and callus. The latter reflected postero-dorsally over the dental ridges. The dental ridges numbering 27 are spread fanwise posteriorly from the callus and are separated by spaces about twice as wide as the ridges at the ventral side of the anterior area. The dental ridges are finely denticulated at their free margin. The dental ridges of the anterior part meet those of the anterior median at almost right angles. The anterior median portion is narrower than the auricle or the posterior median, and bears about thirty ridges which are closely crowded, bearing stout denticles arranged in a regular row. The middle median is a narrow area, with a furrow extending from the umbo to the ventral knob, and is crossed by enfeebled non-denticulated extensions of the dental ridges, which are further extended into the posterior median portion. The latter is broader than the middle median and anterior median combined. The surface of this area is white and smooth, but for the feeble extensions of the dental ridges. This portion forms a strong auricle, the latter bearing on it concentric lines of growth.

Interior white, the anterior and median parts smooth, the middle median clearly demarcated with a ridge in the middle. The shelf very narrow, projecting into the cavity of the posterior median. The lines of growth are prominent on the inside as well. The apophysis is given off from the ventral side of the dorsal knob. It is flat, tapering towards the end, extending for more than half the distance into the cavity of the shell.

Pallets.—(Fig. 6, *b-c.*) With stalk longer than the blade, and cylindrical, gradually becoming broader towards the blade. The blade has a calcareous basal portion capped at the distal end by a well developed elongated black periostracum, which forms about 2/3 the length of the blade. It is cupped distally. The outer free border of the cup is more concave and is produced into horns laterally. The stalk at its base is surrounded by a fold of the mantle forming a collar.

Siphons.—The exhalant siphon is narrower and shorter than the inhalant siphon, being only half its length in formalin preserved specimens.

Collar.—A muscular collar is well developed in this form at the base of the pallets.

Burrow.—With a thin lining of calcareous matter forming a tube which is adherent to the wood.

Remarks.—A study of the figures and descriptions of 130 species recorded under the genus *Teredo* shows that thirty species undoubtedly belong to the subgenus, *Teredo* of Bartsch (1922), of which four species approach closely the present form, namely, *Teredo navalis* Linnæus, *T. furcillatus* Miller, *T parksi* Bartsch, and *T pocilliformis* Roch. The form resembles the figure of the shell of *T navalis,* as given by

Jeffrey, in the number of ridges for the anterior lobe, but differs from it in having the same number for the anterior median also instead of fifteen ridges as shown in the aforementioned figure. In the present form, the pallet has an overall length of 6·3 mm. of which 3·3 mm. belong to the stalk, whereas the pallet of *Teredo navalis* has a stalk shorter than the blade, and the proximal end of which is slightly swollen and bent, unlike the present form in which it is straight and tapering. *Teredo furcillatus* is different as its anterior part is higher than broad, unlike this form in which it is broader than high. The pallet of *Teredo furcillatus* has a stalk which is long with a small blade, while in the present form it is significantly different. Stalk—3·3 mm., blade—3 mm. The proportion of the shell and pallet is also different. The overall length of the pallet is 3·7 mm. when the shell is 3 mm. high and 3·4 mm. long in that form. The absence of a dark periostracum is another distinctive feature of the pallet of *T furcillatus*. *Teredo parksi* is different in the possession of a small auricle, which according to Miller, is a character which exhibits less variability in this species. The pallet is with a long stalk and a short deeply excavated blade, unlike in the present form. The information about *T pocilliformis* is incomplete but appears to be different from this, as its pallet is described as resembling that of *T navalis*, with the distal excavation deeper and cup-shaped. The present form appears to be new and can be defined as follows :—

Shell in which the anterior lobe is broader than high, with a well developed auricle, with the anterior median and middle median bearing each about 30 dental ridges, when the shell is 4 mm. high and 4 mm. long, pallet with a straight stalk longer than the blade, the distal 2/3 of the latter being covered by a black periostracum which is cupped distally, the outer free border of which is more concave and produced into two projections laterally.

Types.—The holotype will be deposited in the Indian Museum, Calcutta, and the paratypes in Zoology Laboratory, Madras.

Subgenus **Teredora** Bartsch, 1921.

1921. *Teredora, Bartsch., Proc. Biol, Soc. Washington,* Vol. 34, p. 26.

The auricle in this subgenus is placed upon the posterior median portion, that half of it projects as a shelf inwardly, and the other half outwardly. The pallets have a nail-like depression which may be marked by concentric lines of growth, or these may become even rib-like and it may have longitudinal radiating riblets, confined to the basal portion of the nail-like part or these also may be strong and rib-like.

Type.—Teredo malleolus Turton.

Teredo (Teredora) gregoryi Dall, Bartsch, and Rehder.

(Figure 7, *a-d.*)

1938. *Teredo (Teredora) gregoryi*, Dall, Bartsch, and Rehder, *B. P. Bishop Mus. Bull.* 153, pp. 212, 213, pl. 55, figs. 1-5.

1942. *Teredo (Teredora) gregoryi*, Edmondson, *B. P. Bishop Mus. Occ. Papers* 17 (10), pp. 127, 129, figs. e to i.

Occurrence.—Drift logs washed ashore on Madras beach during December-January, and wooden structures and fishing floats exposed to sea water in this locality, are infested with this shipworm in large numbers. The maximum length of the specimen I have collected is 29 cms. from Indian red-cedar. As has been reported for the Hawaiian species by Edmondson, young specimens have thick bodies as compared with their length. A specimen 20 cms. long has been selected as the type for description.

Size.—Shell height—9·8 mm. Length—8·8 mm. Pallet length—8·6 mm. Stalk—2·1 mm. Maximum diameter—4·1 mm.

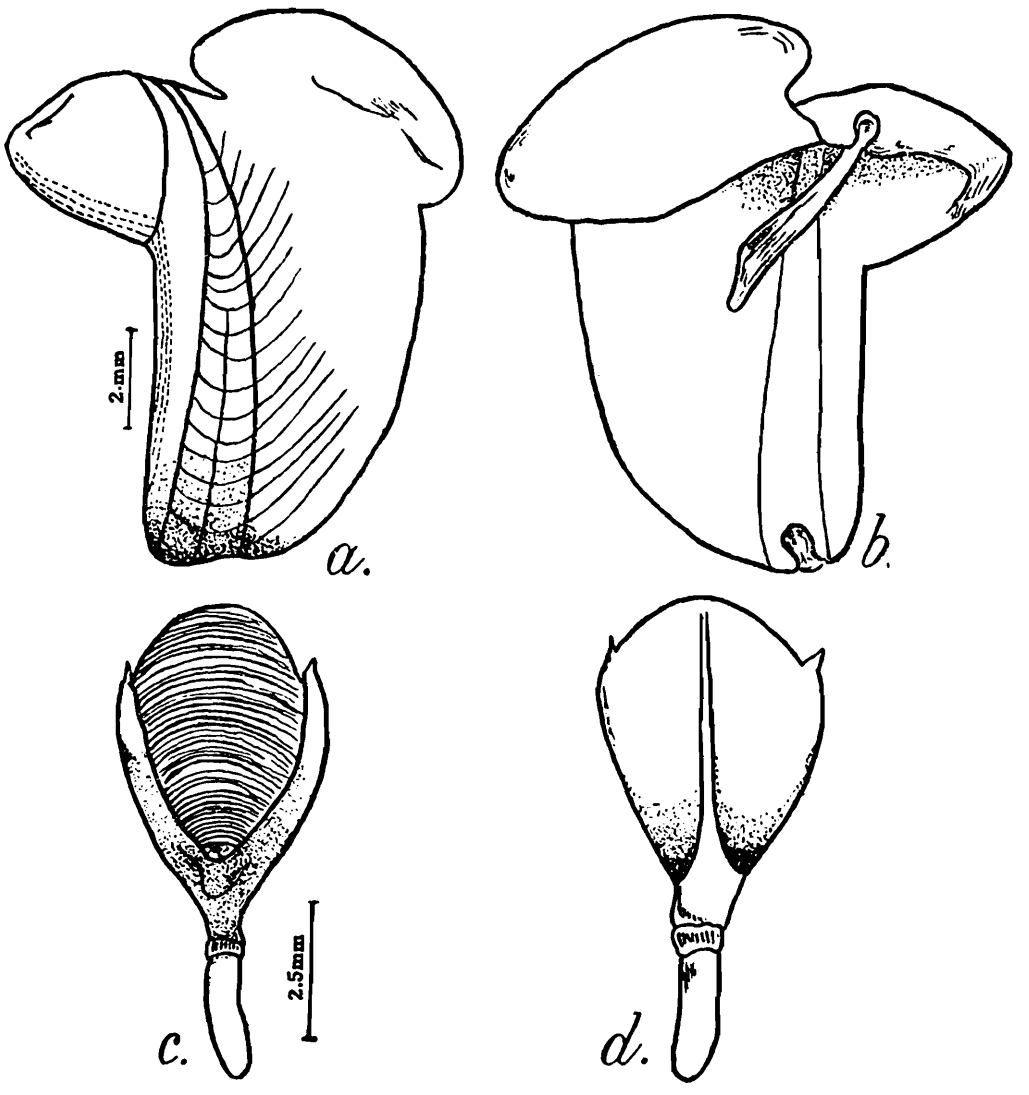

FIGURE 7.—*Teredo* (*Teredora*) *gregoryi*, Dal, Bartsch, and Rehder.
(*a-b*) Outer and inner faces of shell respectively, (*c-d*) Outer and inner faces of pallet respectively.

Shell.—(Fig. 7, *a-b*.) Large and white, anterior lobe with sinus and reflected callus and thirty dental ridges radiating backwards from the callus. At the post-extremity the dental ridges are separated by spaces about twice as wide as themselves. Anterior median area is marked by closely-spaced denticulated ridges that join those of the anterior part at a little more than a right angle. The middle median part is concave and is further marked by a depressed groove, and is crossed by curved nondenticulated extensions of the dental ridges of the anterior median

region, and also by strong lines of growth. These make the surface of this region rough. The posterior median part is wider than the anterior median and middle median parts taken together, and is placed obliquely on the posterior median portion, about 1/3 projecting as a shelf inwards and 2/3 outwards, with its free border curving upwards, creating a broad concavity on the external surface.

Viewed from within, the anterior and median portions are joined by a slender suture. The dorsal and ventral knobs are very prominent. The whole interior is smooth except for the auricle, where prominent concentric lines of growth are perceivable. Pendant slightly obliquely from the umbonal region is the narrow flat apophysis, the flat surface being parallel to the shell.

Pallets.—(Fig. 7, *c-d.*) Spatulate, with a short cylindrical stalk which is slightly curved at its proximal part. The junction of the stalk with the blade is marked by a ring-like prominence. The outer surface of the blade resembles a finger nail in its nailbed. The nail-like median portion is marked by rough concentric lines. The inner palletal surface is smooth and shows a rib running through its centre very much as if the stalk portion is extended towards the tip through the pallet.

Siphons.—In formalin preserved specimens the siphons are almost of equal length, fringed with tentacles at the rim.

Collar.—Slightly developed.

Burrow.—Lined by calcareous material which forms a thick tubing.

Remarks.—This form agrees with the figures and descriptions of *Teredo (Teredora) gregoryi* by Dall, Bartsch, and Rehder (1938) and also the specimens of the above form from Hawaii, sent to me by Dr. Edmondson for comparison, especially in having a very prominent obliquely placed auricle which is curved upwards at the free border and when viewed from within is seen projecting as a shelf 1/3 inward and 2/3 outwards. The pallets are also identical being spoon-shaped, the stalks being short which merge with the matrix of the expanded blade, on the inside of which it appears as a strong crest. In both, the inside of the pallet is smooth and on the outside the nail-like area is marked by concentric lines. However, the present form possesses two small spinous projections at the distal margin of the pallet laterally. The denticles of the shell also vary in the two forms when they are examined under an oil immersion lens. This feature alone is not a very reliable factor. "Sometimes species which are known to be different have denticles quite similar."*

NOTE.—While the typical form of the species has been recorded from various localities in the Pacific ocean, such as, Olowalu (Thaanum), Hæna, Kauai (Bryan), Hauula, Oahu (Edmondson), Johnston island and Wake island (Thaanum), this species has not been recorded hitherto from the Indian ocean. Hence the occurrence of this form here is of special interest and shows the remarkable range of distribution of this species of ship-worms. Their ready appearance in fair numbers in test planks suggests that this species is a well established one in Madras waters.

* Edmondson—personal communication.

Teredo (Teredora) clava Gmelin (Fig. 8, *a-c*).

1817. *Teredo clava*, Dillwyn, Descriptive catalogue of recent shells, 2, p. 1088.
1931. *Teredo clava*, Roch and Moll. *Mitt., Zool. staatsinst. Zool. Mus. Hamburg*, p. 8.

Occurrence.—This form has been recorded from Madras by Gravely (1941). Eleven specimens have been collected from the floating corky seeds of the mangrove *Carapa moluccensis*.

Size.—Shell height—7 mm., length—4·5 mm., Pallet length—7 mm., stalk—2 mm., maximum diameter of blade 2·6 mm.

Shell.—Very short with median part elongated and covered by a periostracum which is dark brown over the anterior and anterior median parts. The anterior portion with the usual sinus and reflected callus. The dental ridges that radiate from the callus area proceed backwards in a gentle even curve. Thirteen such ridges are present, the first three ridges parallel to the ventral edge are arranged closely, the next four above them are wide apart and stand out as strong lamellae, finely denticulated at their free border. These dental ridges are continued

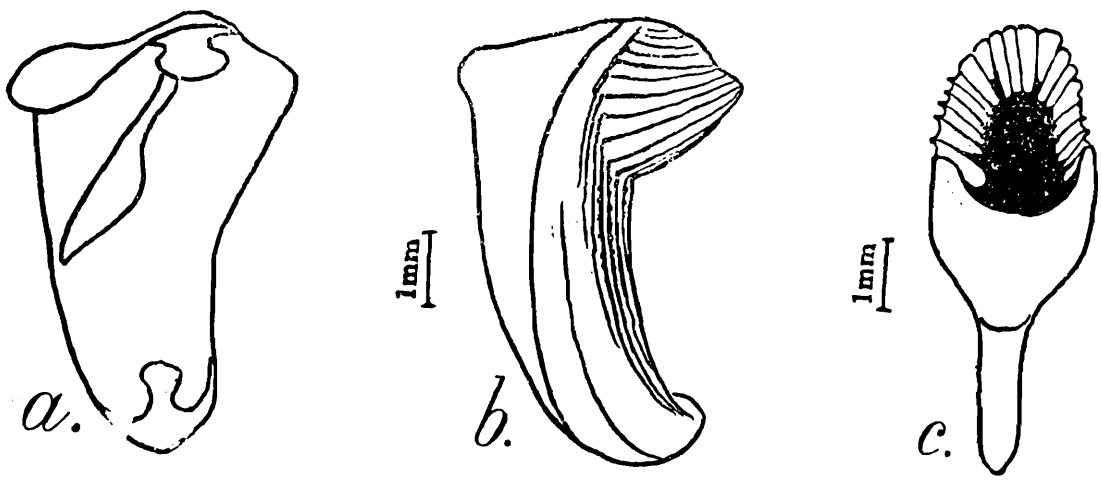

FIGURE 8.—*Teredo (Teredora) clava*, Gmelin.
(*a-b*) Inner and outer faces of shell respectively, (*c*) Outer face of pallet.

without interruption from the anterior into the anterior median lobe after making a sharp bent of slightly more than a right angle and proceed downwards (Fig. 8, *b*). The median area is elongated in the dorso-ventral axis and its anterior part is narrow bearing the denticulated ridges numbering about 10. These are not closely crowded and the periostracum covering it is eroded. The boundary between the anterior and anterior median is not clear. The middle median is a slightly depressed area crossed by a number of concave lines of growth and non-denticulated upturned extensions of the dental ridges. The boundary of the middle median and posterior median is not clear, but the surface of the latter is free from growth lines and ridges, being covered only by a thin light brown periostracum. The posterior median forms a very narrow auricle which appears as a slightly projecting area of the former from its dorsal side.

Viewed from within (Fig. 8, *a*), the whole of the interior is smooth. The auricle is shaped like a pallet, with the stalk pointing to the umbone and so attached to the posterior median part that as much of the shelf

thus formed projects inward, as there is auricle projecting outward. The apophysis is pendant from the ventral side of the umbo obliquely postero-ventrally. At the extreme ventral edge of the median part, the ventral knob is well developed.

Pallets.—Spoon-shaped, broad and thick. The junction of the blade and the stalk is clearly marked. The proximal part of the blade is solid and thick, while the distal part is marked by radiating longitudinal ribs looking somewhat like the leaf of a palm. (Fig. 8,*c.*)

Collar.—A little enlarged.

Burrow.—The burrows are lined by a thick-walled calcareous tubing. These tubes are closely crowded and very often twisted together and are not closely adherent to the walls of the burrow.

Remarks.—The present form agrees with the figures and descriptions of *Teredo clava* by Gravely (1941) and Roch & Moll (1931).

Teredo (Teredora) rehderi, sp. nov. (Fig. 9, *a-d*).

Occurrence.—Drift logs washed ashore by N. E. monsoon winds on Madras coast during December-January were infested heavily by this shipworm. Seventyfive specimens were collected, the longest one being 4 cms. long. They were recovered from different types of timbers, such as, pieces of Indian red-cedar, planks of mango timber (*Mangifera sp.*), Red pear (*Bursera*), Teak (*Tectona*), drifting bamboo poles, and other as yet undetermined pieces of timber.

Size.—Length of Shell—3·5 mm., height of shell—3·5 mm., length of pallet—3·9 mm., length of stalk—1·7 mm., maximum diameter of blade 1·5 mm.

Shell.—(Fig. 9, *a-b*). Short, white with the median part elongated, the anterior area with sinus and callus. The dental ridges pass from the callus area downwards and then backward parallel to the ventral margin. About seventy denticulated ridges are present in the type specimen. At the umbonal and the ventral aspects of the anterior area the dental ridges are closely crowded, but in its middle part, however, they are separated by spaces as wide as themselves. None of the dental ridges are covered by the callus. The anterior median is narrow, about half as wide as the widest part of the posterior median and bearing closely set denticulated ridges which are separated by mere impressed lines and join those of the anterior portion in almost a right angle. The middle median portion is a slightly shallow groove crossed by the non-denticulated curved extensions of the denticulated ridges of the anterior median portion. The posterior median portion is about as wide as the anterior and middle parts combined, and is marked by the extensions of the markings of the middle median. The auricle is very obliquely placed and marked by concentric lines of growth. The rim of the auricle is curved outward creating a concavity on the external surface. The interior is white and smooth except for the auricle which is marked by concentric lines. The auricle overlaps the posterior median area forming a shelf, which is narrow, the major part projecting outward. Pendant from the ventral side of the umbonal knob is the almost cylindrical blade (apophysis), projecting for more than half the length of the shell downward.

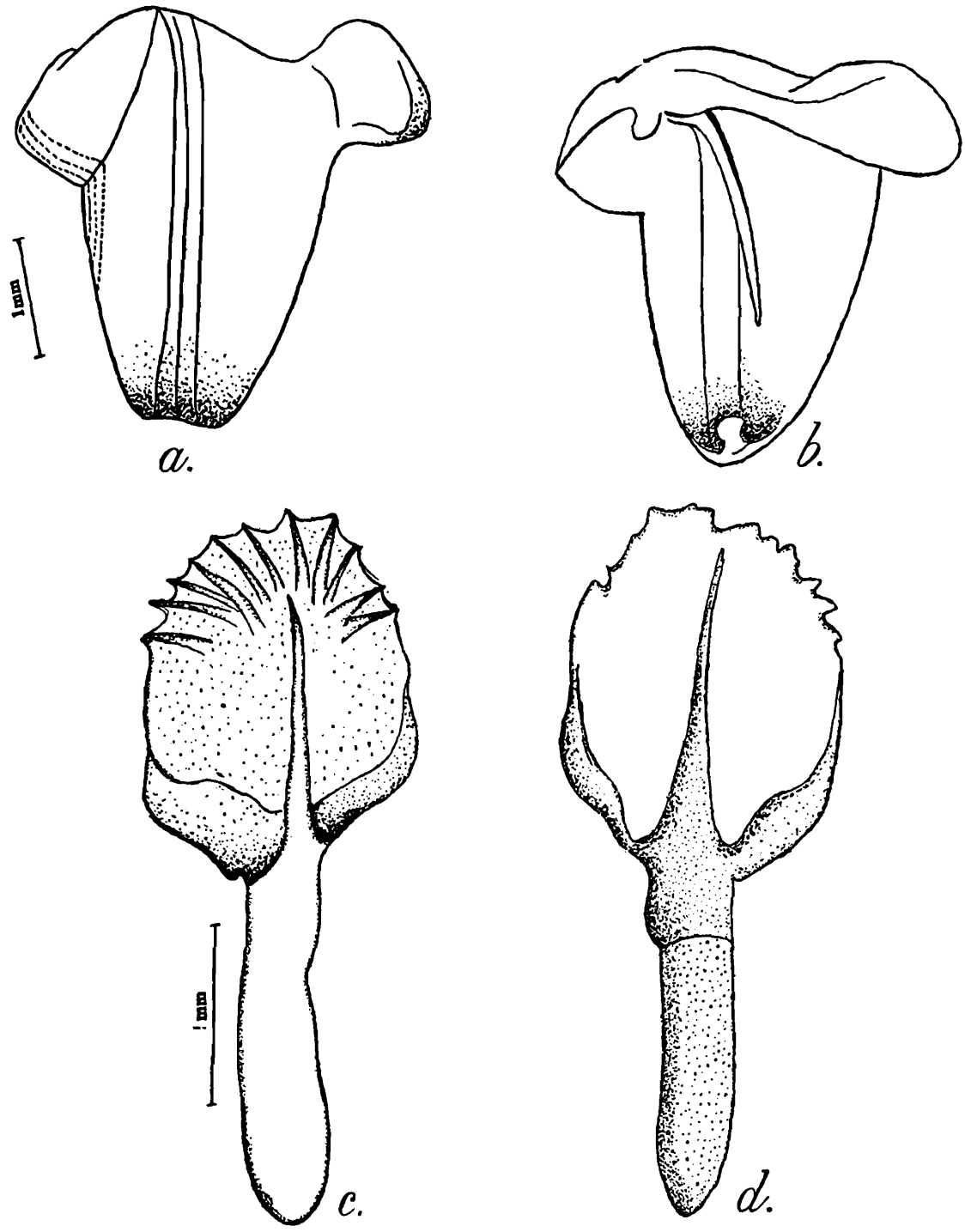

FIGURE 9.—*Teredo (Teredora) rehderi*, sp. nov.
(*a-b*) Outer and inner faces of shell respectively, (*c-d*) Outer and inner faces of pallet respectively.

Pallets.—(Fig. 9, *c-d*). Spoon-shaped, with a short, stout, cylindrical stalk. The basal part of the blade is thick, solid and smooth, while the distal portion is nail-like marked by a series of stout, radiating longitudinal ribs.

Siphons.—Both inhalant as well as exhalant siphons are of equal-length and diameter, fringed with whorls of tentacles at the rim.

Burrow.—Lined with calcareous tubing not firmly adherent to the wood.

NOTE.—Many of the specimens when removed from the wood and kept in a bowl of sea water ejected eggs and sperms which underwent fertilisation and normal cleavage and yielded free swimming larvæ within eighteen hours.

Remarks.—In the possession of spoon-shaped pallets, not cupped at terminal border and without periostracum this form undoubtedly belongs to the subgenus *Teredora* Bartsch. In having an obliquely placed auricle on the dorsal margin of the posterior median, the shell resembles *Teredo* (*Teredora*) *vincentensis* Bartsch, *T.* (*T.*) *gregoryi* Dall, Bartsch and Rehder, and *T. gazellae* Roch, but can be differentiated from the first, in having more denticulated ridges (about seventy) on the anterior area which are more closely spaced, and in having the posterior median area narrower, being only as wide as the anterior and middle median combined, unlike the Vincent shipworm in which the posterior median is about twice as wide as the anterior and middle median combined. It differs from *T* (*T.*) *gregoryi* in having an apophysis which is almost cylindrical and in the possession of a pallet with a blade which is solid, thick, and smooth at the base, the distal portion of which is nail-like marked by a series of stout radiating longitudinal ribs. The information regarding these features is incomplete for *T gazellae.* However, a scrutiny of the photograph given by Roch indicates that the shell is higher than it is broad differing from the present form in which the height is almost the same as its width. The present form resembles *Teredo* (*Teredora*) *panamensis* Bartsch in the nature of the pallet, in having the free stalk being short with the basal portion of the blade solid and thick, while the distal portion is nail-like and marked by a series of longitudinally radiating ribs, but differs from it in having the relative proportions of the pallet very different. The present form has a pallet with an overall length of 3·9 mm., of which 2·2 mm. belong to the blade which has a diameter of 1·5 mm., whereas in the Panama shipworm the pallet length is 4·8 mm. of which 3·5 mm. belong to the stalk and the diameter of the blade is 2·3 mm.

The present form is hence treated as a new species *Teredo* (*Teredora*) *rehderi* and can be defined as follows :—

Shell height equivalent to shell length, with posterior median broad about as wide as the anterior and middle median combined, with an obliquely placed auricle, the rim of which is curved outward, with an apophysis which is cylindrical projecting for more than half the length of the shell into its cavity. Pallets spoon-shaped, with stout cylindrical stalk, shorter than the blade, the latter with thick solid basal part and with nail-like depression distally, marked by stout radiating longitudinal ribs.

Types.—The holotype will be deposited in the Indian Museum, Calcutta, and the paratypes in the Zoology Research Laboratory, Madras.

(The specific name *rehderi* is given after Dr. Harald A. Rehder of the United States National Museum).

Subgenus **Zopoteredo** Bartsch, 1923.

1923. *Zopoteredo,* Bartsch, *Proc. Biol. Soc. Wash.*, Vol. 36, p. 96.

The posterior part (auricle) overlaps the median part on the inside and is completely united with it having no cavity between it, and the median part at the anterior margin of the auricle. The pallet differs from all the other known Teredos in having the calcareous portion semi-

disc shaped that is, very short and broad and the corneous portion partly slit and infolded in the median line on the outside so as to practically divide that part into a double cup, but this is not a true double cup, for it does not involve the calcareous portion.

Teredo (Zopoteredo) bengalensis, sp. nov. (Fig. 10, *a-c*).

Occurrence.—Four specimens were taken from a drift log (timber undetermined) on 5th January, 1954, from Madras beach. All the specimens were alive and their gonads were ripe and full.

Size.—Shell height—3·9 mm., length—3·6 mm., pallet length—5 mm., stalk—2·5 mm.

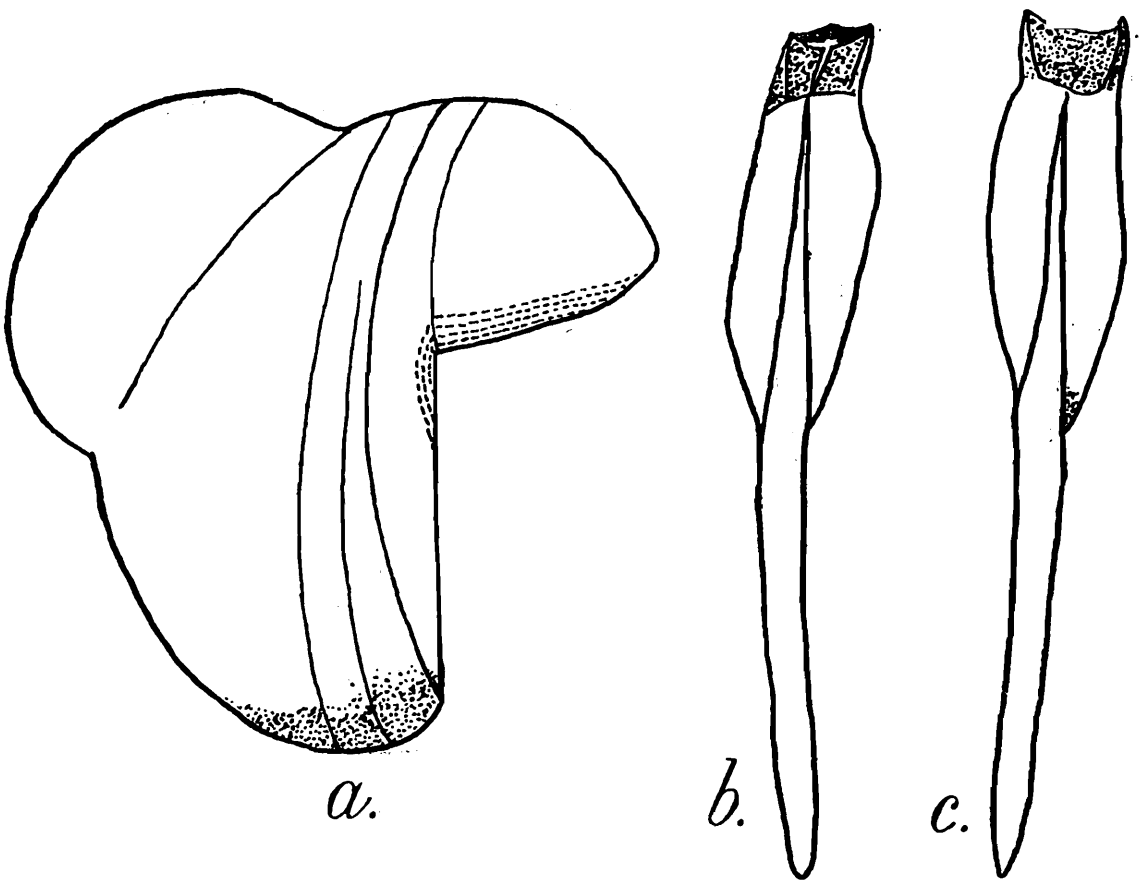

FIGURE 10.—*Teredo* (*Zopoteredo*) *bengalensis*, sp. nov.
(*a*) Shell outer face, (*b-c*) Outer and inner faces of the pallet respectively.

Shell.—(Fig. 10-*a*.) Sub-globular, white. The anterior portion with a deep sinus and reflected, smooth, translucent, callus. The dental ridges radiate from this smooth portion backwards over the rest of the anterior area. About 30 ridges could be counted in the specimen figured. These ridges of the anterior portion meet those of the anterior median at almost right angles. The dental ridges of the anterior median portion are closely crowded being separated by mere lines only and bear fine denticles. The middle median is a somewhat depressed groove. Marking the centre of this area are the curved lines of growth, the enfeebled extensions of which extend over the posterior median as well. The posterior median is broad about 1·5 times the width of the anterior and middle median combined, and forms a strong auricle which is marked by clear concentric lines of growth. Internally the umbo forms a strong knob from the inner side of which is pendant, the flat thin blade. The auricle overlaps the posterior median area forming a narrow shelf.

Pallets.—(Fig. 10, *b-c.*) With cylindrical translucent stalk, slightly longer than the blade, which uninterruptedly continues to the distal end like the shaft of a feather. At the distal end of the calcareous part of the blade is a horn coloured periostracum which is translucent and is slightly cupped with a long narrow sinus traversing its middle median line on the outside.

Remarks.—The subgenus *Zopoteredo* Bartsch includes 3 species namely, *trulliformis*, *fulleri*, and *triangularis*. In the possession of a pallet, the corneous portion of which is partly slit and infolded in the median line on the outside so as to practically divide that part into a double cup, this form belongs to the subgenus *Zopoteredo*. It clearly differs from *trulliformis* Miller, and *triangularis* Edmondson, both in the features of the shell and pallet. However, the present form resembles *Zopoteredo fulleri* Clapp in the possession of a pallet with a slender translucent stalk, which is almost as long as the blade, the latter opaque and milk white and in possessing a narrow horn coloured zone, the distal extremity of which is slightly cupped.

But comparison of the shells and pallets of the present form with those of *fulleri* from Oahu (Hawaii)* shows the following differences :

In the Madras form :

I. The stalk of the pallet continues uninterruptedly into the blade like the shaft of a quill feather without any demarcation into stalk and blade.

II. The narrow sinus traverses only through the distal horn coloured periostracum on the outside and not into the calcareous part.

III. The sides of the pallet blade are not straight but slope gently towards the posterior end.

IV. The auricle of the present form is prominent unlike that of *fulleri* in which it is described as small by Clapp. Hence the present form is treated as a new species *Teredo* (*Zopoteredo*) *bengalensis* and can be defined as follows :—Shell with a well developed auricle with the posterior median part 1·5 times the width of the anterior and middle median put together, and with a pallet having a cylindrical translucent stalk, which uninterruptedly continues to the distal end like the shaft of a quill feather ; and a translucent horn coloured periostracum, with a sinus traversing the middle median line on the outside.

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* I am thankful to Dr. Edmondson for kindly sending me specimens of *T.* (*Z.*) *fulleri* from Oahu (Hawaii) for comparison with the Madras form.

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