IV NOTES ON CRUSTACEA DECAPODA IN THE INDIAN MUSEUM.

V.—HIPPOLYTIDAE.

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(Plates I-VII.)

With the exception of a few more or less isolated records little has hitherto been written on the Hippolytidae occurring in Indian waters. The family is well represented in the Indian Museum, but there can be no doubt that many new and unrecorded forms remain to be discovered.

On a recent visit to the coasts of S: India in the vicinity of Rameswaram Island, made in company with Dr. J R. Henderson of the Madras Museum, several species hitherto unknown from Indian coasts were obtained and there is little doubt that collections from other localities would prove equally interesting. Hippolytidae seem, for the most part, to prefer shallow water and a weedy bottom; it was at any rate in such situations that all the species found in S. India were obtained. Our collection was made in February and at this season the majority of the females were found bearing eggs.

The family Hippolytidae is one of somewhat unusual interest on account of the great diversity of form found in the different genera and of the different modes in which the secondary sexual characters may find expression.

Several genera such as *Leontocaris*, *Cryptocheles*, *Tozeuma* and *Gelastocaris* exhibit structural modifications of the most bizarre character; this specialization is presumably correlated with some unusual form of livelihood, but the reasons for the peculiar adaptations have not as yet been definitely ascertained.

In many of the genera no conspicuous secondary sexual characters are developed, but in others they form a most noticeable feature. In some, such as *Latreutes* and to a less marked extent in *Saron*, the sexes may be distinguished by the development of the upper antennular flagellum, that of the male being longer and stouter than that of the female. Young males of *Saron* in other respects bear a close resemblance to females, but in large individuals of the former sex the third maxillipedes and first peraeopods may attain a monstrous development, being often proportionately twice as long as those of the female. This condition, which is also found in the genus *Alope*, has been discussed at length by Coutière; he considers it to be a case of 'dimorphism', but his application of the term to the phenomena found in these genera is open to question.

In *Thor*, on the other hand, it is the third peraeopods which are affected. In males of this genus the third leg is proportionately much longer than in the female and bears a different type of spinulation.

If my results be accepted, the sexual modifications in one species of *Latreutes* (*L. mucronatus*) are of a very far-reaching nature, the whole form of the animal being different, while distinctions of the most striking character are found in the form of the rostrum.

The normal variation found in the species of certain genera is astonishingly great, especially as regards the form and armature of the rostrum, and it is unfortunate that almost implicit reliance was placed on this character by many of the older authors. As a consequence, a very large number of species stand in need of redefinition and considerable difficulties have been met with in identification, more particularly in the genera *Latreutes* and *Hippolysmata*.

In examining the Indian forms I have described three new species and one variety, while two fresh genera are proposed, both based on forms already described. Out of a total of twenty-two genera, the number now known from the Indo-pacific region[1] is fifteen, of which twelve have been found on the coasts of British India.

A sound basis for the classification of the genera was outlined by Calman in 1906[2] on characters derived from the branchial formula and the development of the mandible. The Indo-pacific genera may be distinguished by the use of the following key, which is adapted and expanded from that given by Calman. The genera *Ogyris*, Stimpson, and *Pterocaris*, Heller, are regarded as members of the Alpheidae and are not included therein. I have not seen examples of the genera *Nauticaris*, *Ligur* and *Mimocaris*.

KEY TO THE INDO-PACIFIC GENERA OF HIPPOLYTIDAE.

A. Arthrobranchiae present at base of first four pairs of peraeopods [mandible with three-segmented palp; many segments in carpus of second peraeopods].

- **I** A movable tooth at base of uropods.
  - A. Mandible with incisor-process ... ... *Saron*.
  - B. Mandible without incisor-process ... ... *Nauticaris*.
- **II.** No movable tooth at base of uropods.
  - A. Mandible with incisor-process; last three peraeopods not abnormally slender ... ... *Merhippolyte*.

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[1] Under this term I include the area extending from the Red Sea and Delagoa Bay to New Zealand, Oceania, the Hawaiian Is. and Japan.

[2] Calman, Ann. Mag. Nat. Hist. (7), XVII, p. 29.

B. Mandible without incisor-process; last three peraeopods abnormally slender ... ... *Ligur* (= *Parhippolyte*).

B. No arthrobranchiae at base of peraeopods.

I. Mandible with palp [carpus of second peraeopods composed of six to eight segments].

A. Mandibular palp three-segmented; supra-orbital spines of carapace very large [incisor-process of mandible present or absent] ... ..., ... *Alope.*

B. Mandibular palp two-segmented; supra-orbital spines of carapace, if present, not very large [mandible with incisor-process] ... ... *Spirontocaris.*

II. Mandible without palp.

A. Mandible with incisor-process.

I. Carpus of second peraeopods composed of six or seven segments; ultimate segment of antennular peduncle with movable distal plate ... ... *Thor.*

II. Carpus of second peraeopods composed of only three segments; ultimate segment of antennular peduncle without movable plate (normal) ... *Hippolyte.*

B. Mandible without incisor-process.

I. Carpus of second peraeopods composed of three segments.

a. No post-ocular spine on carapace; carpus and chela of first peraeopods short and stout, dactyli of last three pairs normal.

1. Form of body stout; lateral process of basal antennular segment anteriorly rounded; third maxillipede with exopod; epipods at base of first three or four peraeopods ... *Latreutes.*

2. Form of body very slender; lateral process of basal antennular segment anteriorly pointed; third maxillipede without exopod; no epipods at base of peraeopods ... ... *Tozeuma.*

b. A post-ocular spine on carapace; carpus and chela of first peraeopods slender; dactylus of last three pairs composed of a short basal portion bearing a cluster of large teeth [third maxillipede without exopod; epipods at base of first four peraeopods] ... ... *Gelastocaris.*

II. Carpus of second peraeopods composed of many segments.

a. Abdomen bearing argespines dorsally and ventrally; carapace with longitudinal lateral carinae [exopod of third maxillipede present ?] ... *Mimocaris.*

b. Abdomen without large spines; carapace without lateral carinae.

1. Third maxillipede with exopod; epipods at base of first four peraeopods, ultimate segment of antennal peduncle not abnormal in size.

α. Upper antennular flagellum unequally biramous ... ... *Lysmata.*

β. Upper antennular flagellum uniramous ... *Hippolysmata.*

2. Third maxillipede without exopod; no epipods at base of first four peraeopods, ultimate segment of antennal peduncle abnormal in size ... ... *Merguia.*

As the literature dealing with the family is much scattered, I have given, at the end of this paper, a list of the Indo-pacific species with references.

Genus **Saron**, Thallwitz.

Saron marmoratus (Olivier).

1869. *Hippolyte kraussi,* Bianconi, Spec. Zool. Mossambic., XVII, in Mem. Acad. Sci. Bologna (2), IX, p. 209, pl. i, fig. *2a.*
1878. *Hippolyte kraussi,* Hilgendorf, Monatsb. Akad. Wiss. Berlin, p. 836.
1898. *Saron marmoratus,* Borradaile, Proc. Zool. Soc. London, p. 1009.
1902. *Saron marmoratus,* Borradaile, in Willey's Zool. Results, p. 413.
1903. *Saron gibberosus,* de Man, Abhandl. Senck. nat. Ges., XXV, p. 852, pl. xxvi, fig. 57.
1905. *Nauticaris grandirostris,* Pearson, Ceylon Pearl Oyster Rep., IV p. 79, pl. i, fig. 6.
1906. *Spirontocaris marmorata,* Rathbun, Bull. U.S. Fish. Comm. for 1903, p. 913.
1906. *Saron gibberosus,* Nobili, Ann. Sci. nat. Zool. (9), IV, p. 40.
1906. *Saron gibberosus,* Nobili, Bull. sci. France et Belg., XL, p. 35.
1910. *Saron gibberosus,* Coutière, Bull. Soc. philomath. Paris (10), II, p. 71, text-figs.

Most of the earlier synonymy of this species is given in full by Borradaile (*loc. cit.*, 1898). It should however be noticed that de Man (*loc. cit.*, 1902) has referred Ortmann's Japanese specimens [1] and some of those recorded by himself both in 1888 [2] and 1897 [3] to a new and very closely allied species, *Saron neglectus,* which is recorded in the present paper from the Andaman Is.

Among the male specimens of *S. marmoratus* preserved in the Indian Museum the variation in the proportional lengths of the third maxillipedes and first pair of peraeopods is enormous; in twenty individuals of this sex from a single locality the third maxillipedes vary from 35 to 77% and the first peraeopods from 30 to 88% of the total length. It is this great variation that has led to the confusion that exists in the taxonomy and has induced earlier authors to describe the species under two separate names, *marmoratus* and *gibberosus.* Thanks to the work of Borradaile and de Man this confusion no longer exists, but there is still, I believe, a certain amount of misconception regarding the occurrence of dimorphism in the genus.

Borradaile, while including *gibberosus* as a synonym of *marmoratus,* notes that in his specimens "the males can be sharply divided into two groups having the *marmoratus* and *gibberosus*-characteristics respectively" and suggests the possibility that the males of the species are dimorphic. This view is upheld by Coutière in a most interesting paper entitled "Les crevettes à mâles dimorphes du genre *Saron*" (*loc. cit.*, 1910); but an examination of the material at my disposal leads me to believe that this supposed dimorphism has no foundation in fact.

The variation shown in the relative lengths of the third maxillipedes and first peraeopods is, as shown in the table on page 85, of enormous extent. In some males these two appendages

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[1] Zool. Jahrb., Syst., V, p. 497 (1890).
[2] Arch. f. Naturgesch., p. 533.
[3] Zool. Jahrb., Syst., IX, p. 761.

attain a monstrous size, while in others they are small and approximate more or less closely to those of the female. But this alone is, in my opinion, insufficient to prove the existence of dimorphism: it is essential that the specimens should fall into two well-defined groups and that their measurements, when plotted, should yield a bimodal curve. Measurements of our specimens show no indication of this. The greatest proportional size of the limbs is found in large specimens, but the figures, when plotted, give little other information of interest; there is no trace of a bimodal curve and even on casual examination of the specimens, it is evident that for all practical purposes the series is a graded one.

MEASUREMENTS OF MALE *Saron marmoratus.*

Locality.	Total length.	LENGTH OF		PERCENTAGE OF TOTAL LENGTH.	
		3rd mxpde.	1st prpd.	3rd mxpde.	1st prpd.
	mm.	mm.	mm.		
Karachi	42	16·5	14	39·3	33·3
	43·5	19·5	17·5	44·8	40·2
	44	19	17	43·2	38·6
	44	19	16·4	43·2	37·3
	46	22·5	21·5	48·9	46·7
	48	25	25	52·1	52·1
	49·5	23·5	22·3	47·5	45
	49·5	23·5	22·5	47·5	45·4
	51	24·2	22	47·4	43·1
	53	25·5	24	48·1	45·3
	53	28	26·7	52·3	50·4
	53	29	30·5	54·7	57·5
	53·5	26·5	26·5	49·5	49·5
	55	30	29	54·5	52·7
	56	32	—	57·1	—
	58	33	34·5	55·2	59·5
	58	44·5	51	76·7	87·9
	61	37	42	60·6	68·8
	61·5	—	45·5	—	72·3
Andamans	33	11·7	10	35·4	30·3
	43	19	15·2	44·2	35·3
Port Canning ...	41	15	12·8	36·6	31·2
	43·5	16	14	36·8	32·2
	46	19	16·5	41·3	35·9
	49	21	16·7	42·8	34·1
	52	—	21·7	—	41·7
	61·5	27·7	25·5	45	41·5

In the measurements taken my specimens seem to agree with those examined by Coutière who has nowhere stated that they can be sharply divided into two groups. They are, however, directly at variance with the results obtained by Borradaile and for this I am unable to offer any adequate explanation.

Judging from the Indian examples the variation in the males of *Saron marmoratus* is closely similar to that found in certain freshwater prawns of the family Palaemonidae. In a number of species of this family the second peraeopods of some males are found to have attained a huge size, while in other individuals of the same sex and species they resemble those of the female: if sufficiently large numbers are examined it is found that the specimens fall into a more or less well-graded series and that it is impossible to separate them into two or more groups. Coutière considers that dimorphism also occurs in the Palaemonidae; but his detailed study of its occurrence in *Palaemon* (*Eupalaemon*) *lar*,[1] although of great interest, does not convince me that this is the case.[2]

Smith defines high and low dimorphism in the following terms[3]:—" It consists essentially in the existence among the males of any species of a graduated series, as regards size and the development of the secondary sexual characters, such that the smaller males have relatively poorly developed secondary sexual characters while the larger males attain to a much greater relative development of those characters. The smaller males are then termed 'low,' and the larger males "high": when there is a more or less abrupt transition in point of numbers from high to low males we may most properly speak of a high and low dimorphism existing in the males of that species, but we also apply the term more loosely to those cases in which no such abrupt transition is proved to occur."

If the last sentence in this paragraph be accepted, the phenomena found in these Caridea may correctly be described as dimorphism, but to do so would, in my opinion, only tend to obscure the real nature of the case. In *Saron*, *Palaemon*, and certain other genera it appears that the male may become sexually mature at a period when, in its secondary sexual characters, it shows but little external difference from the female; but that it gradually assumes the more striking features of its sex in the course of subsequent moults, just as the male parr in which the milt may be ripe gradually assumes the appearance of the adult milt salmon. In Caridea, therefore, the case is one of gradual transition rather than of true dimorphism, by which is implied either a

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[1] Coutière, Ann. Sci. nat. Zool. (8), XII, p. 292 (1901).

[2] Henderson and Matthai in their account of the freshwater Palaemonidae of Southern India (Rec. Ind. Mus., V, 1910, p. 280) have advanced certain facts which seem to indicate that *Palaemon scabriculus*, *P. dolichodactylus* and *P. dubius*, belong in reality to a single species. This suggestion is a most interesting one and, if it be proved, trimorphism in the males of Palaemonidae will be established. The case, however, is on an entirely different footing from that cited above, for the three forms, all founded on males of large size, differ from one another in well-marked characters drawn from the proportional lengths of the individual segments of the second peraeopods.

[3] Smith, Mitth. zool. Stat. Neapel, XVII, p. 312 (1906).

discontinuity in the development of the individual or a marked dichotomy of evolution within the limits of a species.

Coutière at the close of his paper on the males of the genus *Saron* gives an account of certain investigations which he has made on the condition of the testes in *S. marmoratus* and *neglectus*. In those specimens in which the third maxillipedes and first peraeopods were very large he found that the testes were reduced. The suggestion that he makes to account for the condition of the individuals that he examined is a most interesting one, namely that the production of very large limbs is the result of senility. This suggestion should form the basis of further investigation, but the fact that Coutière does not state whether all or any of his specimens, which came from widely separated localities, were killed during the breeding season, makes it impossible to accept his views without further evidence and this, unfortunately, my own material does not provide.

The specimens of *Saron marmoratus* in the Indian Museum were obtained at the following localities:—

$\frac{8103}{9}$	Queensland, Australia.	Queensland Museum.	One, 44 mm.
$\frac{248}{7}$ $\frac{2455}{10}$ $\frac{6403}{10}$	Andaman Is.	A. R. Anderson, J. Wood-Mason.	Six, 33-44 mm.
$\frac{6400}{10}$	Port Canning, Ganges delta.	J. Wood-Mason.	Six, 41-61·5 mm.
$\frac{8456}{10}$	Kilakarai, Ramnad Dist., S. India. From coral reef.	S. Kemp.	One, 44 mm.
$\frac{8454-5}{10}$	Pamban, Ramnad Dist., S. India. From coral reef.	S. Kemp.	Twenty-four, 10-43 mm.
1637 $\frac{3186}{5}$ $\frac{3169-77}{7}$	Karachi, M. of R. Indus.	Karachi Museum.	Forty-eight, 36-65 mm.
$\frac{6401}{10}$	Kubbar I. reef, Persian Gulf.	Investigator.'	Two, 34 and 59 mm.
$\frac{1460}{7}$	Mauritius.	(Purchased.)	One, 50 mm.

The Pamban specimens were collected in February, 1913. All the larger individuals are ovigerous females and many of them bear coarse tufts of hairs on the rostrum, carapace and abdomen much as in *Hippolyte varians* form *fascigera*.

Saron marmoratus has been recorded from Australia (Milne-Edwards) from the Hawaiian Is. (Randall), and from many localities in Oceania and in the Malay Archipelago (Dana, Heller, de Man, Borradaile, etc.). It is also known from Ceylon (Pearson), Mozambique (Bianconi, Hilgendorf), Zanzibar (Ortmann), the Arabian coast (Nobili), and from the Red Sea (Heller, Nobili).

Saron neglectus, de Man.

1888. *Hippolyte gibberosa*, de Man, Arch. f. Naturgesch, LIII, i, p. 533 (*partim*).

1890. *Hippolyte gibberosa*, Ortmann, Zool. Jahrb., Syst., V p. 497 (*nec. syn.*).

1897. *Hippolytc gibberosa*, de Man, Zool. Jahrb., Syst., IX, p. 761 (*partim*).
1902. *Saron neglectus*, de Man, Abhandl. Senck. naturf. Ges., XXV p. 854, pl. xxvi, fig. 58.
1910. *Saron neglectus*, Coutière, Bull. Soc. philomath., Paris (10), II, p. 71, figs. pp. 73, 78.

I have nothing to add to the excellent descriptions and figures given by de Man and Coutière. There can be no doubt that the species is valid.

$\frac{9178}{6}$	S. Sentinel I., Andamans.	Investigator.'	Two, 24 and 25 mm.
$\frac{3427\text{-}8}{10}$	Andamans.	Investigator.'	Two, 15 and 23 mm.

The largest specimen is an ovigerous female.

Saron neglectus is known from Kagoshima, Japan (Ortmann), New Caledonia (Coutière), Ternate (de Man), Batavia (de Man), Djibouti, Red Sea (Coutière) and Madagascar (Coutière).

Genus **Nauticaris**, Bate.

1906. *Nauticaris*, Calman, Ann. Mag. Nat. Hist. (7), XVII, p. 31.

I have seen no Indian examples of this genus. Pearson[1] has recorded three species from Ceylon. The first of these, *N. grandirostris*, is, as Dr. Pearson has kindly informed me, synonymous with *Saron marmoratus*, the second *N unirecedens*, Bate, is a species of *Hippolysmata*, while the third *N futilirostris*, Bate, was originally described from Japan. This last form may be a true *Nauticaris*, but inasmuch as the branchial formula and mandibular palp have not been examined, it is impossible to come to any satisfactory conclusion regarding its generic status.

Genus **Merhippolyte**, Bate.

1906. *Merhippolyte*, Calman, Ann. Mag. Nat. Hist. (7), XVII, p. 32.

The identity of the forms recorded under the names *Hippolyte spinifrons* and *Merhippolyte spinifrons* is discussed on p. 90; that they have been incorrectly referred to the genus *Merhippolyte* can scarcely be doubted.

Merhippolyte calmani, Kemp and Sewell.

1912. *Merhippolyte calmani*, Kemp and Sewell, Rec. Ind. Mus., VII, p. 20, pl. i, figs. 1-4.[2]

When describing this species Capt. Sewell and I remarked on its close external resemblance to *Spirontocaris kauaiensis*, Rathbun,[3] from the Hawaiian Is.; I have now, thanks to the kindness of Miss Rathbun, been able to examine a specimen and some dissected portions of individuals belonging to that species.

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[1] Ceylon Pearl Oyster Rep., IV, p. 81 (1905).

[2] It should be noted that in fig. 3 the incisor-process of the mandible is foreshortened, the process is in reality equal in length to the mandibular palp.

[3] Bull. U. S. Fish Comm. for 1903, XXIII, p. 827 (1906).

Spirontocaris kauaiensis possesses arthrobranchs at the base of the peraeopods and a three-segmented mandibular palp, while there are 13 or 14 segments in the carpus of the second peraeopods. The species must, in consequence, be transferred to the genus *Merhippolyte* and is a very close ally of *M. calmani.*

The two forms are, I believe, specifically distinct. *M. calmani* seems, on the whole, a slightly more slender form than *M. kauaiensis* with legs proportionately a trifle shorter. The branchiostegal angle of the carapace is more abruptly rectangular and the eyes decidedly larger than in the specimen from the Hawaiian Is.; the breadth of the cornea is about one-quarter the median length of the carapace in the former, whereas in the latter it is about one-fifth. In the eye of *M kauaiensis*, moreover, there is a small ocellus, touching the cornea but quite distinct from it, and of this in the Indian species there is no trace.

In *M. kauaiensis* the second peraeopods fail to reach the apex of the antennal scale by the whole length of the chela, whereas in *M. calmani* they extend by almost the same amount beyond the apex. The exopod on the third maxillipede is rather shorter in *M kauaiensis* than in its ally and there are no epipods on the last three pairs of legs; in *M calmani* only the epipod of the fifth leg is absent.

Genus **Alope**, White.

The generally accepted definition of this genus must be modified in one important respect in order to include *Alope australis*, Baker, a species in which the incisor-process of the mandible is obsolete. In *A. palpalis*, White, the type and only other known representative of the genus, this process is considerably reduced, so that it is not altogether surprising to find that it is absent in the allied species.

Alope still remains well defined, for among the Hippolytidae only two other genera, *Nauticaris*, Bate, and *Ligur*, Sarato (=*Parhippolyte*, Borradaile) possess a mandible which is devoid of an incisor-process and at the same time furnished with a three-segmented palp and from both of these it is at once distinguished by the absence of arthrobranchs at the base of the peraeopods.

Alope palpalis, White.

(Plate I, figs. 1, 2.)

? 1837. *Hippolyte spinifrons,* H. Milne-Edwards, Hist. nat. Crust., II, p. 377.
1847. *Alope palpalis*, White, Ann. Mag. Nat. Hist. (2), I, p. 226.
1874. *Alope palpalis*, Miers, Zool. Voy. 'Erebus' and 'Terror,' Crust., p. 4, pl. iv, fig. 1.
1876. *Alope palpalis,* Miers., Cat. Crust. N. Zealand, p. 80.
? 1876. *Hippolyte spinifrons*, Miers., *ibid.*, p. 80.
1886. *Hippolyte spinifrons*, Filhol, Mission de l'île Campbell, III, p. 431, pl. liii, fig. 13.
1886. *Alope palpalis*, Filhol, *ibid.*, p. 433.
1899. *Alope palpalis*, Coutière, Ann. Sci. nat. Zool. (8), IX, p. 79, text-fig. p. 36.

1903. *Alope palpalis*, Thomson, Trans. Linn. Soc., Zool. (2), VIII, p. 440, pl. xxviii, figs. 3-12.
1903. *Merhippolyte spinifrons*, Thomson, *ibid.*, p. 444.
1909. *Alope palpalis*, McCulloch, Rec. Australian Mus., VII, p. 313, text-figs. 2, 3.
1906. *Merhippolyte spinifrons* = ? *Alope palpalis*, Calman, Ann. Mag. Nat. Hist. (7), XVII, p. 32.

Dr. Calman has suggested that *Hippolyte spinifrons*, Milne-Edwards, is probably a species of *Alope* and with this view I am in entire agreement. It seems likely that the phrase "les épines suborbitaires" in Milne-Edwards' description is a clerical error for "les épines supra-orbitaires"; this hypothesis explains the italicization of the whole passage and appears to me more probable than the view advanced by Bate[1] that the words refer to the lateral process of the antennular peduncle. In other respects the description agrees well enough with *Alope palpalis*; but until the matter has been placed beyond all doubt it is, in my opinion, not advisable to change the name of this well-known form.

Several subsequent authors have recorded both *Alope palpalis* and *Hippolyte spinifrons* from the New Zealand coast; but it does not appear that any of them, with the possible exception of Filhol, examined both forms. Filhol's *Hippolyte spinifrons*, as is shown by the figure, is undoubtedly synonymous with White's *Alope palpalis*; he refers to the supra-orbital spines as "épines sus-orbitaires" following Milne-Edwards' mistake in terminology. He gives no description of his *Alope palpalis* and it is possible that he has supplied records of its occurrence without examining specimens; his work, as a whole, is not such as to inspire confidence.

Thomson, under the name *Merhippolyte spinifrons*, merely quotes Filhol's account, and the examples subsequently recorded by Chilton[2] under this name from the Kermadec Is. are, as I have been able to determine by examination of specimens kindly sent me by the author, to be referred to the genus *Lysmata* (see p. 110). It is, I believe, most improbable that Milne-Edwards' description was based on this species.

Alope palpalis is represented in the Indian Museum by a single ovigerous female which differs rather markedly from Thomson's description and figures (*loc. cit.*). In the second pair of peraeopods the ischium and merus on the right side are composed of two segments and the carpus of seven (fig. 2). On the left side the ischium is two-, the merus three- and the carpus eight-segmented (fig. 1). The processes on the thoracic sternum bear little resemblance to Thomson's figure and are closely similar in form to those of the allied species, *A. australis* (see pl. I, fig. 5).

Thomson does not refer in any definite way to the great development of the third maxillipedes and first peraeopods in

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[1] Bate, Rep. Challenger Macrura, pp. 621, 622 (1888).
[2] Chilton, Trans. N. Zealand Inst., XLIII, p. 547 (1911).

large males of this species, but from Mier's figure (1874, *loc. cit.*) it is evident that this is sometimes a conspicuous feature.

$\frac{8157}{10}$	New Zealand.	Canterbury Mus. exch.	One, 39 mm.

Alope palpalis appears to be restricted to the coasts of New Zealand and the neighbouring islands, the records of its occurrence in Australian waters refer to the following species.

Alope australis, Baker.

(Plate I, figs. 3-5.)

1882. *Alope palpalis*, Haswell, Cat. Australian Crust., p. 193.
1898. *Alope palpalis*, Stead, Zoologist (4), II, p. 211.
1904. *Alope australis*, Baker, Trans. Roy. Soc. S. Australia, XXVIII, p. 154, pl. xxx, figs. 1-7.
1909. *Alope australis*, McCulloch, Rec. Australian Mus., VII, p. 313, text-fig. 1.

The chief distinctions between this species and *A. palpalis*, White, are as follows :—

A. australis.	*A. palpalis.*
Rostrum not reaching as far forwards as basal segment of antennular peduncle.	Rostrum reaching as far forwards as basal segment of antennular peduncle.
Supra-orbital spines scarcely reaching beyond base of eye-stalks.	Supra-orbital spines reaching to tips of eyes.
Lateral process of basal segment of antennular peduncle extending little, if at all, beyond end of segment.	Lateral process of basal segment of antennular peduncle extending far in advance of basal segment.
Mandible without incisor-process.	Mandible with incisor-process.

The five Burmese specimens examined differ from Baker's description and figures in a few particulars. The antennular peduncle reaches beyond the middle of the antennal scale, the second segment is longer than the third and is longer than broad; the lateral process of the basal segment extends at most to the distal end of the segment, usually falling far short of it (fig. 3).

Baker states that *A. australis* differs from *A. palpalis* " in the less divided state of the second pereiopods—except the carpus " and in his figure the merus and ischium of this limb are not segmented. In four of the Indian examples the ischium and merus of this pair are each divided into two segments, while the carpus is composed of seven. In the fifth specimen, a large male, the left leg is similarly segmented, but the right, which is abnormally short, shows traces of subdivision into two and three segments in the ischium and merus and the carpus consists of ten segments, two of these, however, being only feebly indicated (fig. 4).

Three of the specimens examined possess five dorsal teeth on the rostrum; in the other two there are only four.

The mandible agrees closely with Baker's figures; but the second segment of the palp is as broad as long. A small ridge at the base of the palp is all that remains of the incisor-process.

The processes on the thoracic sternum of the large male (fig. 5) consist of (i) a sharp upstanding keel between the third and fourth pairs of peraeopods, (ii) a pair of acute backwardly directed teeth between the fourth and fifth pairs, and (iii) a conspicuous plate, very deeply bifurcated anteriorly, behind the base of the last pair. In small males and in an ovigerous female the processes are similar, but the anterior bifurcation in the plate behind the fifth peraeopods is much less pronounced.

The endopod of the first pair of peraeopods is, in the male, unequally bifid at the apex; in the female it is simple and ends acutely.

In the large male example the third maxillipedes are as long as the entire length of the animal (measured from the tip of the rostrum to the apex of the telson), though in other males and in the female they are less than half the same proportional length. The five specimens yield the following measurements:—

Sex.	Total length.	Length of 3rd mxpde.	Ratio of 3rd mxpde. to total length.
	mm.	mm.	
♂	22	8·5	39
♂	25	11	44
♂	30	14	47
♂	44	44	100
♀	30	12·3	41

The phenomenon is doubtless precisely similar in nature to that already discussed in the case of *Saron marmoratus.* It is to be noted, however, that in males of *Saron* and also, according to Mier's figure, in those of *A. palpalis,* the first peraeopods grow *pari passu* with the outer maxillipedes, whereas in *A. australis* the latter alone appear to affect an extreme development. The point is one of some interest, but it cannot be decided until large collections of both species have been examined.

The specimens of *Alope australis* in the Indian Museum were all found at one locality.

$\frac{6398}{10}$ Arrakan coast, Lower Burma. W. Theobald. Five, 22-44 mm.

The species has hitherto been recorded only from the Australian Coast, from Port Jackson (Stead), Kangaroo I., Smith's Bay (Baker) and Sydney (McCulloch).

Genus **Spirontocaris**, Bate.

1860. *Hippolyte*, Stimpson, Proc. Acad. Nat. Sci. Philadelphia, pp. 33-35.
1906. *Spirontocaris*, Calman, Ann. Mag. Nat. Hist. (7), XVII, p. 32 (*ubi cet. syn.*)

Spirontocaris pandaloides (Stimpson).

1860. *Hippolyte pandaloides*, Stimpson, Proc. Acad. Sci. Philadelphia, p. 34.
1902. *Hippolyte pandaloides*, Doflein, Abhandl. bayerisch. Akad. Wiss., XXI, p. 637.
1907. *Spirontocaris pandaloides*, de Man, Trans. Linn. Soc., Zool. (2), IX, p. 418, pl. xxxii, figs. 47, 48.

The Indian specimens differ from the long description given by de Man only in respect of the length of the sixth abdominal somite which, in all the larger examples, is little, if at all, more than two-thirds the length of the preceding somite.

On comparison with examples collected at Yokohama by Dr. Haberer and received in exchange from the Munich Museum the only difference that I can find is that in the Japanese specimens the distal end of the third abdominal somite is rather more strongly produced: in the proportions of the last two abdominal somites there is close agreement.

The rostrum in the Indian specimens bears 8 to 12 (usually 9) teeth on the upper margin and 8 to 12 on the lower. The two posterior teeth of the dorsal series are always situated on the carapace behind the orbit.

$\frac{6399}{10}$	Karachi, mouth of R. Indus.	Karachi Museum.	Nine, 33-53 mm.
$\frac{7731}{10}$	Yokohama, Japan.	Munich Mus. exch.	Three, *ca.* 42-50 mm.

Spirontocaris pandaloides has hitherto been recorded only from Japan; from Hakodadi (Stimpson), Yokohama (Doflein) and the Inland Sea (de Man).

Genus **Thor**, Kingsley.

1878. *Thor*, Kingsley, Proc. Acad. Sci. Philadelphia, XXX, pp. 6, 94.
1899. *Thor*, Kingsley, American Naturalist, XXXI, pp. 714, 718.
1901. *Thor*, Rathbun, Bull. U. S. Fish Comm. for 1900, II, p. 116.
1905. *Paschocaris*, Nobili, Bull. Mus. d'Hist. nat., Paris, p. 394.
1906. *Paschocaris*, Nobili, Ann. Sci. nat. Zool., Paris (9), IV, p. 37.

The genus *Thor* is very closely related to *Hippolyte*, but differs from *H. varians*, the type species of the latter genus, in the greater number of segments in the carpus of the second peraeopods and in the absence of supra-orbital and pterygostomian spines from the carapace. It is also distinguished by the presence of a curious movable triangular plate situated dorsally at the end of the ultimate segment of the antennular peduncle.

Thor paschalis (Heller).

Plate I, figs. 6-10.

1861. *Hippolyte paschalis*, Heller. Sitz-ber. Akad. Wiss. Wien, XLIV, p. 276, pl. iii, fig. 24.
1878. *Thor floridanus*, Kingsley, Bull. Essex Inst., X, p. 64.
1878. *Thor floridanus*, Kingsley, Proc. Acad. Sci. Philadelph., pp. 7, 95.
1879. *Thor floridanus*, Kingsley, *ibid.*, p. 421, pl. xiv, fig. 6.
1887. *Hippolyte paschalis*, de Man, Arch. f. Naturgesch., LIII, i, p. 534.
1887. *Hippolyte amboinensis*, de Man, *ibid.*, p. 535.
1901. *Thor floridanus*, Rathbun, Bull. U. S. Fish Comm. for 1900, II, p. 116.
1901-3. *Thor floridanus*, Verrill, Trans. Conn. Acad., XI, p. 19.
1905. *Hippolyte paschalis*, Lenz, Abh. Senck. naturf. Ges. Frankfurt, XXVII, p. 382.
1905. *Paschocaris paschalis*, Nobili, Bull. Mus. d'Hist. nat., Paris, p. 394.
1906. *Paschocaris paschalis*, Nobili, Ann. Sci. nat. Zool., Paris (9), IV, p. 38, pl. iii, fig. 1.

The synonymy shown above is given with confidence. Not only is it at once evident from comparison between Nobili's description of *Paschocaris* (1906) and that of *Thor*, as given by Miss Rathbun, that the two genera are identical, but I have been able to compare American examples, received under the name of *Thor floridanus* from the United States National Museum, with specimens from S. India which unquestionably belong to the form described by Nobili as *Paschocaris paschalis.*

The identity of the two forms is complete, unless it be that any importance can be attributed to the slightly stouter and more gibbous form of the S. Indian specimens: microscopic examination of the appendages fails to yield evidence for the recognition even of a subspecies in the case of the American form. The fact is one of considerable interest, for, among littoral Decapoda, it is most unusual to find a species inhabiting both the Atlantic and the Pacific without exhibiting any distinct structural differences.[1]

It is scarcely necessary to describe the species in detail for good accounts have already been given by Heller, de Man, Rathbun and Nobili.

In the examples from S. India the rostrum is bifid at the apex (in one specimen trifid) and bears three or four (very rarely two) teeth on its dorsal margin; one of the dorsal teeth is usually situated on the carapace behind the orbital notch. In the American examples the apex is bifid in four specimens, trifid in a fifth, and there are four dorsal teeth.

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[1] Faxon (Mem. Mus. Comp. Zool. Harvard, 1895, XVII, p. 235, footnote) gives a list of Decapoda which have been recorded both from the Gulf of Panama and from the West Indian side of America: the identity of the species of *Alpheus* mentioned in this list is, as he remarks, doubtful. Excluding free-swimming forms such as *Pasiphaë sivado* and those having a circumpolar distribution, the only littoral Decapoda Natantia that I can call to mind which inhabit both the Atlantic and the Indo-pacific are *Peneus caramote, Stenopus hispidus, Processa canaliculata* and *Athanas nitescens,* and some of these cases require further investigation.

The carpus of the second peraeopod is composed of six, less commonly of seven, segments. It is described by Miss Rathbun as "five annulate", and six segments are distinct in the American examples which I have examined. The two proximal articulations are much less clearly marked than the remaining three, and the fact that in one specimen (fig. 9) there is a further subdivision, making three short proximal segments, indicates that the character is subject to some variation. In the normal 6-segmented carpus the proportional lengths of the segments differ somewhat from Miss Rathbun's description, but agree closely with the account given by Nobili. Comparison of fig. 7, which represents the carpus and chela of a specimen from Florida, with fig. 8, in which the same segments of a S. Indian individual are shown, will indicate the almost exact similarity in segmentation.

A feature of the species which seems to have escaped notice hitherto is the great development of the third peraeopod in the male. In the female (fig. 6) this limb is closely similar to those of the two succeeding pairs, but in males, both from Florida and from S. India, it is very much longer (fig. 10), reaching beyond the apex of the antennal scale by the dactylus and about one-half of the propodus. The propodus, moreover, is broadened towards its ultimate end and the inferior margin is, for rather more than its distal third, thickly beset with slender spines. The dactylar spines of the limb are also far more numerous.

As regards the spinulation of the merus in the last three pairs of legs there is considerable variation. In one example (from America) it bears five spines, in others two, three, or none at all. The telson bears three pairs of dorsal spinules: in some specimens four on one side and three on the other. The spinulation of the apex of the telson agrees with Nobili's description.

The following specimens have been examined :—

$\frac{8462-3}{10}$	Kilakarai, Ramnad Dist., S. India.	S. Kemp.	Seventeen, 7-12 mm.
$\frac{8464}{10}$	Pamban, Ramnad Dist., S. India.	S. Kemp.	One, 12 mm.
$\frac{7977}{10}$	Punta Rassa, Florida.	Smiths. Inst.	Five, 10-14 mm.

The specimens from Kilakarai and Pamban were found among weeds in water only a few feet deep. They were caught in February, 1913, and all, with the exception of two, are ovigerous females.

Thor paschalis has been recorded from Amboina (de Man), the Red Sea (Heller, Nobili) and from Zanzibar (Lenz). In the Atlantic it is known from the West Indies, the Bermudas, Florida, Yucatan and neighbouring localities (Kingsley, Rathbun, Verrill).

Genus **Hippolyte**, Leach.

1860. *Virbius*, Stimpson, Proc. Acad. Nat. Sci. Philadelphia, p. 35.

Hippolyte ventricosus, H. Milne-Edwards.

Plate II, figs. 1-3.

1837. *Hippolyte ventricosus*, H. Milne-Edwards, Hist. nat. Crust., II, p. 371.
1878. *Virbius mossambicus*, Hilgendorf, Monatsb. Akad. Wiss. Berlin, p. 836, pl. iv, fig. 1.

This species is very closely related to *Hippolyte varians*, Leach, and should perhaps be regarded merely as a subspecies. The two forms may be distinguished by the following characters :—

H. ventricosus.	*H. varians.*
Rostrum rather more slender; armed with one or two dorsal teeth in its proximal third; apex acuminate (fig. 1).	Rostrum less slender, armed (usually) with only a single dorsal tooth in its basal third; a small dorsal tooth nearly always present close to apex, giving it a bidentate appearance.
Antennal scale not more than three times as long as broad (fig. 2).	Antennal scale three and a quarter to three and a half times as long as broad (fig. 4).
Thoracic appendages proportionately stouter; middle carpal segment of second peraeopods as broad as long (fig. 3).	Thoracic appendages proportionately more slender ; middle carpal segment of second peraeopods nearly twice longer than broad (fig. 5).
Sixth abdominal somite about one and a half times as deep as long.	Sixth abdominal somite twice as deep as long.
Size smaller, ovigerous females not exceeding 20 mm. in length.	Size larger, ovigerous females sometimes 31 mm. in length.

Apart from the characters afforded by the rostrum, which, owing to the enormous range of variation that exists in both species, must necessarily be somewhat inconclusive, the principal difference between the two forms rests in the stouter build of that found in the Indo-pacific region. Structural distinctions of this nature are found in almost every part of the body, but in most cases they are so slight that it is scarcely possible to demonstrate them mathematically. They are, however, clearly shown in the proportions of the last abdominal somite and carpal segments of the second peraeopods and find less well-marked expression in the form of the antennal scale. The three segments composing the carpus of the second peraeopods have the same longitudinal proportions as in *H. varians.* The mouth parts of the two species are in closest agreement (the mandibles are nearly identical in structure) and no noteworthy differences are to be found in the arrangement of the gills and epipods or in the spinulation of the telson-tip and of the dactyli of the last three pairs of peraeopods.

Milne-Edwards' description of *Hippolyte ventricosus* is extremely brief and runs as follows:—

" Espèce extrêmement voisine de l'H. variable, mais dont le rostre ne porte en dessus qu'une seule dent située près de sa base, et dont les prolongemens latéraux des trois premiers anneaux de l'abdomen présentent des dimensions très-considerables. Longuer environ 4 lignes."

" Trouvée par M. Dussumier dans les mers d'Asie. (C. M.) "

The species does not seem to have been recorded—as *H. ventricosus*—since Milne-Edwards' time; but I believe that *Virbius mossambicus*, a name given by Hilgendorf in 1879 to a species found off the mouth of the Zambesi, is synonymous.

Milne-Edwards' reference to the abdominal segments is perplexing, for no definite differences are to be found in this respect between the Indian specimens and English examples of *Hippolyte varians*. The description of the rostrum seems, however, to leave little doubt of the identity of the species, more especially as, with the exception of *V mossambicus*, no form closely resembling *H. varians* has yet been found in Asiatic waters.

The species appears to be very nearly related to *H. orientalis*, Heller[1], and it is possible that this name must be included in the synonymy of *H. ventricosus*. South Indian specimens agree well with Heller's description except that it is extremely rare to find among them an example with four teeth on the inferior margin of the rostrum.

Nobili[2] considers Paulson's *H. proteus*[3] a synonym of Heller's *H orientalis*; but according to Czerniavsky[4] Paulson has confounded under the former name several known species, viz. *H. brullei*, Guérin, (=*H. prideauxiana*, Bell), *H. gracilis*, Heller, and *H. leptocerus*, Heller. Czerniavsky may be right, in part; but on general grounds it appears to me very unlikely that *H. prideauxiana* and *H. gracilis* occur in the Red Sea. It is probable that *H. ventricosus* does so, but it is impossible to speak with any certainty until further information is available. Indian specimens of *H. ventricosus* differ from *H. proteus*, as figured by Paulson in the shorter antennular peduncle and in the carpal segmentation of the second peraeopods.

The specimens of *H ventricosus* in the Indian Museum are registered thus:—

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[1] Heller, Sitzber. math.-naturw. Klasse d. Kais. Acad. Wiss. Wien, XLIII, p. 277 (1861).

[2] Nobili, Ann. Sci. nat. Zool. (9), IV, p. 33 (1906).

[3] Paulson, Red Sea Crustacea, Kiew, p. 109, pl. xvi, figs. 2-5; pl. xviii, fig. 1 (1875).

[4] Czerniavsky, Crustacea Decapoda Pontica Littoralia, p. 13 (1884).

$\frac{8458-60}{10}$	Kilakarai and Apa I., Ramnad Dist., S. India, 0-2 fms.	S. Kemp.	Many, 7-20 mm.
$\frac{8461}{10}$	Pamban, Ramnad Dist., S. India, 0-2 fms.		

The species was found in abundance at both the above localities, living among Zostera and other weeds inside the coral reef at depths ranging from low water to two fathoms. The specimens were obtained in an environment closely similar to that in which *H. varians* abounds on the English and Irish coasts and, at the time of capture, it was thought they must certainly belong to that species.

In colour the majority were of a brilliant green; but very many other types, each having its counterpart in home waters, were observed. The collection, which was made in February, 1913, contains a high proportion of ovigerous females.

Hippolyte australiensis (Stimpson).

Plate II, fig. 6.

1860. *Virbius australiensis* Stimpson, Proc. Acad. Sci. Philadelphia, p. 35.

1882. *Virbius australiensis*, Haswell, Cat. Australian Crust., p. 186.

Specimens of this species received in exchange from the Australian Museum differ from those of the preceding form in possessing no teeth on the dorsal margin of the rostrum and in having from four to six teeth (rarely three) ventrally. The ultimate segments of the antennular peduncle are shorter and broader, the second being broader than long, the antennal scale (in an ovigerous female) is three and a third times as long as broad and the last segment of the third maxillipede is scarcely twice the length of the penultimate. The proportions of the segments in the carpus of the second peraeopods are also different (fig. 6). The middle segment, as in *H. varians* and *H. ventricosus*, is much the shortest, but the third is decidedly longer than the first. The last three pairs of legs are stout. In an ovigerous female the propodus of the fifth pair is only five and a half times as long as broad and is little more than twice the length of the dactylus (spines included).

$\frac{7634-9}{10}$	New South Wales Coast.	Australian Mus. exch.	Twelve, 13-22 mm.

Hippolyte australiensis is known only from the Australian coast.

Genus **Latreutes**, Stimpson.

1906. *Latreutes*, Calman, Ann. Mag. Nat. Hist. (7), XVII, p. 33 (*ubi syn.*)

Carapace without supra-orbital, but with antennal spine; a series of small spines on antero-lateral margin. Basal process of antennular peduncle anteriorly rounded; upper antennular flagellum uniramous. Mandible without incisor-process or palp.

Third maxillipede with exopod. No arthrobranchs at base of peraeopods; epipods present on at least first three pairs. Carpus of second peraeopods composed of three segments.

Nearly all the species of this genus stand in need of re-definition. They are for the most part based on the character of the rostrum which, in this genus, is subject to even greater variation than in *Spirontocaris* or *Hippolyte*.

The three species known from the Indian coasts may be separated thus:—

I. Dactyli of last three pairs of peraeopods with conspicuous spines on margin.
  A. Form very slender, basal segment of antennular peduncle three times as long as wide, antennal scale more than six times as long as wide; legs short, second pair not reaching to end of eyes ... ... *L. pygmaeus.*
  B. Form stouter, basal segment of antennular peduncle twice as long as wide, antennal scale not more than four and a half times as long as wide (less in adults); legs longer, second pair reaching beyond end of antennular peduncle ... ... *L. mucronatus.*
II. Dactyli of last three pairs of peraeopods simple claws, without spines on margin ... ... *L. anoplonyx.*

I have seen no specimens of the very curious *Latreutes ceylonensis* described by Pearson from the Ceylon pearl banks.[1] The species differs from all other members of the genus with which I am acquainted in the peculiar spinulation of the carapace and antennal scale and in the armature of the dactyli of the last three peraeopods. In many respects it appears to be allied to Nobili's *Latreutes paronae* which is here regarded as the type of a new genus, *Gelastocaris*.

Latreutes pygmaeus, Nobili.

Plate II, figs. 7, 8; Plate III, figs. 1-7.

1904. *Latreutes pygmaeus*, Nobili, Bull. Mus. d'hist. Nat., Paris, p. 230.
1906. *Latreutes pygmaeus*, Nobili, Bull. sci. France Belg., XL, p. 37, pl. iii, figs, 4, a-h.
1906. *Latreutes pygmaeus*, Nobili, Ann. Sci. nat. Zool. (9), IV, p. 41.

Large series of specimens obtained at Kilakarai and Pamban in S. India may undoubtedly be referred to this species, which is a very close ally of the Atlantic *L. ensifer*.

Nobili's account may be supplemented as follows:—

The small dorsal spine on the carapace behind the orbit is movable, as in *L. ensifer*, and not fixed as in certain other species of the genus. The rostrum is sometimes wholly unarmed, but more usually bears from 1 to 3 dorsal teeth and 1 to 3 ventral teeth, all situated in the distal third. The apex may be acute or bluntly rounded (pl. II, figs. 7, 8; pl. III, figs. 1-3).

Close to the cornea on the inner and superior aspect of the stalk the eye bears a small conical process similar to that described by Nobili in allied species.

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[1] Ceylon Pearl Oyster Rep., IV, p. 81, pl. ii, figs. 7, 7 *a*—*e*.

The antennular peduncle reaches to less than half the length of the antennal scale. Its basal segment is elongate (pl. III, fig. 4), about three times as long as broad, and its lateral process is anteriorly rounded and feebly bilobed. The second segment is, in the female, longer than broad. The antennal scale (pl. III, fig. 5) is very sharply pointed anteriorly and is more than six times as long as broad.

The third maxillipedes reach to the base of the antennal scale, the peraeopods of the second pair to the middle of the eye, those of the fifth pair extending scarcely further forwards. Of the three segments composing the carpus of the second peraeopods the middle one is the longest and the third the shortest. The middle segment is about one and a half times the length of the first and the first is one and a third, or rather more than one and a third times the length of the third : there is a little variation in the precise measurement of these segments. The dactyli of the last three peraeopods terminate in sharp curved spines : there are a few other spines on the posterior margin, the ultimate being large and placed close to the terminal spine, giving the apex a biunguiculate appearance (pl. III, fig. 6). Epipods are present at the base of the first four pairs of legs.

The sixth abdominal somite is fully one and three quarters the length of the fifth. The telson in S. Indian specimens bears only two pairs of dorso-lateral spinules in addition to those at the apex, not three as Nobili has stated.

The male is very different in appearance to the female. It is much more slender in build and the rostrum seldom bears more than one tooth on either margin near the apex. The antennular peduncle is shorter than in the other sex, but the upper flagellum is stouter and very much longer. In the female the flagellum does not nearly reach the apex of the antennal scale, whereas in the male it extends beyond that point by almost half its length.

The colour of living specimens is very variable. As a rule they are of a uniform dull green, but olive, brown and brownish red specimens are frequent.

Latreutes pygmaeus has exceedingly close affinities with *L. ensifer*, Milne Edwards, the type species of the genus. I have compared South Indian specimens of the former species with examples of the latter obtained in the Sargasso Sea. The Atlantic form is slightly more robust in build, the rostrum is more strongly concave above and the teeth are more closely restricted to the apex. The legs are a little longer, the second pair reaching the ends of the eyes, the antennal scale is proportionately a trifle broader and the sixth abdominal somite is shorter and a little less slender. The second segment of the antennular peduncle is about as broad as long in the female Probably the best distinction between the two forms rests in the number of epipods at the base of the legs; in *L. pygmaeus* they are found on the first four pairs, while in *L. ensifer* they occur only on the first three.

$\frac{8471-6}{10}$	Kilakarai, Ramnad Dist., S. India.	S. Kemp.	Many, 9-20 mm.
$\frac{8477-8}{10}$	Pamban, Ramnad Dist., S. India.		

Latreutes pygmaeus was common at both of the above localities living among weeds in a few feet of water; in life the species bore a close general resemblance to the British *Hippolyte prideauxiana*. The collection, made in the month of February, includes a large proportion of ovigerous females.

The species has been recorded by Nobili from the S. E. coast of Arabia and the Red Sea.

Latreutes mucronatus (Stimpson).

Plate III, figs. 8-15; plate IV, figs 1, 2.

1860. *Rhynchocyclus mucronatus*, Stimpson, Proc. Acad. Sci. Philadelphia, p. 28.
1902. *Latreutes mucronatus*, Doflein, Abhandl. bayerisch. Akad. Wiss., XXI, p. 638, pl. v, fig. 6.
1904. *Latreutes gravieri*, Nobili, Bull. Mus. Hist. nat., p. 231.
1906. *Latreutes gravieri*, Nobili, Bull. sci. France et Belg., XL, p. 39, pl. iii, figs. 4-44.
1906. *Latreutes gravieri*, Nobili, Ann. Sci. nat. Zool. (9), IV, p. 41.
1906. *Latreutes mucronatus* var. *multidens*, Nobili, *ibid.* p. 41, pl. ii, fig. 3.

Examination of a series of specimens from S. India suggests that *L. gravieri* must be regarded as a synonym of *L. mucronatus* and that there is no foundation for the retention of the varietal name *multidens*.

The series comprises twenty-nine examples, and of these eighteen were immediately separated from the rest on account of their stout and gibbous form and more or less circular rostrum (pl. III, figs. 8, 9; pl. IV, fig. 1). They were at once referred to *L. mucronatus* and examination of their rostral formulae indicated that the type specimen of *L. mucronatus* with a formula of $\frac{6}{6}$ and those referred by Nobili to his var. *multidens*, with formulae ranging from $\frac{2-15}{8-21}$, are only terms in a series exhibiting continuous variation. The formulae which the S. Indian specimens yield are as follows[1] :—

$$\frac{1)15}{15}\quad\frac{1)13}{13}\quad\frac{1)12}{13}\quad\frac{1)11}{12}\quad\frac{1)10}{11}\quad\frac{1)11}{9}\quad\frac{1)9}{8}\quad\frac{1)7}{8}\quad\frac{1)12}{7}\quad\frac{1)9}{7}$$

$$\frac{1)8}{7}\quad\frac{1)8}{7}\quad\frac{1)8}{7}\quad\frac{1)7}{7}\quad\frac{3)10}{6}\quad\frac{3)9}{6}\quad\frac{1)8}{6}\quad\frac{4)13}{4}$$

The remaining specimens characterized by their more slender form and narrower rostrum (pl. III, figs. 10, 11; pl. IV, fig. 2) afforded a more difficult problem. Not only did the rostrum exhibit a most remarkable diversity of form, but the proportions

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[1] The figure on the left, separated by a bracket, represents the number of teeth on the carapace in the median line.

of the antennal scale and the spinulation of the antero-lateral margin of the carapace also showed extensive variation. A single specimen, however, the only one which possessed two teeth on the carapace (pl. III, fig. 11) was referred without difficulty to to *L. gravieri*, and by an attentive study of the remainder the conclusion that they also must belong to that species was reached.

It was only when these preliminary results were obtained that it was noticed that all the examples referred to *L. mucronatus* were female, while all referred to *L. gravieri* were male. The fact that both forms were found together at each of the two localities where specimens were obtained, suggested that the conclusions derived from the form of the animal and the characters of the rostrum were fallacious and a renewed study of the proportional measurements of the appendages and comparison with the sexual distinctions found in *L. pygmaeus* led to the conclusions outlined in the above synonymy.

In the female specimens (pl. IV, fig. 1) the rostrum reaches almost to or a little beyond the end of the antennal scale. At its base it is inferiorly excavate for the accommodation of the eye and in lateral view the length from the back of the orbit to the apex is less than twice, often not more than one and a half times the greatest height. Anteriorly the rostrum is sometimes almost circular in outline, but more often it is distinctly pointed. The dorsal and ventral teeth are borne only in its distal half.

The carapace is strongly arched dorsally. It is not carinate in the median line but bears, as a rule, a single stout fixed tooth behind the base of the rostrum: in rare instances three or four teeth (pl. III, fig. 8) are found in this position. There is a sharp antennal tooth and a series of small spines, usually 11—14, on the antero-lateral margin.

The eyestalk is a trifle wider than the cornea and bears a conspicuous pointed process on its inner distal aspect. The antennular peduncle reaches a little beyond the middle of the antennal scale and has the proportions shown in pl. III, fig. 12. The antennal scale (pl. III, fig. 13) is about three times as long as wide.

The outer maxillipede reaches a little beyond the antennal peduncle.

The second peraeopods reach about to the apex of the rostrum. The carpus is divided into three segments, of which the first and third are approximately equal, each being about half the length of the middle segment. The palm is a little longer than the last carpal segment and is decidedly longer than the dactylus.

The dactylus of the last three pairs of peraeopods, as in *L. pygmaeus*, terminates in two stout claws and bears three or four small spines on the posterior margin. In the fifth pair the carpus is a little more than two-thirds the length of the propodus. The dactylus is rather more than one third the length of the propodus.

The last abdominal somite is about twice the length of the fifth. The telson bears two pairs of dorsal spinules and terminates in a narrow pointed process flanked by a pair of spines on either side. The innermost of these is more than twice the length of the outer and is often nearly twice as long as the median process. The outer uropod is shorter than the inner and is about three and a half times as long as broad.

In the male the whole form of the animal is far more slender, as will be seen on comparing figs. 1 and 2, plate IV The rostrum is longer and much narrower in lateral view; it extends well beyond the apex of the antennal scale and exhibits the following spine formulae —

$$\frac{1)7}{9} \quad \frac{1)7}{9} \quad \frac{1)7}{7} \quad \frac{1)8}{6} \quad \frac{1)5}{6} \quad \frac{1)5}{6}$$

$$\frac{1)4}{6} \quad \frac{1)4}{6} \quad \frac{1)5}{4} \quad \frac{1)6}{1} \quad \frac{2)5}{0}$$

It seems that, as in *L. pygmaeus*, the teeth are on the whole less well-developed in males than in females; some of the males, however, are of very small size and may not have developed the full complement. Seen laterally the greatest length of the rostrum from the back of the orbit to the apex varies from two and a half to four times its greatest height: proportions strikingly variable and different from those found in the female (*cf.* pl. III, figs. 10, 11, pl. IV, fig. 2, and pl III, figs. 8, 9, pl. IV, fig. 1).

The carapace is not arched in lateral view. It bears a single dorsal fixed spine in ten of the specimens examined, while in the eleventh, which in this respect resembles the type of *L. gravieri*, there are two. It will be noticed that one, three, or four spines have been found in this situation in females.

The differences in other respects between the two sexes are less striking. There may be only six or seven spines on the antero-lateral margin of the carapace. The upper antennular ramus is stouter and very considerably longer than in the female; this feature affording the readiest distinction between the two sexes. The antennal scale may be four and a half times as long as broad in young males (pl. III, fig. 14); in older specimens the length is usually about three and a half times the breadth. In one individual the outer margin is very definitely concave (pl. III, fig. 15).

The third maxillipede scarcely reaches beyond the antennular peduncle. The second peraeopods in large specimens reach beyond the middle of the antennal scale, but are shorter in small examples. They agree precisely with those of the female in the proportional length of the segments.

The dactylus of the last three pairs agrees with that of the female and is a little more than one third the length of the propodus. The propodus of the fifth leg is usually shorter than in the female and is not quite so long as the merus.

According to Miss Rathbun[1] Stimpson's *Rhynchocyclus mucronatus* is synonymous with *Latreutes planirostris* (De Haan); but no reasons are advanced for this view and Stimpson appears to have had both species before him when writing in 1860. The Indian specimens differ widely from *L. planirostris* as figured and described by De Haan.[2]

$\frac{8472}{10}$	Kilakarai, Ramnad Dist., S. India.	S. Kemp.	Twenty nine, 9-13·5 mm.
$\frac{8473}{10}$	Pamban, Ramnad Dist., S. India.		

The specimens were obtained in February, 1913, among weeds in water only a few feet deep; the females are ovigerous.

Latreutes mucronatus has been recorded from Sagami Bay, Japan (Doflein), Hongkong (Stimpson), Java (Nobili, *sub* var. *multidens*), the S. E. coast of Arabia and the Red Sea (Nobili, *sub* var. *multidens* and *L. gravieri*).

Latreutes anoplonyx, sp. nov.

Plate IV, figs. 3—5.

This species, founded on a single adult female, is readily distinguished from the two preceding by the simple claw-like dactyli of the last three peraeopods.

The specimen is robust in build. The carapace is not carinate mid-dorsally, but bears a single prominent fixed tooth in the middle of its anterior third. The antennal spine is strong and there is a series of eleven small spines on either antero-lateral angle (fig. 3).

The rostrum is triangular in shape; it reaches beyond the apex of the antennal scale and is rather more than three-quarters the length of the carapace; its greatest height in lateral view is rather more than one-third its extreme length from the back of the orbit. The dorsal margin is concave (the apex being directed obliquely upwards) and bears thirteen teeth in the distal two-thirds of its length; the inferior margin is evenly curved and is furnished with nine teeth in its distal half. The extreme apex is broken off and on it one or two additional teeth may have been situated.

On the eyestalk there is a lobe similar to that found in the preceding species, but much less conspicuous.

The antennular peduncle is very short, reaching to little more than one-third the length of the antennal scale. The lateral process is rounded and the second segment is broader than long. The stout upper antennular ramus reaches (in the female) almost to the end of the scale. The antennal scale (fig. 4) is pointed anteriorly and is about four times as long as wide.

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[1] Proc. U.S. Nat. Mus., XXVI, p. 46 (1902).

[2] In Siebold's Fauna Japonica, Crust., p. 175, and atlas, pl. xlv, fig. 7 (1843-9).

The oral appendages do not differ noticeably from those of the two preceding species. The third maxillipedes reach beyond the end of the antennular peduncle; the ultimate segment is less than twice the length of the antepenultimate.

In the chela of the first peraeopods the finger is about as long as the palm. The second peraeopod reaches to the middle of the rostrum. Of the three segments composing the carpus, the first is scarcely half the length of the second and is a little longer than the third; the chela is as long as the middle segment and the dactylus is shorter than the palm.

The third peraeopods reach forward a little beyond the end of the second and the fifth extend to the end of the eyes. The dactylus in each of the last three legs consists of a strong curved claw about one third the length of the propodus; it may bear a few microscopic spinules, but is otherwise wholly unarmed.

Large epipods are present at the base of the first four pairs of peraeopods.

The sixth abdominal somite is more than one and a half times the length of the fifth. The outer uropod is two and two-thirds times as long as broad. The telson bears two pairs of dorsal spinules and terminates in a narrow apex composed of a short median process with two spines on either side; the inner spine is longer than the median process and nearly twice the length of the outer (fig. 5).

In the absence, in the majority of cases, of any information regarding the spinulation of the dactyli of the last three legs, it is difficult to make suggestions regarding the affinities of the species described above. It appears to be most nearly related to Ortmann's *L. laminirostris*, but differs from that, and apparently from all other known species of the genus, in the form of the rostrum.

Bombay.	Bombay Nat. Hist. Soc.	One, ovigerous female, 39 mm. TYPE.

For the opportunity of examining the single known example of this species I am indebted to the Secretary of the Bombay Natural History Society.

Genus **Tozeuma**[1], Stimpson.

1860. *Tozeuma,* Stimpson, Proc. Acad. Sci. Philadelphia, p. 26.
1863. *Angasia*, Bate, Proc. Zool. Soc. London, p. 498.

Form extremely slender. Carapace without supra-orbital, but with antennal spine; a single spine at antero-lateral (pterygostomian) angle. Lateral process of antennular peduncle sharply pointed anteriorly. Upper antennular flagellum uniramous. Mandible without incisor-process or palp. Third maxillipede without exopod.

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[1] Stimpson informs us that this name is derived from the Greek Τόξευμα, but, if the spelling is emended, the name is preoccupied by Walker for a genus of Hymenoptera.

No arthrobranchs or epipods at base of peraeopods. Carpus of second peraeopods composed of three segments.

Tozeuma armatum, Paulson.

1875. *Tozeuma armatum*, Paulson, Red Sea Crustacea, Kiew, p. 99, pl. xv, figs. 2, *a-o*.
1893. *Angasia stimpsoni*, Henderson, Trans. Linn. Soc., Zool., V, p. 437, pl. xl, figs. 18-20.
1906. *Angasia armata*, Nobili, Ann. Sci. nat. Zool., Paris (9), IV, p. 42.

The specimens agree well with the published descriptions and figures. In two perfect individuals there are respectively twenty and twenty-four teeth on the inferior margin of the rostrum. Of the segments composing the carpus of the second peraeopods the first is the longest and the second the shortest, the third being only a little longer than the second. The dactyli of the last three pairs of legs bear several spines much as in Paulson's figure, but in an ovigerous female only two are found in this position.

All the examples bear a sharp inferior spine on either side of the sixth abdominal somite near its distal end. The lateral spine on the posterior edge of the fifth somite is present in all the specimens and in one individual there is a second large spine on this margin placed lower down: the difference is not correlated with sex.

The only male individual is badly damaged, but in the proportions of the upper antennular flagellum does not differ from the female.

$\frac{8599}{6}$	Off Cinque I., Andamans, 36 fms.	Investigator.	One, imperfect.
$\frac{8479}{10}$	S. E. of Ceylon ; 6° 2′ 30″ N., 81° 29′ E., 52-68 fms.	Investigator.'	Three, the largest an ovigerous female, 77 mm.

Tozeuma armatum has been recorded from the Gulf of Martaban, Burma (Henderson) and from the Red Sea (Paulson and Nobili).

Genus **Gelastocaris**, nov.

Carapace without supra-orbital spine and without spine or spinules on antero-lateral margin. Post-orbital and antennal spines present, the latter strong and flanked by a well-marked carina. Rostrum triangular in dorsal view, forming eaves which conceal the eyestalks. Basal segment of antennule terminating in an upstanding process which protects the eyes anteriorly; its lateral process large and subquadrate. Upper antennular flagellum uniramous. Outer margin of antennal scale furnished with spinules. Mandible without incisor-process or palp. Third maxillipede without exopod. Carpus and chela of first peraeopods elongate; chela smaller than that of second peraeopods and furnished with peculiar interlocking spines at apex. Carpus of second peraeopods composed of three segments. Dactylus of last three pairs consisting of a very short basal portion bearing four large spines two of which are lateral in position. No arthrobranchs at base of peraeopods, epipods present on first four pairs.

This genus is instituted to receive the very peculiar species described by Nobili under the name of *Latreutes paronae.* In the absence of the exopod on the third maxillipede and in the presence of epipods at the base of the peraeopods the genus is intermediate in position between *Latreutes* and *Tozeuma*, but differs from both in the extraordinary structure of the first peraeopods and in several other characters mentioned in the above diagnosis; it is most improbable that it has any close genetic relationship with either of these genera. The structure of the second maxillipede is peculiar; the ultimate segment of the exopod articulates terminally with the penultimate, resembling that found in the primitive families of Caridea.

Gelastocaris, like several other genera of Hippolytidae, shows an extraordinary degree of specialization and, except for the fact that it belongs to the Latreutid section of the family, its affinities are obscure. Judging from its peculiar structure it seems probable that the genus is specially adapted to some unusual mode of life; but inasmuch as only three specimens are known, regarding none of which are any biological data available, this must remain a matter of conjecture.

Gelastocaris paronae (Nobili).

Plate V, figs. 1—11.

1905. *Latreutes paronae,* Nobili, Boll. Mus. Torino, XX, No. 506, p. 2, text-fig.

The species is of a very robust build; the carapace, rostrum and abdomen are beset with minute papillae, while on many of the appendages there are delicate feathery setae.

The carapace (fig. 1) is not definitely carinate above, but there is a rounded mid-dorsal prominence a little behind the middle and anteriorly, a huge blunt ridge which is highest above the orbital notch and thence rapidly declines to the smooth non-carinate surface of the rostrum. There is no supra-orbital spine, but the anterior margin is produced to a sharp point defining the lower limit of the orbit and immediately below this point, above the insertion of the antennae, is a sharp outstanding post-orbital spine. The antennal spine is very strong and is flanked by a sharp carina which extends backwards to the middle of the carapace. The antero-lateral portion beneath this carina is flexed inwards on either side, enclosing the first two pairs of maxillipedes. The antero-lateral angle is obtusely rounded; it is not provided with a spine, or, as in *Latreutes*, with a series of spinules. In lateral view the inferior margin of the carapace is seen to be excavate posteriorly, leaving the apices of the last four pleurobranchs exposed.

The rostrum is triangular in dorsal view and its breadth at the base is fully two-thirds its length. In transverse section it would be T-shaped as in *Tozeuma*, for the inferior part of the blade is well developed, the dorsal part is flat or only a trifle convex, and there is a sharp ridge on either side running to the back of the orbit. This lateral ridge is produced in the vicinity of the eye and forms an eave which conceals the greater part of the eyestalk. In lateral view the dorsal line of the rostrum is straight and greatly depressed, forming an angle of nearly 45° with the mid-dorsal line of the carapace. The total length of the rostrum is about half that of the carapace; it extends a little beyond the apex of the antennal scale and terminates in a sharp upwardly directed point. On the dorsal surface, close behind the apex, there is a conspicuous movable spine. The greatest depth of the inferior blade is nearly one-half the total length. It is strongly curved in lateral view, excavated at the base for the accommodation of the eyes, and is devoid of spines.

The corneal part of the eyes is well pigmented and is a little narrower than the stalk.

The antennular peduncle is peculiar. The basal segment appears as if moulded round the eye; in lateral view it is almost semicircular in shape and distally it projects upwards in front of the cornea in the form of a thin lamella. The lateral process is large, parallel-sided and apically truncate; it projects outwards at right angles from the segment and its distal portion, which is somewhat reflected upwards, is pressed closely against the eyes. The second and third segments are extremely short. The upper ramus is thickened and (in the female) reaches a little beyond the apex of the rostrum; the lower ramus is more slender and a trifle longer.

The antennal scale (fig. 2) is about twice as long as broad and is very strongly narrowed apically. It terminates in a stout spine and on its outer margin there is a series of small movable spinules, twenty to twenty-two in number Its dorsal surface is covered with small papillae similar to those found on the carapace; the ventral surface is beset with very long finely plumose setae (fig. 3), a few occurring on the upper surface also.

The mandible is furnished neither with incisor-process nor palp. The second maxillipedes (fig. 4) are peculiar in that the ultimate segment of the endopod is not applied as a strip along the whole length of the penultimate, as in the more typical Caridea, but is terminal in position resembling that found in the more primitive families, the Pasiphaeidae and Bresiliidae. The epipod is entire and not partially divided into branchial plumes as in many Hippolytidae.

The third maxillipedes reach a little beyond the rostrum and possess an epipod but no exopod. The basal segments are very broad and the ultimate, which is about twice the length of the penultimate, bears a series of eight spines on its margins (fig. 5).

The first peraeopods (fig. 6) differ from those found in most Hippolytidae in being slender; they reach a little beyond the eyes. The ischium is short and the merus, which is rather strongly curved, is one and a half times the length of the carpus. The carpus is four times, and the chela, which is a little longer, is four and a half times as long as broad. The length of the dactylus, excluding its spines, is contained nearly two and a half times in that of the palm. The armature of the chela is, I believe, unique. The fingers (fig. 7) bear no teeth on their inner margins, but the apex of each is truncate. At the end of the fixed finger there are three large blunt spines, curved near the tip, arranged side by side in a transverse row; the dactylus is similarly armed, but bears only two spines which, when the claw is closed, fit into the interstices between those of the opposing segment. All the spines are movable. At their base, on either side both of the dactylus and of the fixed finger, there is a tuft of long setae which are shortly plumose; two of these setae, situated alongside the dactylar spines but on a slightly lower level, are stouter than the rest and probably assist in grasping.

The second peraeopods (fig. 8) are more normal in structure. They reach to the apex of the rostrum and are stouter than those of the first pair. The merus, the middle of the three segments composing the carpus, and the chela are approximately equal in length. The first carpal segment is equal to the third and the two combined are a little longer than the median segment. The dactylus is about two-thirds the length of the palm. There are no teeth on the inner edges of the claw, but the fixed finger has an angulate prominence a little behind its middle point. The limb bears scattered plumose setae.

The last three pairs of legs are similar; the third reaches to the end of the antennal scale and the fifth to the anterior third of the carapace; all are densely beset with long plumose setae. In the third pair (fig. 9) the merus is about four times as long as wide; it bears a stout spine at the distal end of its inferior margin and movable spinules on its upper edge. The carpus is massive and the protuberance at the distal end, overhanging the articulation with the propodus (found in most Hippolytidae), is very strongly developed; the total length of the carpus is nearly three-quarters that of the propodus. In the fifth leg the merus is much broader, about twice as long as wide, but the proportions of the other segments are much the same. The dactylus is very peculiar. In the third and fourth pairs it consists of a very short basal portion to which four large teeth are attached. Two of these lie in the same plane (the normal plane of the dactylus), while the others, which are a little smaller, are attached one on each side. In the fifth pair the arrangement is similar, but the lateral teeth are, in one specimen, reduced to small conical processes.

The abdominal somites are obscurely furrowed transversely and their inferior margins bear short spines. These are most strongly developed on the fourth and fifth somites, where there are in one specimen five and seven respectively. The sixth somite is only a very little longer than the fifth.

The telson (fig. 10) is broad at the base and narrows rapidly towards the apex; it bears two pairs of dorsal spinules. The apex (fig. 11) consists of a slender median tooth with a pair of spines on either side, the inner nearly twice the length of the outer. The outer uropod is less than twice as long as broad.

The specimens examined are ovigerous females; the eggs measure from ·55 to ·65 and from ·45 to ·55 mm. in longer and shorter diameter.

The specimens described above agree well with Nobili's brief account. In the type, however, the carina from the antennal spine extends backwards nearly to the posterior end of the carapace and the ultimate carpal segment of the second peraeopods is said to bear a spine at its distal end.

There are two examples in the Indian Museum—

$\frac{8485}{10}$	3 miles N.N.W. of Pt. Pedro, Ceylon.	Investigator'.	One, 15 mm.
$\frac{8496}{10}$	Ceylon Pearl banks.	T Southwell.	One, 14 mm.

The type was found in shallow water at Zanzibar.

Genus **Lysmata**, Risso.

Carapace without supra-orbital, but with antennal spine; pterygostomian spine present or absent. Lateral process of antennular peduncle anteriorly pointed. Upper antennular flagellum biramous, the two rami fused at base. Third maxillipede with exopod. Epipods but no arthrobanchs at base of first four peraeopods. Carpus of second peraeopods composed of many segments.

Lysmata chiltoni, sp. nov.

Plate VI, fig. 1-4.

1911. *Merhippolyte spinifrons*, Chilton, Trans. N. Zealand Inst., XLIII, p. 549.

Owing to the doubt that exists regarding the identity of Milne-Edwards' *Hippolyte spinifrons*, a species referred to the genus *Merhippolyte* by subsequent authors, I asked Dr. Chilton if he would permit me to examine the specimens which he recorded under this name in 1911 from the Kermadec Is. He very kindly sent me two examples, which most unfortunately dried up in transit, and subsequently forwarded two others, all the material that remained at his disposal.

The question of the identity of Milne-Edwards' *H. spinifrons* is discussed above and the conclusion I have reached is the same as that advanced by Calman, namely that the species is in all probability synonymous with *Alope palpalis*. Dr. Chilton's examples do not agree at all closely with Milne-Edwards' description.

Examination shows that the mandible lacks both incisor-process and palp, that there are no arthrobranchs at the base of the peraeopods and that the inner antennular flagellum is conspicuously biramous. The species therefore belongs to the genus *Lysmata* and I believe has not hitherto been described.

The rostrum (fig. 1) commences as a median dorsal crest a little in front of the middle of the carapace; it is straight and extends only a trifle beyond the eyes. On its upper margin it bears five teeth, two of which are situated on the carapace behind the orbital notch, while the third is placed almost immediately above that point; the distance between the two posterior teeth is slightly greater than that between those placed further forwards. Inferiorly the rostrum bears two or three teeth very much smaller than those on the upper edge and placed close to the apex in advance of the anterior dorsal tooth.

The only spine on the carapace is the antennal, the pterygostomian angle is obtuse but not spinous.

The lateral process on the basal segment of the antennular peduncle (fig. 2) is sharply pointed anteriorly and reaches to the end of the segment; the second segment is about as broad as long. The inner antennular flagellum is biramous; but the two branches are fused basally for a distance equal to half the length of the shorter ramus. The fused portion is composed of from nine to twelve segments.

The antennal scale is a little less than three and a half times as long as wide and is not much narrowed distally. The outer margin is concave and terminates in a spine which scarcely extends beyond the lamellar portion.

The third maxillipedes reach beyond the antennal scale by one-half the length of the ultimate segment. The exopod is conspicuous.

The first peraeopods just fail to reach the apex of the scale. The carpus is a trifle shorter than the chela and the finger is about half the length of the palm. The second peraeopods, in the single perfect specimen examined, are a little unequal, the longer one extending beyond the antennal scale by the whole length of the carpus and chela. Both ischium and merus are annulate and there are 25 or 26 segments in the carpus. The last carpal segment is about as long as the palm, and the dactylus, which is decidedly longer than the fixed finger and bears two small teeth at its apex, is almost as long as the palm (fig. 4).

The third peraeopods reach beyond the antennal scale by the dactylus and three-quarters the length of the propodus; the fifth scarcely reach the apex of the scale. There are no spines on the ischium and merus, but there are four large teeth, increasing in size distally, on the dactylus.

The fifth abdominal somite, measured dorsally, is three quarters the length of the sixth and is about half as long as the telson. The telson is shorter than both inner and outer uropods. It bears two pairs of dorsal spinules and its convex lateral margins meet in a comparatively narrow setose apex, minutely pointed in the middle and with two pairs of spines on either side, the innermost much the longest.

Lysmata chiltoni[1] differs in many respects from the well-known *L. seticaudata*, Risso, the chief points being the length and dentition of the rostrum, the form of the pterygostomian angle and antennal scale, the length of the fused portion of the rami of the upper antennular flagellum and the number of segments in the carpus of the second peraeopods. *Lysmata intermedia* (Kingsley) may be distinguished by the much greater length of the fused portion of the antennule and by the comparatively short dactylus of the first peraeopods.

It is in Heller's *Lysmata pusilla* from the Red Sea that *L. chiltoni* seems to find its nearest ally; but in that species the thicker ramus of the upper antennular flagellum is fused proximally with its fellow for only one-third its length, there are only four dorsal teeth on the rostrum and the two situated on the ventral margin are more widely spaced. In the antennal scale, moreover, the distal spine projects beyond the apex of the lamella.

Four specimens were obtained at Meyer I. in the Kermadec group. The type specimen is 27 mm. in length and is preserved in the Canterbury Museum, New Zealand.

Genus **Hippolysmata**, Stimpson.

Carapace without supra-orbital, but with antennal spine; antero-lateral (pterygostomian) spine present, reduced, or absent. Lateral process of antennular peduncle anteriorly pointed. Upper antennular flagellum uniramous. Mandible without incisor-process or palp. Third maxillipede with exopod. Epipods (sometimes rudimentary), but no arthrobranchs at base of first four peraeopods. Carpus of second peraeopods composed of many (more than 10) segments.

The only difference between this genus and Risso's *Lysmata* is that in the latter the outer antennular flagellum is split and is composed of two unequal rami which are fused basally. In *Hippolysmata* the flagellum is simple. The character does not seem a very important one, but in my experience is reliable[2]; it is, however, not improbable that further investigation will reveal such a degree of gradation that two distinct genera can no longer be recognized, and in this case all the species must take rank under *Lysmata*.

In two West Indian species, *Hippolysmata moorei*, Rathbun[3] and *H. intermedia*,[3] Kingsley, the additional ramus is well developed and they must in consequence be transferred to Risso's genus.

Two new species are here described from material in the

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[1] I have compared specimens with both *L. seticaudata* and *L. intermedia.*

[2] In addition to the species mentioned in this paper I have examined *Lysmata seticaudata*, Risso, *Lysmata intermedia* (Kingsley), *Hippolysmata californica*, Stimpson, and *Hippolysmata wurdemanni* (Gibbes).

[3] See Rathbun, Bull. U. S. Fish Comm. for 1900, XX, ii, pp. 115, 116 (1902).

Indian Museum. One of these, *H. ensirostris*, a peculiar form which shows but little affinity with any species hitherto known, is remarkable for its wide range of variation. It seems, indeed, that extensive variation exists throughout the genus in regard to the rostral armature, the proportional length of the legs and the number of segments in the carpus of the second pair; in consequence it is not advisable to found species on these characters alone. In the case of the Indian species the armature of the dactylus of the last three peraeopods, the development of the epipods and of the antero-lateral spine of the carapace and the form of the telson have proved of considerable value in systematic work. The colouration of at least some of the species is very striking and it is probable that they could be more easily recognized in the field than from preserved material.

The Indian species of *Hippolysmata* may be determined by the following characters :—

I. Rostrum shorter than carapace, without elevated basal crest; pterygostomian spine, if present, smaller than antennal: lateral margins of telson convex, apex blunt with a pair of spines.
  A. Rostrum not reaching beyond second segment of antennular peduncle, inferior margin with 2-4 teeth; dactylus of last three peraeopods terminating in two large claw-like spines.
    1. A minute spine at antero-lateral angle of carapace; fingers of first peraeopods, when closed, meeting only at tips.
      a. Second peraeopods symmetrical, carpus composed of 15-24 segments ... ... *H. vittata.*
      b. Second peraeopods asymmetrical, carpus composed of 28-32 segments. ... ... *H. vittata*, var.
    2. No spine at antero-lateral angle of carapace; fingers of first peraeopod, when closed, meeting throughout their length. ... ... *H. kükenthali.*
  B. Rostrum reaching beyond antennular peduncle, inferior margin armed with 6-7 spines; dactylus of last three peraeopods simple. ... ... *H. dentata.*

II. Rostrum longer, usually very much longer than carapace, with an elevated dentate basal crest; pterygostomian spine as large as antennal; lateral margins of telson concave, apex acute and unarmed.
  A. Carapace smooth or sparsely punctate laterally, depression between branchial and cardiac regions usually obscure; basal crest of rostrum with 7-12 teeth; fifth peraeopods not extending beyond antennal scale. ... *H. ensirostris.*
  B. Carapace coarsely and closely punctate laterally, depression between branchial and cardiac regions distinct; basal crest of rostrum with 4-8 teeth; fifth peraeopods extending beyond antennal scale by at least length of dactylus. ... ... do. var. *punctata.*

Hippolysmata vittata, Stimpson.

Plate VI, figs. 6—10.

1901. *Hippolysmata vittata*, Lanchester, Proc. Zool. Soc., London, p. 563.
1906. *Hippolysmata vittata*, Nobili, Ann. Sci. nat. Zool. (9), IV, p. 46.
1907. *Hippolysmata vittata*, de Man, Trans. Linn. Soc., Zool. (2), IX, p. 423, pl. xxxiii, figs. 49, 50.

Under the last reference de Man quotes the earlier synonymy of this abundant species. To his detailed description I have little to add. I would, however, remark on the presence of a small (pterygostomian) spinule at the antero-lateral angles of the carapace (fig. 6) and to the gape at the base of the fingers of the chela of the first peraeopods when the claw is closed (fig. 7); it is only by attention to these seemingly trivial details that spirit specimens of *Hippolysmata vittata* can be distinguished from the allied *H kükenthali.*

The rostrum in Indian examples of *H vittata* bears six to nine dorsal teeth; the hindmost is situated just in front of the middle of the carapace and is always separated by a considerable interval from the next of the series. On the inferior margin there are from two to four very small teeth

The antennal scale, in adults, is a little less than three times as long as broad.

The second peraeopods are symmetrical and the distal end of the merus, which may be annulated, reaches to about one-third the length of the antennal scale. The carpus is composed of 15—19 segments. Stimpson in his original description gives 20, and subsequent authors 17—24. In the proportions of the last segment and of the chela the specimens agree closely with de Man's account. On the last three legs there are five or six dactylar spines which increase in size as they approach the apex (fig. 8)

The telson (fig. 9) has convex margins and a comparatively broad apex which is furnished with the two pairs of spines found in most members of the family.

The colour of living specimens is very striking The whole animal is practically transparent with narrow longitudinal stripes and streaks on the carapace and abdomen. At the anterior end of the first abdominal somite there is a complete transverse band and another is distinct at the anterior end of the fourth somite. The latter stops half way down on either side where it meets the uppermost of the three complete longitudinal stripes of the abdomen. There are other short longitudinal streaks on the carapace and abdomen, those on the anterior portion of the former being oblique. There is a median red stripe on the telson and on each inner uropod. The thoracic appendages are clear red and the eggs light green.

The following specimens are preserved in the Indian Museum:—

$\frac{6677}{10}$	Madras.	J. R. Henderson.	One, 31 mm.
$\frac{8451-3}{10}$	Kilakarai Ramnad Dist., S. India, 0—2 fms.	S. W. Kemp.	Many, 14—27 mm.
$\frac{8450}{10}$	N. Cheval Paar, Ceylon.	T. Southwell.	One, 21 mm.
$\frac{3187}{5}$ $\frac{3045-60}{7}$ $\frac{3193}{7}$	Karachi.	Karachi Museum.	Forty, 18—30 mm.
$\frac{6682}{10}$	Persian Gulf, 28° 59′ N., 50° 3′ E., 25 fms.	'Investigator.	Three, 24—34 mm.

The examples from Kilakarai were found among weeds in only a few feet of water; many of them are ovigerous females.

The Persian Gulf specimens differ from others in the collection in having the teeth on the inferior margin of the rostrum (4 or 5 in number) larger, though still smaller than those on the upper edge. The rostrum also is longer, reaching to the middle of the ultimate segment of the antennular peduncle (fig. 10). The form perhaps deserves nomenclatorial recognition.

Hippolysmata vittata has been recorded from the Inland Sea of Japan (de Man), Hongkong (Stimpson), Cebu (Thallwitz), Penang (Lanchester) and the Red Sea (Nobili).

H. vittata var.?

Two specimens in the collection differ from typical *H. vittata* in the development of the second pair of peraeopods.

In the larger example the left merus of this pair of limbs reaches beyond the apex of the antennal scale by one-fifth of its length and the carpus, which is composed of 31 segments, is as long as the rostrum and carapace combined. In this specimen the right leg of the second pair is unfortunately missing.

In the smaller example the right merus reaches to three-quarters the length of the antennal scale and the carpus, which is composed of 28 segments, is almost three-quarters the length of the carapace and rostrum. On the left side the ischium, merus and carpus are each almost exactly two-thirds the length of the same segments on the right; the carpus, however, is composed of the same number of segments.

The rostrum in each case bears seven teeth above and two below.

The form is, in all probability, merely a variety of *H. vittata* in which the second peraeopods are unequal and with a greater number of segments in the carpus. In all other respects there appears to be the closest resemblance between the specimens and typical examples.

The variation is similar to, though not as extensive as that found in *Processa canaliculata* on the Irish coast.[1]

The two specimens were found at the Andamans, in which locality typical *H. vittata* have not yet been found.

$\frac{6396}{10}$ East I., Andamans. A. R. Anderson. Two, 14 and 23 mm.

Hippolysmata kükenthali (de Man).

Plate VI, fig. 11.

1892. *Merhippolyte orientalis,* de Man (*nec* Bate), in Weber's Zool. Ergebn. Reise in Niederland. Ost-Ind., II, p. 407.
1902. *Merhippolyte orientalis* Bate?, de Man, Abhandl. Senck. naturf. Ges. Frankfurt, XXV, p. 849, pl. xxvi, fig. 56.

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[1] Kemp, Fisheries Ireland, Sci. Invest. for 1908, p. 124 (1910).

1902. *Hippolyte kükenthali,* de Man, *ibid.*, p. 850.
1905. *Nauticaris unirecedens,* Pearson (*nec* Bate), Ceylon Pearl Oyster Rep., IV, p. 81.
1907. *Hippolysmata kükenthali,* de Man, Trans. Linn. Soc. Zool. (2), IX, p. 426.

Along with an example of the preceding species obtained by Mr. T. Southwell on the Ceylon pearl banks and forwarded to the Indian Museum preserved in formalin are specimens of a very closely allied form which appears to be the same as that originally described by de Man under the name of *Merhippolyte orientalis,* Bate When received, the two forms were distinguished at once by their colouration, for the specimen of *H vittata* was streaked longitudinally with narrow red stripes, as already described, while those of *H. kükenthali* were broadly banded transversely, the colour of the bands being bright red in the preserved material.

The species is so closely allied to *H. vittata* that had it not been for the colour distinction it is possible that the distinctions would have escaped detection; the only important structural differences that I have been able to find are the following:—

H. vittata.	*H. kükenthali.*
A minute spine at antero-lateral angles of carapace (fig. 5).	No spine at antero-lateral angles of carapace
Fingers of first peraeopods, when closed, meeting only at the tips (fig. 7).	Fingers of first peraeopods, when closed, meeting throughout their length (fig 11)

These two characters seem to prevail with absolute constancy.

The rostrum in *H. kükenthali* is a trifle more bent downwards and is provided on an average with fewer teeth. On the dorsal margin there are from four to seven, usually five or six; the two hindmost, as in *H vittata,* are situated on the carapace and are separated by a considerable interval from the next of the series. On the inferior margin there are one or two, rarely three, small teeth.

The lateral process of the antennular peduncle is a trifle longer than in the allied form and often reaches the distal end of the proximal segment.

In the antennal scale, oral appendages, maxillipedes and peraeopods there appears to be the closest resemblance between the two forms, the only difference being that noticed above in the shape of the chelae of the first peraeopods, a feature not mentioned by de Man. The carpus of the second peraeopod is divided into 19-21 segments, the proportions of the proximal segment and of the chela being as in *H. vittata*; the spinulation of the dactyli of the last three pairs is the same as in that species.

The epipod at the base of the fourth leg appears to be more deeply bifid apically than in *H. vittata,* otherwise the branchial formulae of the two forms are in agreement. No differences could be found in the structure of the male pleopods, in the proportions of the abdominal somites, or in the characters of the telson and uropods.

I believe I am correct in referring these specimens to *H. kükenthali* (de Man); at any rate I am unable to point to any features in which they differ noticeably from his lengthy descriptions. The examples recorded by Pearson in 1905 from the Ceylon pearl banks under the name of *Nauticaris unirecedens*, Bate, almost certainly belong to the same species. *N unirecedens*, Bate, as de Man has pointed out, is a synonym of *H. vittata*; but Pearson notes that in his specimens the rostral teeth are less numerous than in those described in the 'Challenger' Report.

The specimens in the Indian Museum were caught during the months of January and February and many of the females bear eggs.

$\frac{8415-9}{10}$ N. Cheval Paar, Ceylon, 6 fathoms. T. Southwell. Many, 20-32 mm.

The species is recorded by de Man from Ternate and Flores.

Hippolysmata dentata, sp. nov.

Plate VI, fig. 5.

This species differs from *H. vittata* in the following particulars:—

The rostrum, which is only slightly shorter than the carapace, extends beyond the apex of the antennular peduncle (fig 5). Dorsally it is provided with seven or eight teeth, the hindmost of which, as in *vittata*, is situated just in front of the middle of the carapace and is separated by a considerable interval from the next of the series. On its inferior margin it is furnished with six or seven teeth which are as large as those above. The pterygostomian spine on the antero-lateral angle of the carapace is much more prominent than in *H. vittata*, but is not nearly as large as the antennal.

The eyes are short and reach only to half the length of the basal segment of the antennular peduncle; the cornea is a little wider than the stalk. The antennular peduncle reaches almost or quite to the apex of the antennal scale and its lateral process scarcely extends as far as the eyes[1]

The form of the antennal scale is similar to that of *H. vittata* but in the larger (type) specimen the apical spine reaches well beyond the lamellar part.

The oral appendages, maxillipedes and first peraeopods resemble those of *H. vittata*; in the chelae of the first pair the fingers meet only at the tips when the claw is closed. In the second peraeopods the carpus is composed of from 20 to 22

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[1] In the smaller of the two examples this process is considerably shorter than the eyes, which themselves reach well beyond the middle of the basal peduncular segment.

segments; the merus in the larger example is divided into eight segments and there are traces of sub-division in the ischium. The last carpal segment, the palm and the dactylus are almost equal in length.

The last three peraeopods are longer than in *H. vittata* or *H. kükenthali.* Those of the third pair reach beyond the antennal scale by the whole length of the carpus, propodus and dactylus; the fourth reach beyond the same point by the length of the last two segments and the fifth by the dactylus and one-half of the propodus. The usual spines are found on the ischium and merus; in the third peraeopod there are two or three on the former and four on the latter. The dactylus in all three pairs is slender and curved and nearly one-third the length of the propodus. It bears a few very slender spines close to the base, but otherwise is wholly unarmed, offering a striking contrast to the same appendage in *H. vittata* (cf. figs. 5 and 8).

In the proportions of the abdominal somites and in the characters of the telson and uropods *H. dentata* does not present any noticeable difference from its allies.

Two specimens are preserved in the Indian Museum:—

$\frac{1630}{7}$	Off M. of Irrawaddy R., 15°20' N., 94° 55' E., 20 fms.	'Investigator.' One, 33 mm. TYPE.
$\frac{2945}{7}$	False Point Harbour, Orissa, Bay of Bengal.	Investigator. One, 18 mm.

The colour of the species in life, according to a note found in the bottle containing the smaller specimen, is as follows:—"Carapace and abdomen striped pink. Antennae and antennules pink. Thoracic appendages light pink."

Hippolysmata ensirostris, sp. nov.

Plate VII, figs. 1—4.

The carapace, measured dorsally from the back of the orbit to the posterior margin, is a little less than half the length of the abdomen, excluding the telson. The branchiostegal walls are smooth in some specimens, in others punctate, sometimes rather closely so. The pterygostomian spine is prominent and is as large as the antennal (fig. 1).

The rostrum (figs. 1, 2) is always longer than the carapace and in some specimens (presumably those in which it has escaped fracture throughout the animal's existence) is fully twice the length. Dorsally it bears from 11 to 16 teeth, of which the posterior 7 to 12 form an elevated basal crest, extending on to the carapace. The teeth on this crest diminish in size from before backwards. In front of the crest there are scarcely ever more than five widely separated teeth on the upper edge of the blade. The inferior margin is armed with 7 to 16 stout teeth which are close-set proximally. The rostrum is a little depressed basally; but, after passing the second segment of the antennular peduncle, is slightly ascendant and thence to the apex is quite straight or (rarely) a trifle upturned.

The carapace is bluntly carinate mid-dorsally in its anterior half and bears one, less commonly two, minute spinules behind the basal crest of the rostrum.

The corneal portion of the eyes is, in dorsal view, only very little wider than the stalk and is smaller than in the preceding species. The antennular peduncle hardly reaches to two-thirds the length of the antennal scale; the second segment is longer than the third and the lateral process, though it extends beyond the eyes, fails to reach the distal end of the segment. The antennal scale is unusually variable in form and ranges from three to rather more than three and a half times as long as wide. The distal end of the lamella always extends well beyond the spine which terminates the straight or slightly concave outer margin, and the flagellum is nearly twice the entire length of the animal measured from the tip of the rostrum to the apex of the telson.

The mandibular palp bears neither incisor-process nor palp and the oral appendages are closely similar to those of *H. vittata.* The third maxillipede falls short of the apex of the antennal scale, the exopods reaching to rather more than half the length of the antepenultimate segment.

The carpus of the first peraeopods is a little shorter than the chela, the dactylus is scarcely two-thirds the length of the palm and the fingers, when the claw is closed, are in contact throughout their length. In the second peraeopods the merus is indistinctly divided into from 7 to 11 segments, while the carpus is composed of from 12 to 17. The palm of the chela is shorter than the last carpal segment and is a little longer than the fingers.

The last three pairs of peraeopods are provided with a variable number of spines on the ventral aspect of the merus. Those of the fifth pair extend to two-thirds or three-quarters the length of the antennal scale. The dactylus varies considerably in length; it is usually one-quarter or one fifth the length of the propodus; but occasionally in smaller examples is longer (two-sevenths the length of the propodus). The dactylus (fig. 4) is furnished with a few small spinules posteriorly; in several ovigerous females a small spine is also found near the apex; but this is never sufficiently large to give it the characteristic appearance seen in *H vittata* and *H kükenthali.*

The epipods at the base of the first four pairs of peraeopods are strikingly different from those found in the preceding species. They are short and rudimentary and entirely concealed from view by the downward growth of the pleurobranchs.

The sixth abdominal somite is one-quarter longer than the fifth. The telson (fig. 3) is about twice the length of the sixth somite and bears two pairs of dorsal spinules. Its lateral margins are concave, setose towards the apex, and terminate in a very narrow and acute point which reaches almost to, or considerably beyond, the distal end of the uropods. It differs widely in shape from that found in the preceding species and there is no trace of the usual terminal spines.

This very variable and, as it appears, abundant species of *Hippolysmata* seems to be rather an outstanding form, differing markedly from any species of the genus with which I am acquainted in the peculiar characters of the rostrum and telson and in the rudimentary condition of the epipods.

The following specimens are in the Indian Museum :—

$\frac{680-1}{7}$	Madras.	...	Two, 51 and 54 mm.
$\frac{6676}{10}$	Pondicherry.	J. Wood-Mason.	One, 64 mm.
$\frac{6395}{10}$	Colombo.	J. Anderson.	Six, 50-79 mm. TYPES.
$\frac{6397}{10}$	Akyab, Lower Burma.	F. Stoliczka.	Four, 52-60 mm.
$\frac{6402}{10}$	Bombay.	H. P. Mesurier.	Two, 35 and 63 mm.

var. **punctata**, nov.

Plate VII, figs. 5—7.

The rostrum in this form is nearly always more upturned distally than in typical *ensirostris* (figs. 5, 6). It bears from 8 to 13 dorsal teeth of which the posterior 4 to 8 form a basal crest. On the carapace a groove above the oral region, barely distinguishable in the typical form, is comparatively well-marked and a depression between the branchial and cardiac regions is always definite (fig. 5). The cardiac regions are somewhat swollen on each side of the middle line, so that the posterior third of the carapace is nearly flat dorsally. The branchiostegal walls are covered with a rather coarse pitting, the pits being very close and often confluent (fig. 7).

The antennal scale is hardly ever more than three times as long as wide. The third maxillipedes reach as far as, or a little beyond, the apex of the antennal scale. The carpus of the second pair of peraeopods is composed of 15 to 22 segments and the fifth pair reaches beyond the antennal scale by at least the whole of the propodus and sometimes by as much as one-half of the propodus as well. The dactylus of this pair is longer than in most typical examples of the species, the propodus being only three and a half times its length.

After careful examination I have come to the conclusion that this form is nothing more than a variety of *H ensirostris*, for the points of difference are entirely matters of degree. The variety *punctata* appears to be an extreme form of *ensirostris* in which the areolation and pitting of the carapace is more definite, the legs longer and more slender and the basal crest of the rostrum composed of a smaller number of teeth.

$\frac{3434-5}{10}$	Green I., Amherst, Tenasserim,	Investigator.'	Fifty-two, 35-60 mm.
$\frac{6471}{10}$	Thongwa, Burma.	I. H. Burkill.	Three, 51-63 mm.
$\frac{3137-47}{7}$	Sandheads, Ganges delta.	A. J. Milner.	Twenty-four, 37-60 mm.

Genus **Merguia**, nov.

Carapace without supra-orbital or antero-lateral (pterygostomian) spines ; antennal spine present. Upper antennular flagellum uniramous. Mandible without incisor-process or palp. Third maxillipede without exopod. Neither epipods nor arthrobranchs at base of first four peraeopods. Carpus of second peraeopods composed of many (24 or 25) segments.

This genus is founded to receive de Man's *Hippolyte oligodon*, of which species the type and only known example is preserved in the Indian Museum.

Examination of the mandible shows that both incisor-process and palp are absent (pl. VII, fig. 8) and that in the number of segments in the carpus of the second peraeopods and in the suppression of the arthrobranchs at the base of the first four thoracic limbs it approaches the genera *Lysmata* and *Hippolysmata*. From both these it is easily distinguished by the absence of the exopod on the third maxillipede and of the epipods at the base of the peraeopods.

In addition the species differs from other Hippolytidae in two very peculiar features. The first of these is the enormous development of the second segment of the antennal peduncle, which reaches beyond the apex of the antennal scale : this feature is well shown in de Man's figure The second is the undivided condition of the distal endite of the second maxilla (pl. VII, fig. 9). Except in the Pasiphaeidae in which both endites are suppressed, the distal endite is, in the Caridea, always divided.

Merguia oligodon (de Man).

Plate VII, figs. 8, 9.

1888. *Hippolyte oligodon*, de Man, Journ. Linn. Soc., XXII, p. 27, pl. xviii, figs. 1-6.

To de Man's detailed description there is little to add except as regards the characters of the oral appendages, noted above, the absence of the exopod on the third maxillipede and the suppression of the epipods at the base of the peraeopods.

The specimen, as de Man noted, is not in perfect condition ; the antennules are broken off shortly above the base of the peduncle, but enough remains to render it almost certain that no additional ramus is present on the upper flagellum The flagellum is, indeed, very different in appearance to that found in *Hippolysmata*, for it is round in section and without setae, whereas in the preceding genus it is more or less oval at the base, apparently formed by the fusion of two rami, and bears numerous setae, probably olfactory in function, on its inferior aspect.

$\frac{8239}{6}$ Elphinstone I., Mergui Archipelago. J. Anderson. One, 28 mm. TYPE.

SYNONYMIC LIST OF THE INDO-PACIFIC SPECIES OF HIPPOLYTIDAE.

Genus **Saron**, Thallwitz.

Saron marmoratus (Olivier).

See p. 84.

Saron neglectus, de Man.

See p. 87.

Genus **Nauticaris**, Bate.

Nauticaris marionis, Bate.

1888. *Nauticaris marionis*, Bate, Rep. Challenger' Macrura, p. 603, pl. cviii.
1902. *Merhippolyte australis*, Hodgson, Rep. 'Southern Cross' Crust., p. 233, pl. xxix.
1902. *Nauticaris marionis*, Lenz, Zool. Jahrb. Syst., suppl. Bd. V, p. 735.
1906. *Nauticaris marionis*, Calman, Ann. Mag. Nat. Hist. (7), XVII, p. 31.

Prince Edward I., Falkland Is., Auckland I., Cavancha.

Nauticaris stewarti (Thomson).

1888. *Hippolyte stewarti*, Thomson, Trans. N. Z. Inst., XXI, p. 259, pl. xiii, fig. 1.
1903. *Nauticaris stewarti*, Thomson, Trans. Linn. Soc. (2), VIII, p. 445, pl. xxix, fig. 1.

New Zealand.

Genus **Merhippolyte**, Bate.

Merhippolyte calmani, Kemp and Sewell.

See p. 88.

Merhippolyte kauaiensis (Rathbun) (see pp. 88, 89).

1906. *Spirontocaris kauaiensis*, Rathbun, Bull. U. S. Fish Comm. for 1903, XXIII, iii, p. 913, pl. xxiv, fig. 5.

Hawaiian Is.

Merhippolyte orientalis, Bate.

1888. *Merhippolyte orientalis*, Bate, Rep. Challenger Macrura, p. 621.
1907. *Merhippolyte orientalis*, de Man, Trans. Linn. Soc., Zool. (2), IX, p. 426.

Off New Guinea.

The original description is almost valueless and the type specimen (*fide* Calman, see de Man, *loc. cit.*) is in hopelessly bad condition.

Genus **Ligur**, Sarato.

1885. *Ligur*, Sarato, Moniteur des Etrangers, IX, année, n. 222, p. 2, (Nice)[1].
1902. *Parhippolyte*, Borradaile, in Willey's Zool. Results, p. 414.
1903. *Ligur*, Senna, Bull. Soc. entom. Ital., ann. XXXIV, p. 319.

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[1] I have not been able to consult this publication.

Ligur uveae (Borradaile).

1902. *Parhippolyte uveae*, Borradaile, in Willey's Zool. Results, p. 414, pl. figs. 11, *a-g*.

Loyalty Is.

Genus **Alope**, White.

Alope palpalis, White.

See p. 89.

Alope australis, Baker.

See p. 91.

Genus **Spirontocaris**, Bate.

Spirontocaris alcimede, de Man.

1906. *Spirontocaris alcimede*, de Man, Ann. Mag. Nat. Hist. (7), XVII, p. 404.
1907. *Spirontocaris propugnatrix*, de Man, Trans. Linn. Soc., Zool. (2), IX, p. 416, pl. xxxii, figs. 42-46.

Japan.

Spirontocaris geniculata (Stimpson).

1860. *Hippolyte geniculata*, Stimpson Proc. Acad. Nat. Sci. Philadelphia, p. 34.
1890. *Hippolyte geniculata*, Ortmann, Zool. Jahrb., Syst., V, p. 503, pl. xxxvii, figs. 3, 3*d-i*.
1902. *Hippolyte geniculata*, Doflein, Abh. Akad. Wiss. München, XXI, iii, p. 636.
1902. *Spirontocaris geniculata*, Rathbun, Proc. U. S. Nat. Mus., XXVI, p. 45, fig. 19.

Japan.

Spirontocaris gracilirostris (Stimpson).

1860. *Hippolyte gracilirostris*, Stimpson, Proc. Acad. Sci. Philadelphia, p. 34.

Japan.

Spirontocaris grebnitskii, Rathbun.

1902. *Spirontocaris grebnitzkii*, Rathbun, Proc. U. S. Nat. Mus., XXVI, p. 44, fig. 18.

Japan.

Spirontocaris jordani, Rathbun.

1902. *Spirontocaris jordani*, Rathbun, Proc. U. S. Nat. Mus., XXVI, p. 44, fig. 17.

Japan.

Spirontocaris leptognatha (Stimpson).

1860. *Hippolyte leptognatha*, Stimpson, Proc. Acad. Sci. Philadelphia, p. 34.
1879. *Hippolyte leptognatha*, var., Miers, Proc. Zool. Soc., pp. 22, 56.

Japan.

Spirontocaris mororani, Rathbun.

1902. *Spirontocaris mororani*, Rathbun, Proc. U. S. Nat. Mus., XXVI, p. 43, fig. 16.

Japan.

Spirontocaris ochotensis (Brandt).

1851. *Hippolyte ochotensis*, Brandt, in Middendorff's Reise Sibiriens, II, Zool., i, p. 120, pl. v, fig. 17.
1860. *Hippolyte ochotensis*, Stimpson, Proc. Acad. Sci. Philadelphia, p. 34.
1910. *Spirontocaris ochotensis*, Rathbun, Harriman Alaska Exped., X, Crust., p. 71, text-fig. 26.

Bering Sea to Sitka, Kamchatka, Okhotsk Sea, Japan.

Spirontocaris orientalis (de Man).

1890. *Hetairocaris orientalis*, de Man, Notes Leyden Mus., XII, p. 122, pl. vi, fig. 6.
1890. *Hippolyte ponapensis*, Ortmann, Zool. Jahrb., Syst., V, p. 502, pl. xxxvi, figs. 20, 20d.
1892. *Hippolyte ponapensis*, de Man, Notes Leyden Mus., XIV, p. 263.

Caroline Is.

Spirontocaris pandaloides (Stimpson).

See p. 93

Spirontocaris pectinifera (Stimpson).

1860. *Hippolyte pectinifera*, Stimpson, Proc. Acad. Sci. Philadelphia, p. 35.

Japan.

Spirontocaris profunda, Rathbun.

1906. *Spirontocaris profunda*, Rathbun, Bull. U. S. Fish Comm. for 1903, XXIII, iii, p. 914, pl. xxiv, fig. 10.

Hawaiian Is.

Spirontocaris propugnatrix, de Man.

1906. *Spirontocaris propugnatrix*, de Man, Ann. Mag. Nat. Hist. (7), XVII, p. 404.
1907. *Spirontocaris propugnatrix*, de Man, Trans. Linn. Soc., Zool. (2), IX, p. 414, pl. xxxii, figs. 35-41.

Japan.

Spirontocaris rectirostris (Stimpson).

1860. *Hippolyte rectirostris*, Stimpson, Proc. Acad. Nat. Sci. Philadelphia, p. 33.
1902. *Hippolyte rectirostris*, Doflein, Abh. Akad. Wiss. München, XXI, iii, p. 637, pl. iii, fig. 7.
1906. *Spirontocaris rectirostris*, de Man, Ann. Mag. Nat. Hist. (7), XVII, p. 403.
1907. *Spirontocaris rectirostris*, de Man, Trans. Linn. Soc., Zool. (2), IX, p. 411, pl. xxxii, figs. 31-34.

Japan.

Genus **Thor**, Kingsley.

Thor paschalis (Heller).

See p. 94.

Genus **Hippolyte**, Leach.

Hippolyte acuta (Stimpson).

1860. *Virbius acutus*, Stimpson, Proc. Acad. Nat. Sci. Philadelphia, p. 35.
1906. *Hippolyte acuta*, Rathbun, Bull. U. S. Fish Comm. for 1903, XXIII, iii, p. 912, pl. xxiv, fig. 3.

Liu Chiu Is.; Hawaiian Is.

Hippolyte australiensis (Stimpson).

See p. 98.

Hippolyte bifidirostris, Miers.

1876. *Virbius bifidirostris*, Miers, Ann. Mag. Nat. Hist. (4), XVII, p. 224.
1876. *Virbius bifidirostris*, Miers, Cat. N. Z. Crust., p. 81, pl. xi, fig. 1.
1903. *Hippolyte bifidirostris*, Thomson, Trans. Linn. Soc., Zool. (2), VIII, p. 443, pl. xxviii, figs. 13-16.

New Zealand.

Hippolyte orientalis, Heller.

See p. 97.

1861. *Hippolyte orientalis*, Heller, Sitz-ber. Akad. Wiss. Wien, XLIV, p. 277.
? 1875. *Virbius proteus*, Paulson, Rech. Crust. Mer Rouge, p. 109, pl. xviii, fig. 1, pl. x, figs. 2-5.
1906. *Virbius orientalis*, Nobili, Ann. Sci. nat., Zool. (9), IV, p. 33.

Red Sea.

Hippolyte ventricosus, H. Milne-Edwards.

See p. 96.

Genus **Latreutes**, Stimpson.

Latreutes acicularis, Ortmann.

1890. *Latreutes acicularis*, Ortmann, Zool. Jahrb., Syst., V, p. 506, pl. xxvii, figs. 6, 6 d-k, 6 n.
1902. *Latreutes acicularis*, Doflein, Abh. Akad. Wiss. München, XXI, p. 638.
1907. *Latreutes acicularis*, de Man, Trans. Linn. Soc., Zool. (2), IX, p. 421.

Japan.

Latreutes anoplonyx, Kemp.

See p. 104.

Latreutes (?) ceylonensis, Pearson (see p. 99)

1905. *Latreutes ceylonensis*, Pearson, Ceylon Pearl Oyster Rep., IV, p. 81, pl. ii, fig. 7.

Ceylon.

Latreutes compressus (Stimpson).

1860. *Rhynchocyclus compressus*, Stimpson, Proc. Acad. Nat. Sci. Philadelphia, p. 28.

Port Jackson, Australia.

Latreutes dorsalis, Stimpson.

1860. *Latreutes dorsalis*, Stimpson, Proc. Acad. Nat. Sci. Philadelphia, p. 27.

Hakodadi, Japan.

Latreutes laminirostris, Ortmann.

1890. *Latreutes laminirostris*, Ortmann, Zool. Jahrb., Syst. V, p, 506.
1907. *Latreutes laminirostris*, de Man, Trans. Linn. Soc., Zool. (2), IX, p. 422.

Japan.

Latreutes mucronatus (Stimpson).

See p. 101.

Latreutes phycologus, Nobili.

1905. *Latreutes phycologus*, Nobili, Bull. Mus. Hist. nat., p. 159.
1906. *Latreutes phycologus*, Nobili, Bull. sci. France. Belg., XL, p. 41, pl. ii, figs. 6, 6 d.

Persian Gulf.

Latreutes planirostris (De Haan).

1849. *Cyclorhynchus planirostris*, De Haan, Fauna Japonica, Crust., p. 175, pl. xlv, fig. 7.
1860. *Rhynchocyclus planirostris*, Stimpson, Proc. Acad. Nat. Sci. Philadelphia, p. 27.
1879. *Rhynchocyclus planirostris*, Miers, Proc. Zool. Soc., p. 55.
1890. *Latreutes planirostris*, Ortmann, Zool. Jahrb., Syst., V, p. 505, pl. xxxvii, figs. 4d-l, 4 n.
1902. *Platybema planirostre*, Rathbun, Proc. U. S. Nat. Mus,, XXVI, p. 46.
1907. *Latreutes planirostris*, de Man, Trans. Linn. Soc., Zool. (2), IX, p. 421.

Japan.

Latreutes pristis (Nobili).

1899. *Platybema pristis*, Nobili, Ann. Mus. civ. Genova (2), XX, p. 233 (p. 4 of reprint).

Beagle Bay, New Guinea.

Latreutes pygmaeus, Nobili.

See p. 99.

Genus **Tozeuma**, Stimpson.

Tozeuma armatum, Paulson.

See p. 106.

Tozeuma elongatum (Baker).

1904. *Angasia elongata*, Baker, Trans. Roy. Soc. S. Australia, XXVIII, p. 147, pl. xxvii, figs. 1-4.

Port Victor, S. Australia ; 15 fms.

Tozeuma erythraeum, Nobili.

1904. *Tozeuma erythraeum*, Nobili, Bull. Mus. Hist. nat. Paris, p. 231.
1906. *Angasia erythraea*, Nobili, Ann. Sci. nat., Zool. (9), IV, p. 44.

Red Sea.

Tozeuma kimberi (Baker).

1904. *Angasia kimberi*, Baker, Trans. Roy. Soc. S. Australia, XXVIII, p. 149, pl. xxvii, fig. 5.

Port Willunga, S. Australia; 4 fms.

Tozeuma lanceolatum, Stimpson.

1860. *Tozeuma lanceolatum*, Stimpson, Proc. Acad. Nat. Sci. Philadelphia, p. 27.
1879. *Tozeuma lanceolatum*, Kingsley, Proc. Acad. Nat. Sci. Philadelphia, p. 413.

Hongkong.

Tozeuma pavoninum (Bate).

1863. *Angasia pavonina*, Bate, Proc. Zool. Soc., p. 498, pl. xl, fig. 1.

St. Vincent's Gulf, Australia; 4½ fms.

Tozeuma robustum (Baker).

1904. *Angasia robusta*, Baker, Trans. Roy. Soc. S. Australia, XXVIII, p. 150, pl. xxviii, figs. 1-8.

St. Vincent Gulf, S. Australia, 10-12 fms.

Tozeuma tomentosum (Baker).

1904. *Angasia tomentosa*, Baker, Trans. Roy. Soc. S. Australia, XXVIII, p. 152, pl. xxix, figs. 1-4.

S. Australia; 20 fms.

Genus **Gelastocaris**, Kemp.

Gelastocaris paronae (Nobili).

See p. 107.

Genus **Mimocaris**, Nobili.

Mimocaris heterocarpoides, Nobili.

1903. *Mimocaris heterocarpoides*, Nobili, Boll. Mus. Torino., XVIII, no. 447, p. 6, fig. 2.

Borneo.

Genus **Lysmata**, Risso.

Lysmata seticaudata (Risso).

1816. *Melicerta seticaudata*, Risso, Hist. nat. Crust. Nice, p. 110, pl. ii, fig. 1.
1825. *Lysmata seticauda*, Guerin, Encycl. method., X, p. 328.
1826. *Lysmata seticaudata*, Risso, Hist. Nat. de l'Europe Mérid., V, p. 62.
1863. *Lysmata seticauda*, Heller, Crust. südlich. Europa., p. 234, pl. viii, fig. 1.
1902. *Lysmata seticaudata*, Senna, Bull. Soc. entom. Ital., xxxiv, p. 326.

Mediterranean; Atlantic Coast of France and Spain; Channel Is.

var. **ternatensis,** de Man.

? 1849. *Lysmata seticaudata*, De Haan, Fauna Japonica, Crust., p. 176, pl. xlv, fig. 13. (*P. dentatus* on plate).
1888. *Lysmata seticaudata*, de Man, Arch. f. Naturgesch., LIII, i, p. 492.
? 1890. *Lysmata seticaudata*, Ortmann, Zool. Jahrb. Syst., V, p. 507 *(partim)*.
1902. *Lysmata seticaudata*, de Man, Abhandl. Senck. naturf. Ges. Frankfurt, XXV, p. 846.

Ternate; Amboina. Japan ?

Lysmata trisetacea (Heller).

1861. *Hippolyte trisetacea*, Heller, Verhandl. zool-bot. Ges. Wien, XI, p. 29.
1861. *Lysmata pusilla*, Heller, Sitz-ber. Akad. Wiss. Wien, XLIV p. 287, pl. iii, fig. 26.
1888. *Lysmata pusilla*, de Man, Arch. f. Naturgesch., LIII, i, p. 493.

Red Sea.

Lysmata chiltoni, Kemp.

See p. 110.

Genus **Hippolysmata,** Stimpson.

Hippolysmata amboinensis, de Man.

1881. *Hippolysmata vittata* var. *amboinensis*, de Man, Arch. f. Naturgesch., LIII, i, p. 494.
1907. *Hippolysmata amboinensis*, de Man, Trans. Linn. Soc., Zool. (2), IX, p. 426.

Amboina.

Hippolysmata acicula, Rathbun.

1906. *Hippolysmata acicula*, Rathbun, Bull. U. S. Fish Comm. for 1903, XXIII, iii, p. 912, pl. xxiv, fig. 6.

Hawaiian Is.

Hippolysmata dentata, Kemp.

See p. 117.

Hippolysmata ensirostris, Kemp.

See p. 118.

var. **punctata,** Kemp.

See p. 120.

Hippolysmata kükenthali, de Man.

See p. 115.

Hippolysmata multiscissa, Nobili.

1906. *Hippolysmata multiscissa*, Nobili. Ann. Sci. nat. Zool., Paris (9), IV, p. 47, pl. ii, fig. 5.

Red Sea.

Hippolysmata paucidens, Rathbun.

1906. *Hippolysmata paucidens*, Rathbun, Bull. U. S. Fish Comm. for 1903, XXIII, iii, p. 913, pl. xxiv, fig. 4.

Hawaiian Is.

Hippolysmata vittata, Stimpson.

See p. 113.

Genus **Merguia,** Kemp.

Merguia oligodon (de Man).

See p. 121.

INCERTAE SEDIS.

1888. *Nauticaris futilirostris,* Bate, Rep. Challenger Macrura, p. 606, pl. cix, fig. 1.
1905. *Nauticaris futilirostris,* Pearson, Ceylon Pearl Oyster Rep., IV, p. 81, pl. ii, fig 8.

Japan, Ceylon.

1839. *Hippolyte gracilipes,* Randall, Journ. Acad. Nat. Sci. Philadelphia (1), VIII, p. 142.

Hawaiian Is.

1871. *Hippolyte grayi,* Cunningham, Trans. Linn. Soc., XXVII, p. 496, pl. lix, fig. 8.

Port Otway.

1858. *Hippolyte ignobilis,* Kinahan, Journ. Roy. Dublin Soc., I, p. 131.

Port Philip, Victoria.

1830. *Hippolyte leachii,* Guérin, Voy. de La Coquille', II, pt. 2, p. 37.

Caroline group.

1904. *Virbius (?) jactans,* Nobili, Bull. Mus. d'Hist. nat., Paris, p. 239.
1906. *Virbius (?) jactans,* Nobili, Ann. Sci. nat., Zool., Paris (9), IV, p. 37, pl. ii, fig. 2.

Red Sea.

1888. *Latreutes planus,* Bate, Rep. Challenger Macrura, p. 584, pl. lxxix, fig. 5.

Philippine Is.

1837. *Hippolyte quoyanus,* H. Milne-Edwards, Hist. nat. Crust., II, p. 375.

New Guinea.

1837. *Hippolyte serratus,* H. Milne-Edwards, Hist. Nat. Crust., II, p. 377.

" Baie de Jarvis. "

1837. *Hippolyte spinicaudus,* H. Milne-Edwards, Hist. nat. Crust., II, p. 378.
1882. *Hippolyte spinicaudus,* Haswell, Cat. Australian. Crust., p. 184.

New Holland.

1888. *Latreutes unidentatus,* Bate, Rep. Challenger Macrura, p. 586, pl. lxxix, fig. 6.

Philippine Is.

* * *

EXPLANATION OF PLATE I.

Alope palpalis, White.

FIG. 1.—Left second peraeopod of a specimen in the Indian Museum : × 6.

,, 2.—Right second peraeopod of the same specimen : × 6.

Alope australis, Baker.

,, 3.—Anterior part of a specimen from Burma, dorsal view : × 3.

,, 4.—Right second peraeopod of a large male showing abnormal segmentation : × 6.

,, 5.—The processes on the thoracic sternum of the same specimen : × 5.

Thor paschalis, Heller.

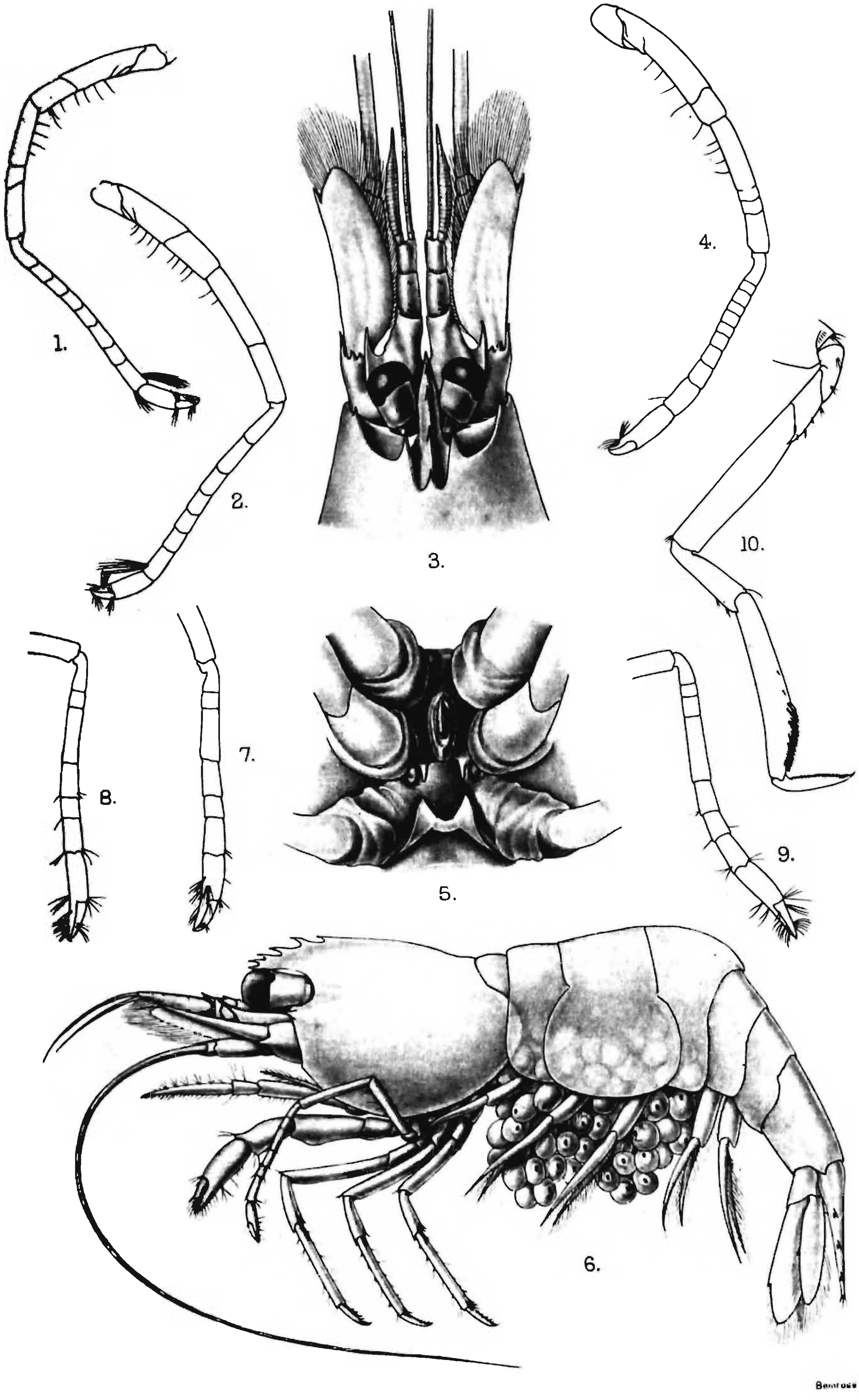
,, 6.—An ovigerous female from S. India in lateral view : × 12.

,, 7.—Carpus and chela of second peraeopod of a specimen from Florida : × 16.

,, 8.—Same segments of a specimen from S. India : × 25.

,, 9.—Same segments of another specimen from S. India showing abnormal segmentation : × 30.

,, 10.—Third peraeopod of male : × 15.



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D. Bagchi, & A. Chowdhary, del

ALOPE, THOR.

EXPLANATION OF PLATE II.

Hippolyte ventricosus, Milne-Edwards.

FIG. 1.—An ovigerous female from S. India in lateral view: × 6.
,, 2.—Antennal scale: × 20.
,, 3.—Carpus and chela of second peraeopod: × 30.

Hippolyte varians, Leach.

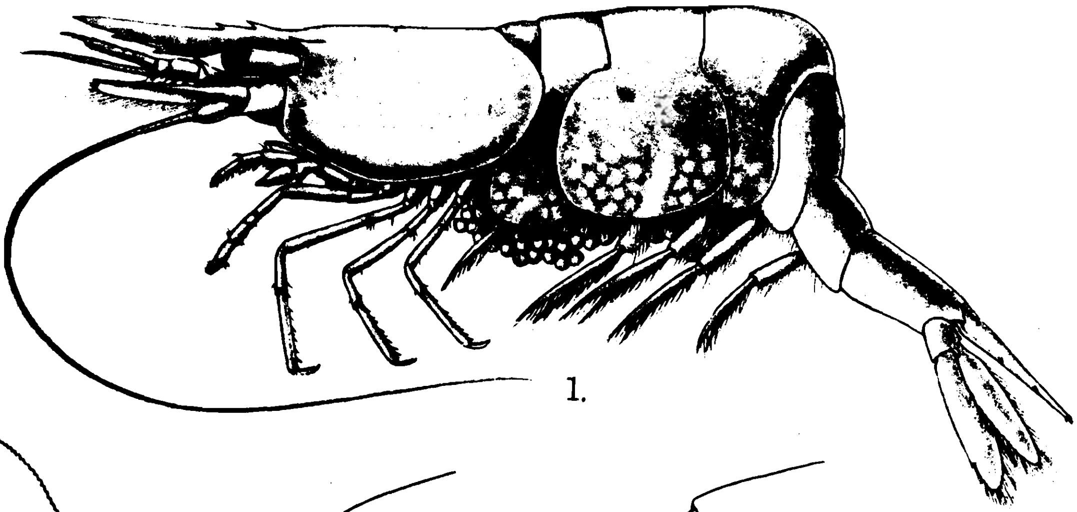
,, 4.—Antennal scale: × 16.
,, 5.—Carpus and chela of second peraeopod: × 20.

Hippolyte australiensis (Stimpson).

,, 6.—Carpus and chela of second peraeopod: × 20.

Latreutes pygmaeus, Nobili.

,, 7.—An ovigerous female from S. India in lateral view: × 7½.
,, 8.—Rostrum, antennule, etc. of a male in lateral view: × 18.



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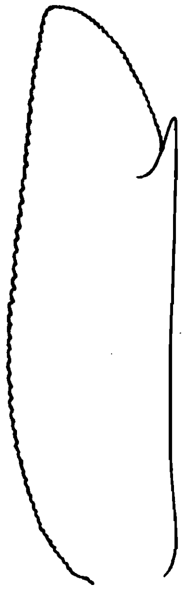

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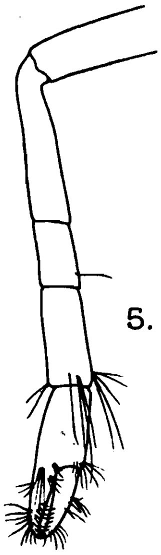

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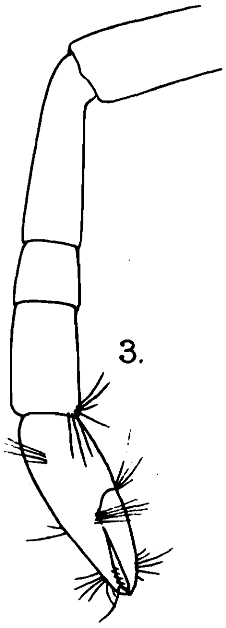

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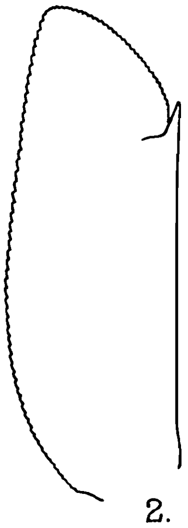

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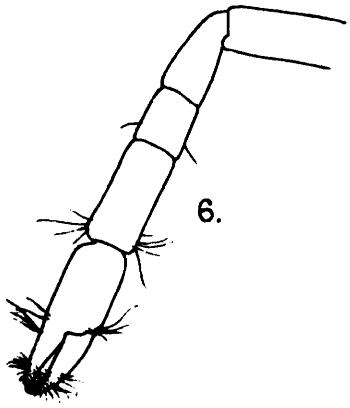

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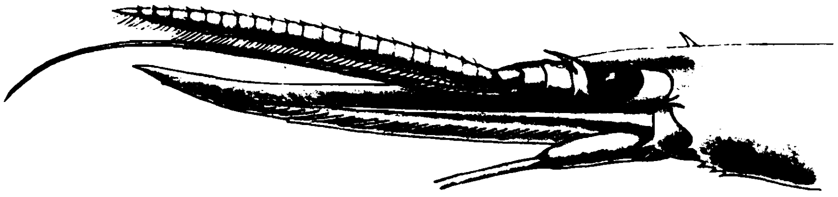

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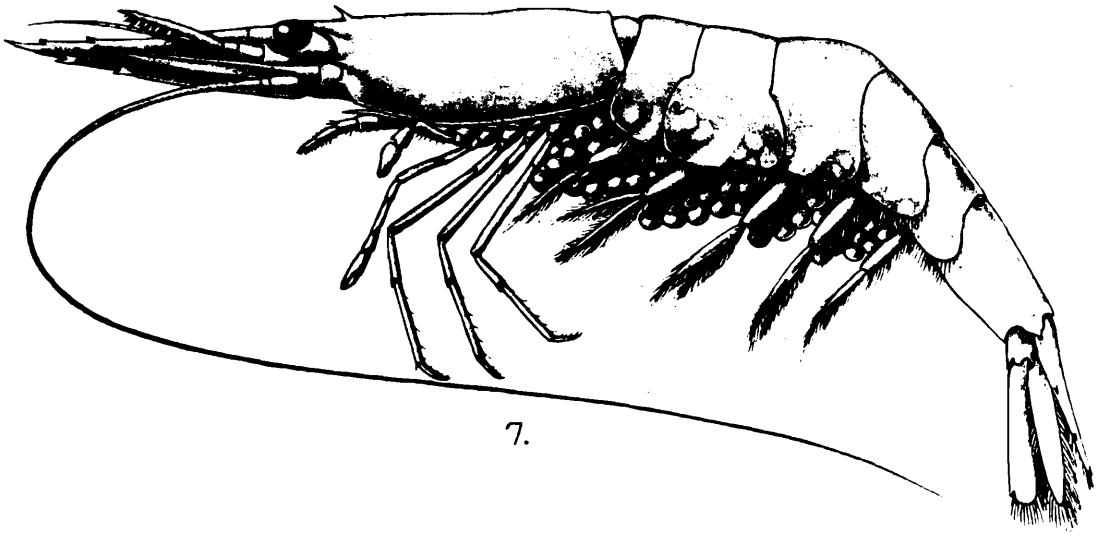

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HIPPOLYTE, LATREUTES.

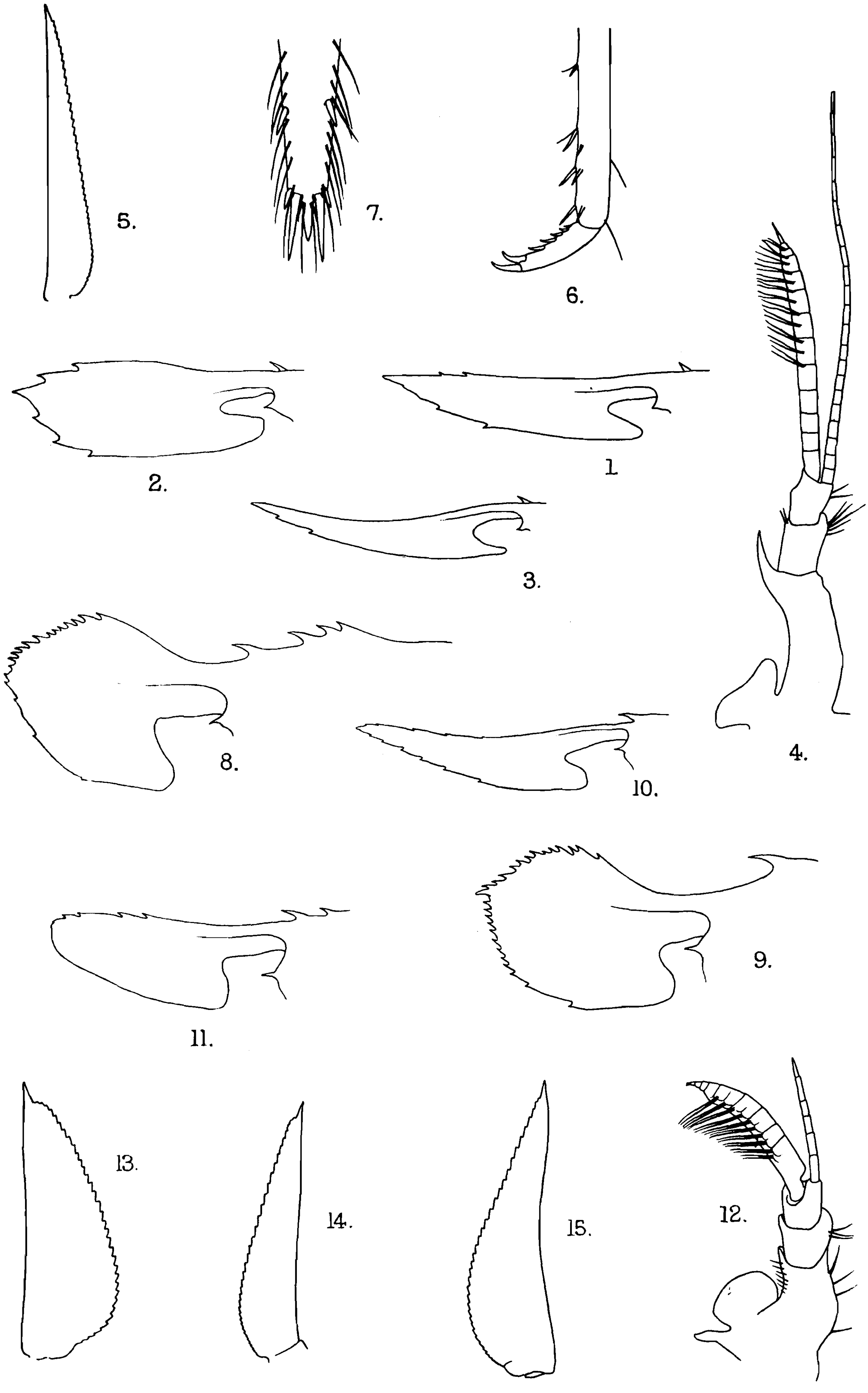
EXPLANATION OF PLATE III.

Latreutes pygmaeus, Nobili.

FIG. 1.—Rostrum of a female : × 7.
,, 2.—Rostrum of another female with abnormally deep blade : × 8.
,, 3.—Rostrum of a male : × 9.
,, 4.—Antennule of a female : × 22.
,, 5.—Antennal scale of a female : × 10½.
,, 6.—Dactylus and part of propodus of fifth peraeopod : × 33.
,, 7.—Apex of telson : × 24.

Latreutes mucronatus (Stimpson).

,, 8.—Rostrum of a female with four dorsal spines on the carapace : × 13
,, 9.—Rostrum of another female with an unusually large number of teeth : × 13.
,, 10.—Rostrum of a male : × 10½.
,, 11.—Rostrum of another male with two dorsal spines on the carapace, resembling the type specimen of *L. gravieri*, Nobili : × 12.
,, 12.—Antennule of a female × 20.
,, 13.—Antennal scale of a female : × 20.
,, 14.—Antennal scale of a male : × 20.
,, 15.—Antennal scale of another male : × 20.



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LATREUTES.

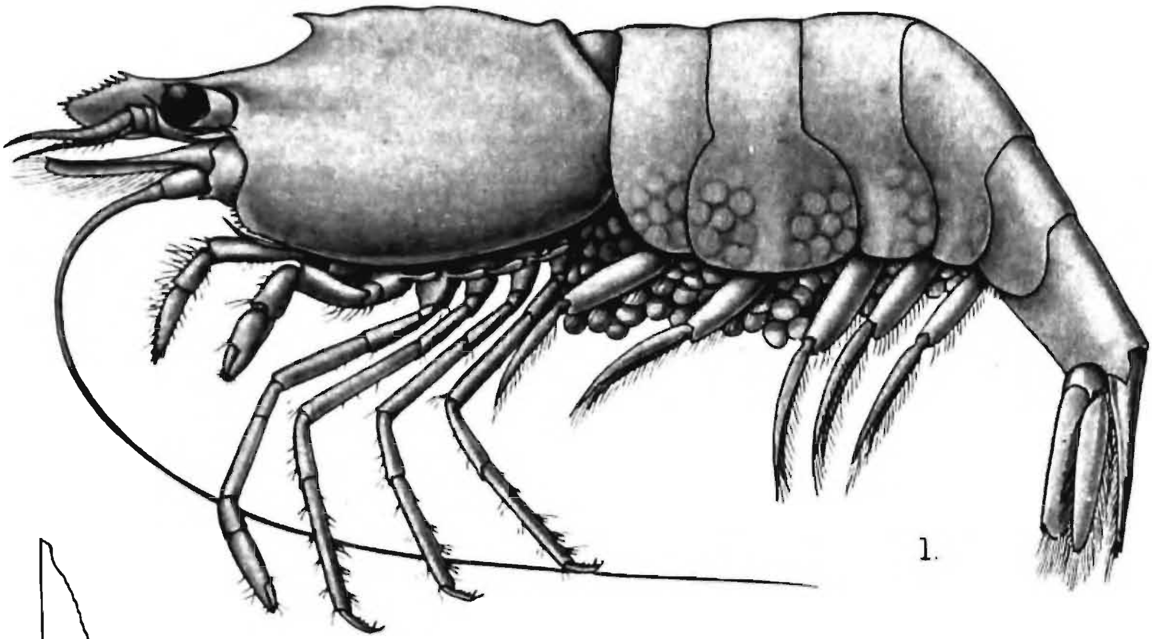
EXPLANATION OF PLATE IV.

Latreutes mucronatus (Stimpson).

FIG. 1.—An ovigerous female in lateral view : × 9½.
,, 2.—A male in lateral view : × 9½.

Latreutes anoplonyx, sp. nov.

,, 3.—Type specimen, an ovigerous female, in lateral view : × 3.
,, 4.—Antennal scale : × 10.
,, 5.—Apex of telson ; highly magnified.



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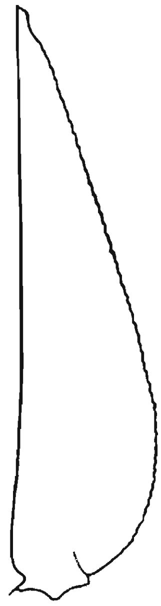

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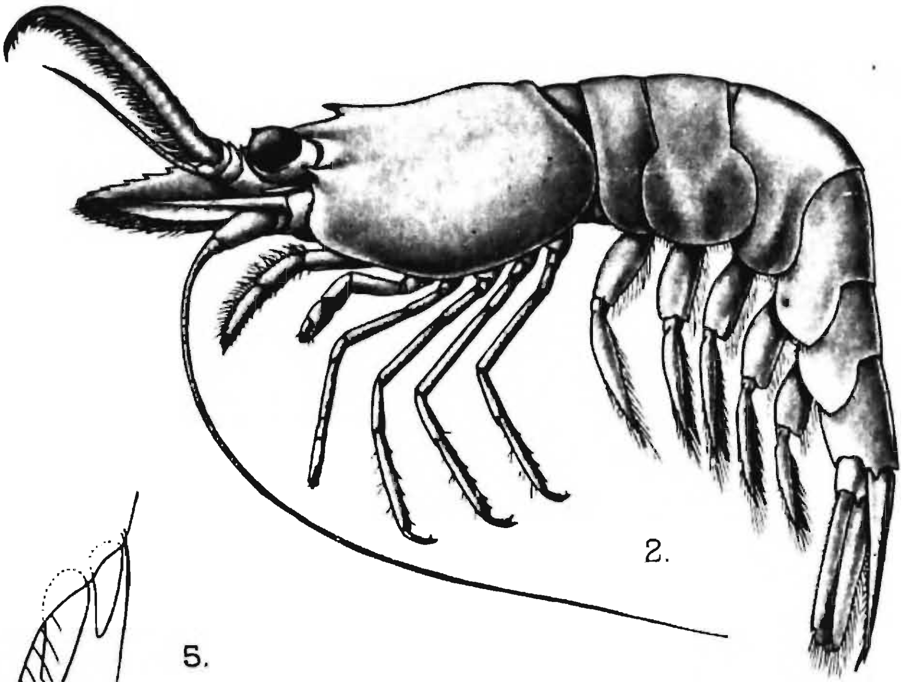

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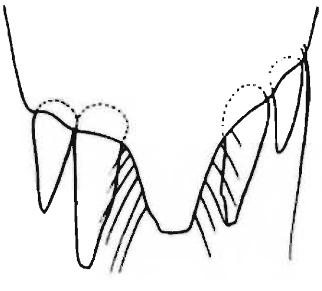

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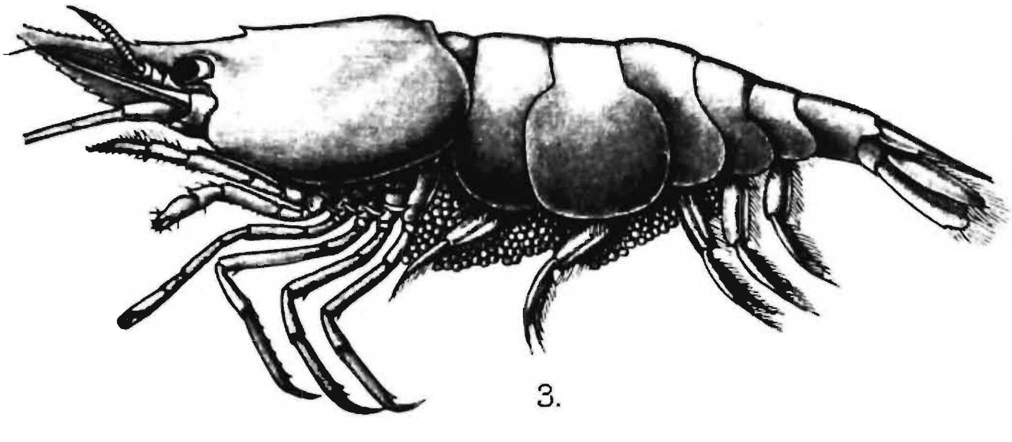

3.

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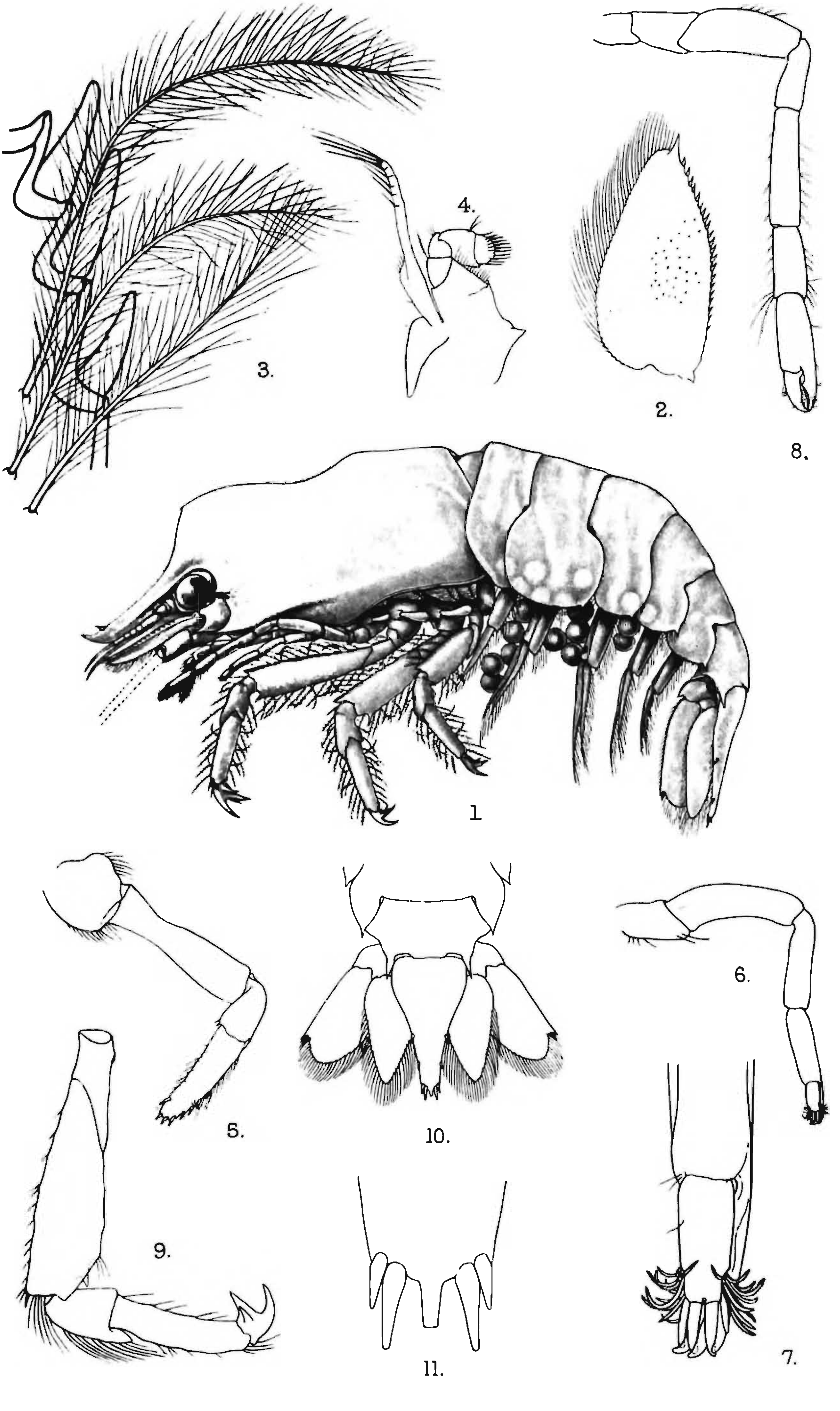
LATREUTES.

EXPLANATION OF PLATE V.

Gelastocaris paronae (Nobili).

FIG. 1.—An ovigerous female in lateral view : × 9½.
,, 2.—Antennal scale : × 15.
,, 3.—A portion of margin of antennal scale seen from below, showing plumose setae : × 75.
,, 4.—Second maxillipede : × 15.
,, 5.—Third maxillipede : × 15.
,, 6.—First peraeopod : × 15.
,, 7.—Chela of first peraeopod, further enlarged.
,, 8.—Second peraeopod : × 15.
,, 9.—Third peraeopod : × 15.
,, 10 —Last abdominal somite and telson in dorsal view : × 8.
,, 11.—Apex of telson, further enlarged : × 50.



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GELASTOCARIS.

EXPLANATION OF PLATE VI.

Lysmata chiltoni, sp. nov.

FIG. 1.—Rostrum, carapace, etc. of the type specimen : × 4.
,, 2.—Antennule of another specimen : × 8.
,, 3.—Antennal scale : × 12.
,, 4.—Last two carpal segments and chela of second peraeopod : × 40.

Hippolysmata dentata, sp. nov.

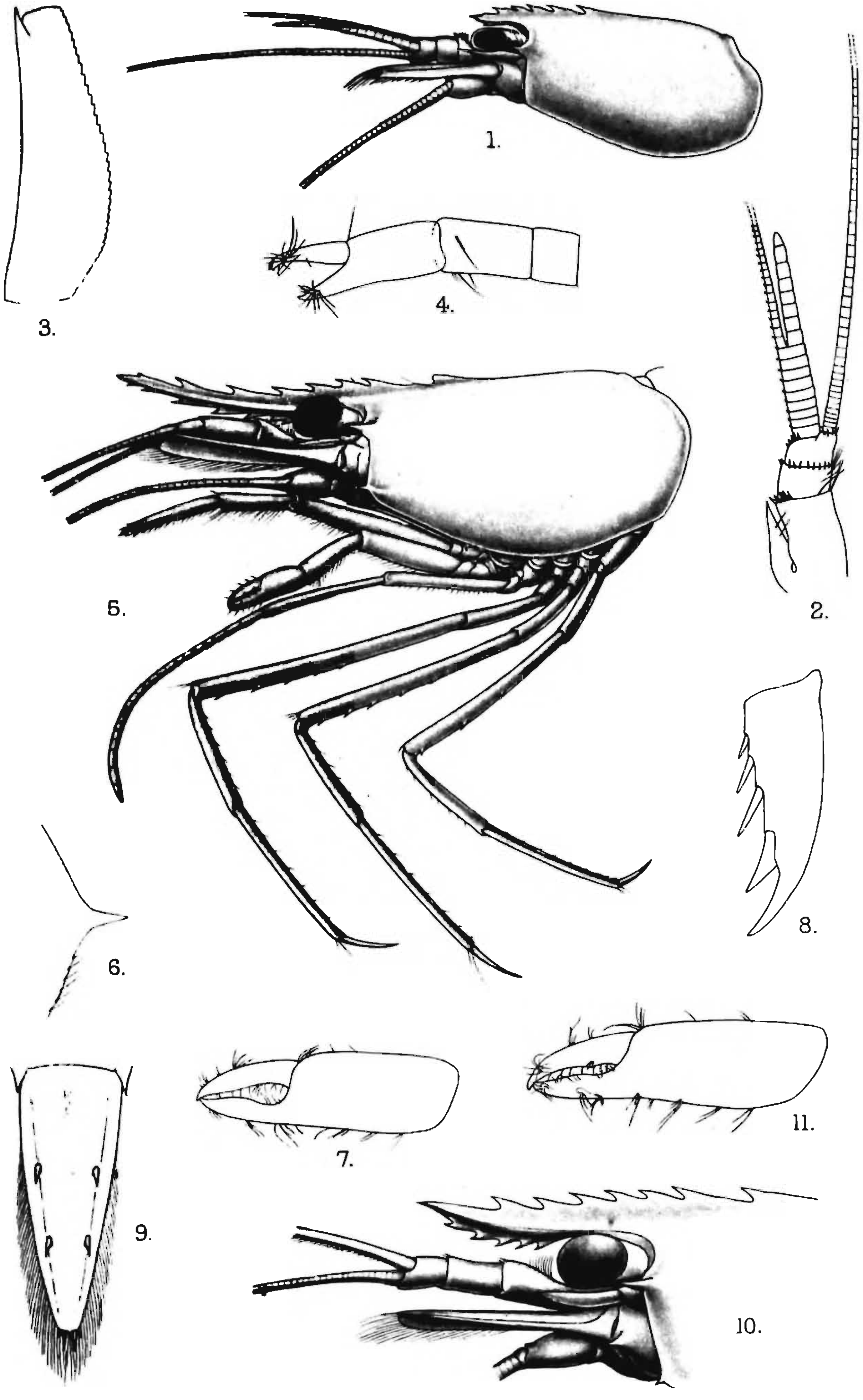
,, 5.—Rostrum, carapace, thoracic appendages, etc. of the type specimen : × 5.

Hippolysmata vittata, Stimpson.

,, 6.—Pterygostomian angle of carapace : × 34.
,, 7.—Chela of first peraeopod : × 14.
,, 8.—Dactylus of fifth peraeopod : × 34.
,, 9.—Telson : × 8.
,, 10.—Rostrum, carapace, etc. of a specimen from the Persian Gulf with unusually long rostrum : × 6.

Hippolysmata kükenthali, de Man.

,, 11.—Chela of first peraeopod ; × 14.



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LYSMATA, HIPPOLYSMATA.

EXPLANATION OF PLATE VII.

Hippolysmata ensirostris, sp. nov.

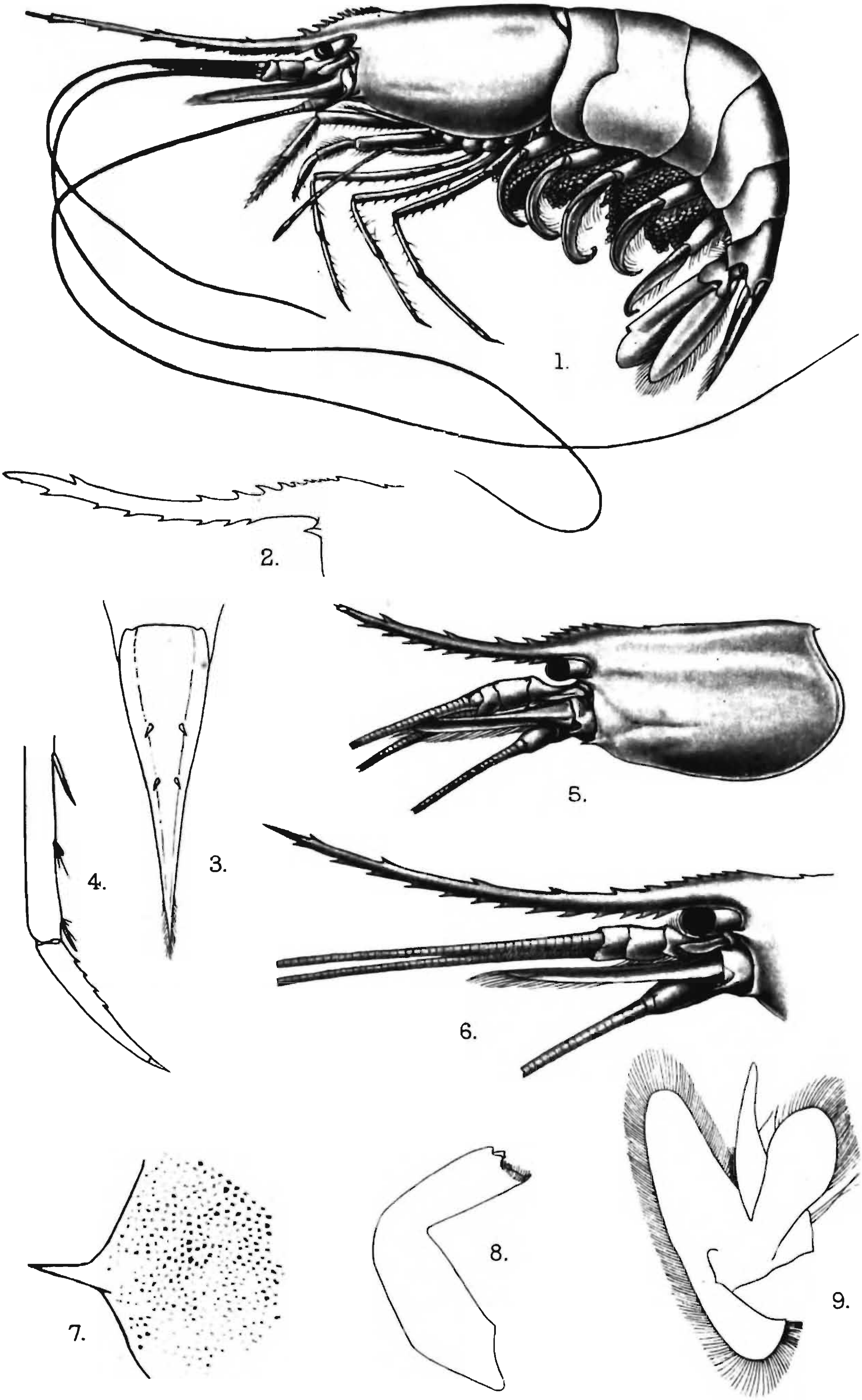
FIG. 1.—An ovigerous female in lateral view : × 2.
,, 2.—Rostrum of another specimen : × 3.
,, 3.—Telson : × 5.
,, 4.—Dactylus and part of propodus of fifth peraeopod : × 16

Hippolysmata ensirostris var. *punctata*, nov.

,, 5.—Carapace, rostrum and frontal appendages in lateral view ; × 3.
,, 6.—Rostrum of another specimen : × 4.
,, 7.—A portion of the carapace in the vicinity of the antennal spine, showing the pitting of the surface : × 16.

Merguia oligodon (de Man).

,, 8.—Mandible : × 22.
,, 9.—Second maxilla : × 16.



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HIPPOLYSMATA, MERGUIA.

V NOTES ON INDIAN FISH

By R. B. SEYMOUR SEWELL, *B.A., Capt., I.M.S., Surgeon-Naturalist to the Marine Survey of India; Hon. Assistant, Zoological Section, Indian Museum, Calcutta.*

(Plate VIII.)

I.—NOTES ON THE GENUS *Malthopsis*.

This genus was created by Wood-Mason and Alcock for a new species of deep-sea fish obtained by the R.I.M.S.S. "Investigator" in the Andaman Sea.

As has previously been pointed out (Lloyd, 1909–10, p. 171), the collection in the Indian Museum, Calcutta, contains two forms which differ very considerably in size and other characters, and the original description by Wood-Mason and Alcock (1891) applies only to the larger form; possibly they thought that the smaller form was merely an immature stage. Further examples of the smaller form were subsequently obtained from the same region and a full description was published by Lloyd (loc. cit., 1909–10) under the name *Malthopsis triangularis*: in the second part of the same paper, however, this author assumes that both these forms are in reality members of the same species and, arguing on this assumption, proceeds to demonstrate "supposed evidence of mutation." Recently Lloyd (1912) has reiterated his views on this supposed evidence: as he himself shows, the individuals of this genus in the present collection can be divided into two groups by the difference in the arrangement of the dermal scutes and the form and degree of development of the opercular spine— groups that he terms "orderly" and "disorderly" respectively. In both forms very considerable differences are to be found in the breadth of the disc proportionally in proportion to the total length, but such differences are only to be expected in cases where the disc is, as in the present case, supported by flexible bony arches and must largely depend on the degree of external pressure and muscular contraction existing at the time of death. As I have elsewhere shown (Sewell, *Rec. Ind. Mus.*, vol. VII, p. 8, Calcutta, 1912), similar variations are to be found in examples of the closely-allied species *Halicmetus ruber*, Alcock.

I have recently had occasion to re-examine the collection and I have no doubt that it contains two absolutely distinct species, the chief structural characters of which I give below:—

Malthopsis luteus, Wood-Mason & Alcock.

(Plate viii, fig. 1.)

Malthopsis luteus, Wood-Mason and Alcock, 1891, p. 26, pl. viii, figs. 2, 2*a*.
Malthopsis luteus, Goode and Bean, 1895, p. 53, fig. 411.
Malthopsis lutea, Alcock, 1899, p. 64.
Malthopsis luteus, A. Brauer, 1908, p. 326.
Malthopsis (in part), Lloyd, 1909-10, p. 171, pls. xlviii, xlix, l.
Malthopsis (in part), Lloyd, 1912, pp. 140-148, fig. 7.
Malthopsis lutea, Ill. Zool. Invest., Fishes, pl. xix, fig. 4.

In this form "the body is covered with hard, granular, adherent plates, each with a large radially striated conical tubercle in its centre. On the dorsal surface of the disc they are of moderate size, in contact along the middle line, but distant and slightly sunken laterally. On the ventral surface of the cephalic disc they are small, distant and sunken" (Alcock). "The space between the pelvic fins and vent is covered with about thirty minute plates which are widely separated from one another by naked skin" (Lloyd). Lloyd described this state of affairs by the term "dermal disorder."

"The subopercular spine is relatively small and irregular" (Lloyd).

In this form the nasal spine takes its origin from the anterior end of the snout, in line with the middle of the eye, and projects forwards and, in some cases, slightly upwards. Immediately behind the spine the dorsal profile rises upwards, to a point above the centre of the eye, and then slopes gradually downwards and backwards.

Below the spine is the tentacular pit, the floor of which also slopes downwards and backwards, so that in a ventral view the pit is easily visible.

The interorbital region narrows considerably about the middle of its length.

In the Indian Museum collection are six specimens obtained at the following "Investigator" stations:—

Station 115:	11° 31′ 40″ N.,	92° 46′ 40″ E.	188–220 fathoms.
Station 222:	13° 27′ 00″ N.,	93° 14′ 30″ E.	405 fathoms.
Station 233:	13° 17′ 15″ N.,	93° 10′ 25″ E.	185 fathoms.

Malthopsis triangularis, Lloyd.

(Pl. viii, fig 2.)

Malthopsis triangularis, Lloyd, 1909-10, p. 169, pl. xlv, figs. 1, 1*a*.
Malthopsis (in part), Lloyd, 1909-10, p. 171, pls. xlviii, xlix, l.
Malthopsis (in part), Lloyd, 1912, pp. 140-148, fig. 7.

In this species the dermal plates are arranged according to a very definite pattern, a condition that Lloyd terms "dermal order."

"On the dorsal surface is a median row of four or five large plates. On either side of the median row is an area of naked skin, which is bounded externally by an oblique row of plates converging in the direction of the base of the tail. On the ventral surface the space between the pelvic fin and vent is occupied by seven large plates, a central one surrounded by the six others. The plates are in contact. The subopercular spine is relatively large and tetrafid" (Lloyd).

The nasal spine arises, in this species, from a point opposite the upper border of the eye, at the junction of the dorsal surface and snout, and points strongly upwards and somewhat forwards; from its point of origin the dorsal profile at once slopes downwards and backwards.

The floor of the tentacular pit, below the spine, is vertical as also is the line of profile of the snout, so that when the animal is viewed from below, the pit cannot be seen.

The interorbital region narrows only very slightly, if at all.

In the Indian Museum there are fifteen specimens obtained at the following "Investigator" stations:—

Station 115: 11° 31′ 40″ N., 92° 46′ 40″ E. 188–220 fathoms.
Station 222: 13° 27′ 00″ N., 93° 14′ 30″ E. 405 fathoms.
Station 233: 13° 17′ 15″ N., 93° 10′ 25″ E. 185 fathoms.
Station 332: 10° 21′ 00″ N., 92° 46′ 15″ E. 279 fathoms.

Further differences between these two species can be seen by comparing their measurements and ratios:—

	Malthopsis luteus.	*Malthopsis triangularis.*
Total length (less caudal fin)	from 39 to 65 mm. Specimens which have been subsequently caught by the 'Siboga' and the 'Valdivia' are even larger. Siboga' examples 68, 80 mm. Valdivia' example 92·5 mm.	from 27 to 42 mm.
Ratio: $\frac{\text{Breadth} \times 100}{\text{Length}}$ … …	from 49 to 73: average 58·3	from 53 to 93: average 75·9.
,, $\frac{\text{Total length}}{\text{Length of spine}}$ …	from 11·1 to 12·5: average 12·86	from 8·6 to 11·1: average 10·0
,, $\frac{\text{Total length}}{\text{diam. of eye}}$ … …	from 6·1 to 6·5: average 6·325	from 5·0 to 6·3: average 5·5.
,, $\frac{\text{Total length}}{\text{Interorbital diam.}}$ …	from 12·25 to 14·6: average 13·4.	from 8·4 to 9·5: average 8·85.
,, $\frac{\text{Length of spine} \times 100}{\text{diam. of eye}}$ …	from 50 to 57: average 51·1.	from 50 to 87: average 54·7.

From the above statement it would seem to be fairly evident that we have here two absolutely distinct species.

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II.—A NEW SPECIES OF *Cryptocentrus*.

Cryptocentrus rubropunctatus, sp. nov.

(Pl. viii, fig 3.)

A single example of what appears to be a new species of *Cryptocentrus* was discovered at "Investigator" Station 414: Fisher Bay in Port Owen, Tavoy Island on the coast of Burma. The animal was found concealed beneath a large stone between tide-marks.

The chief structural characters are as follows:—

D.VI.I/10. A.I/10 C. 17. P. 17. V 5. Ll. 75.

	mm.
Total length (less caudal fin)	55·0
Length of caudal fin	16·0
Length of head	16·0
Length of snout	4·5
Diameter of eye	4·0
Interorbital space	1·0
Height of body	11·0
Ratio of height of body to length	1 : 5
,, ,, length of head to total length	1 : 34
,, ,, diameter of eye to length of head	1 : 4

The body is covered with small cycloid scales which increase somewhat in size towards the posterior extremity; the depth of the body is greatest at the insertion of the spinous portion of the dorsal fin and from that point it tapers gradually to the caudal peduncle.

The head is nearly as wide as it is deep: the measurements of width and height being 11·5 mm. and 12·5 mm. respectively.

The mouth is wide and is somewhat oblique; the jaws are equal and the maxilla extends back to a point situated vertically below the centre of the eye: the jaws are furnished with numerous teeth of unequal size and the lower jaw bears a pair of lateral canines. The head is naked and the cheeks and operculum are traversed with rows of minute warts.

The lateral line, as in the case of *C. filifer* (Cuv. and Val.), is represented by a series of vertical rows of small pores; there appear to be eighteen such rows in all, of which the first is separated by a fairly wide interval from the remainder, of these latter the more anterior are about 2 mm. apart but posteriorly the distance is somewhat less than this.

Fins.—The spinous portion of the dorsal fin is completely separate from the posterior rayed part and is also somewhat greater in height; the 3rd spine is the longest and measures 15 mm. in length, the rayed part of the fin is 10·5 mm. in height. The anal fin is 9 mm. in height. Both caudal and pectoral fin are sharply rounded.

In colouration the specimen was of a pale green on the dorsal aspect fading to a dull white below: the body and tail were crossed by a series of eight nearly vertical bands of a pale mauve colour. The tail was dotted with a series of small ocelli of a bright blue colour, while the cheeks and operculum were marked with scattered crimson spots, each spot being surrounded by a dark circle; a single similar spot was situated on the muscular base of each pectoral fin. The caudal and ventral fins were marked by faint longitudinal stripes of alternate pale green and mauve.

As is usually the case, the spots on the head and tail have completely lost their colour in spirit and the former are now a dull white.

A very closely allied species has been described by Tate Regan[1], but the present specimen differs from it in several particulars and is, I think, a new species. I, therefore, propose the name *Cryptocentrus rubropunctatus* for it.

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[1] Tate Regan, 1907-09. "Report on the Marine fishes collected by Mr. J. Stanley Gardiner in the Indian Ocean." Trans. Linn. Soc., 2nd Ser., Vol. XII, p. 241, pl. 29, fig. 2. London.

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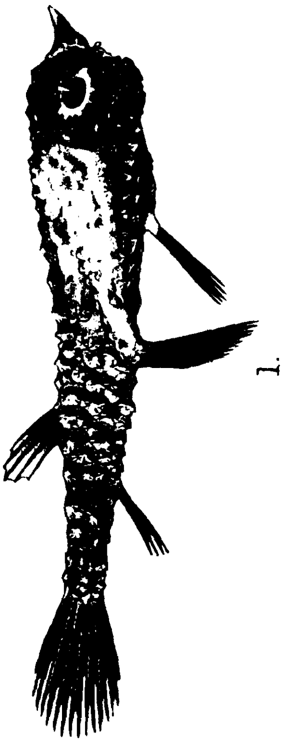
EXPLANATION OF PLATE VIII.

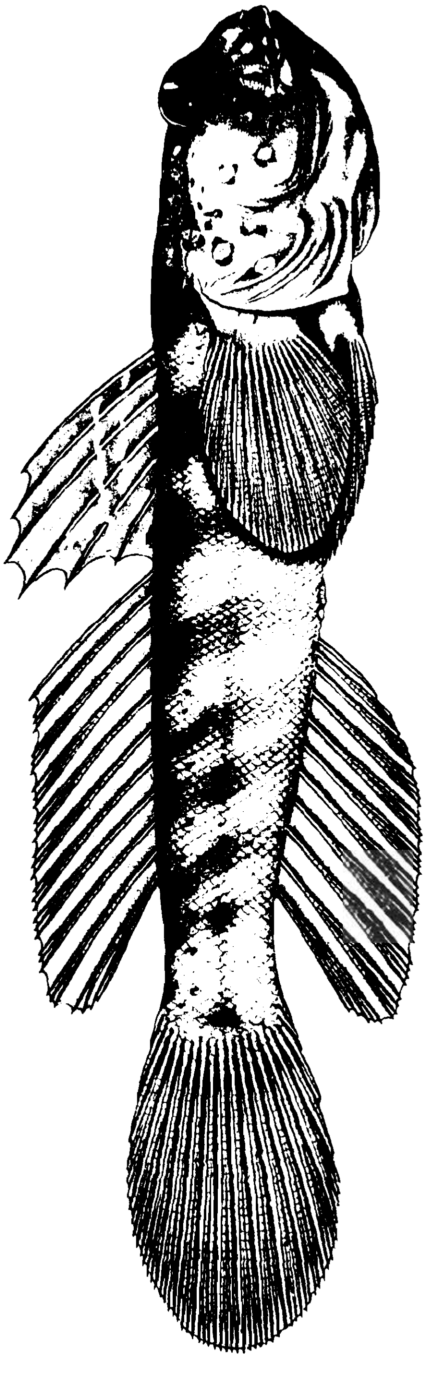
1. *Malthopsis luteus*, Wood-Mason and Alcock, lateral view, × 1.
2. *Malthopsis triangularis*, Lloyd, .. lateral view, × 1½.
3. *Cryptocentrus rubropunctatus*, sp. nov., lateral view, × 2.

Bemrose, Collo. Derby

2.



1.



3.

INDIAN MARINE FISH.

S. C. Mondul, del.

VI FURTHER NOTES ON THE SPONGES OF LAKE BAIKAL.

By N. ANNANDALE, *D.Sc., F.A.S.B., Superintendent, Indian Museum.*

(Plate IX).

In a paper recently published[1] but written some little time ago, I expressed the opinion, tentatively, that the characteristic sponges of Lake Baikal belonged to the subfamily Chalininae and should probably be assigned to the genus *Veluspa*, Miklucho-Maclay. At the time I had had, as I pointed out, no opportunity of comparing specimens from the Siberian lake with marine Haploscleridae. This was still the case at the end of 1912 when I was preparing my report on the sponges of the Lake of Tiberias;[2] but within the last few months I have been able, thanks very largely to the rearrangement of the collection of marine invertebrates in the Indian Museum carried out by Mr. S. W. Kemp, to examine a considerable number of marine Monaxon sponges from different parts of the world. The result has been to confirm my more important contention, that certain of the Baikal sponges were Chalininae; but I find that I was not justified in re-uniting Dybowski's genus *Lubomirskia* with the older genus *Veluspa*, from which he separated it in 1879, or in asserting that all the sponges of the lake (with the exception of those belonging to the Spongillid genera *Spongilla* and *Ephydatia*) were congeneric. It becomes necessary, therefore, to reconsider the generic portion of the species examined, and this will render it possible to discuss their geographical significance.

The precise systematic position of the sponges that constitute one of the most characteristic features of the fauna of Lake Baikal is not only a problem of considerable difficulty, but also one of great geographical interest. Most authorities on the Spongillidae have treated these sponges as a subfamily thereof, or merely as a highly specialized genus allied to the African *Potamolepis* and the South American *Uruguaya*. It is noteworthy that none of those who have hitherto treated in a comprehensive manner of the Spongillidae as a whole have had before them collections from Lake Baikal. Thanks to the authorities of the Zoological Museum of the Imperial Academy of Sciences in St. Petersburg I have been more fortunate in this respect, in that I have been able to examine

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[1] *Ann. Mus. Zool. Ac. Sci. St. Pétersb.* XVIII, p. 96 (1913).

[2] *Journ. As Soc. Bengal*, 1913, p. 77.

a very representative set of specimens of the species assigned by Dybowski to his genus *Lubomirskia*. In discussing more fully the result of comparing preparations of these sponges on the one hand with similar preparations of many true Spongillidae, and on the other with those of marine Monaxon sponges, it will be as well to commence by giving a brief abstract of what has already been published on the Baikal species as a result of the examination of collections from the lake.

So long ago as 1772 or 1773 Pallas[1] described the first of these sponges under the name *Spongia baikalensis*.

In 1870 Miklucho-Maclay[2] redescribed this sponge very briefly and assigned it to his new genus *Veluspa*, treating it as a variety of the Arctic marine species *V polymorpha*.

In 1879 Dybowski[3] again reinstated *Spongia baikalensis* as a distinct species and created a new genus for its reception and for that of all the other sponges from Lake Baikal with which he was acquainted. For this genus he coined the name *Lubomirskia*.

In 1895 several additional species and varieties were described and assigned to *Lubomirskia* by Soukatschoff.[4]

In 1901 Swartschevski[5] pointed out that two distinct genera had been confused under the name *Lubomirskia* and distributed the species described by former authors, together with several new forms described by himself, between the genera *Lubomirskia* and *Veluspa*. He also described some true Spongillinae from Lake Baikal. In the same year Korotneff[6] based some general observations (briefly describing the same Spongillidae) on his own collection, on which Swartschewski also worked. This collection is still being described in a series of monographs.

In my paper of last year[7] I suggested, as a provisional arrangement, that all the genera and species from Lake Baikal placed in *Veluspa* and *Lubomirskia* by other authors, should be reassembled in the latter genus, and that they should be assigned to the subfamily Chalininae of the family Haplosceridae, instead of the Spongillidae.

I. SYSTEMATIC.

It is a disputed point among students of the Porifera whether the classification of the Monaxonida (or Monaxonellida) should be based mainly, if not exclusively, on the form of the microscleres, or whether that of the skeleton-spicules and other macroscleres should not rather be taken first into account. Both parties, how-

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[1] Gauthier de la Peronie's French translation of Pallas's "Travels": "*Voyages de M. P. S. Pallas............Traduits de l'Allemand* (1778–1793)" is the only version available in Calcutta. The reference to the description of *Spongia baikalensis* in this version is vol. IV, p. 680.

[2] *Mém. Acad. Sci. St. Pétersb.* XV, No. 3 (7), p. 4 (1870).

[3] *Mém. Acad. Sci. St. Pétersb.* XXVII, No. 6 (6), p. 11 (1880).

[4] *Trav. Soc. Nat. St. Pétersb.* XXV (2), p. 11 (1895).

[5] *Zapiski Kiev. Obšč. Jest.* XVII (2) (1901).

[6] *Biol. Centralbl.* XXI, p. 306 (1901).

[7] *Ann. Mus. Zool. Ac. Sci. St. Pétersb.* XVIII, p. 96 (1913).

ever, seem to acknowledge that, whatever criterion is adopted in the separation of families, some or all of them will be of polyphyletic origin and include genera that resemble one another because of convergent evolution rather than of direct common descent. The precise classification adopted is, therefore, largely a matter of convenience. If great stress is laid on the microscleres alone there is this difficulty, that in certain genera (*e.g. Homaeodictya*)[1] the microscleres are very liable to be overlooked or lost altogether, and species assigned not only to the wrong genera but even to the wrong family; while in many genera microscleres are invariably absent. In those genera, however, in which they are present there can be little doubt that they form by far the readiest means of identification and separation in the case of properly preserved specimens, and on the whole it is perhaps most convenient to consider them first in separating the larger divisions, although in their absence other characters must be found.

In Prof. Dendy's[2] report on the sponges collected by Prof. Herdman in the Gulf of Manaar (1905) there is, on pp. 133 to 135, a useful discussion of the composition and position of the families of the suborder Sigmatomonaxonellida. This suborder consists of Monaxon sponges in which the typical microscleres are sigmata, or forms derived therefrom, true asters being absent. The first family assigned by Dendy to the suborder is the Haploscleridae, in which, following Topsent[3] he includes the Homorrhaphidae and Heterorrhaphidae as defined by Ridley and himself[4] in 1887 and by other authors He assigns to the Haploscleridae those genera in which chelae and anchorae are absent, the skeleton-spicules being as a rule amphioxi or amphistrongyli and the spicule-fibres typically nonplumose. The marine subfamilies to be considered here belong to this family but have no microscleres.

In dealing with the Baikal sponges it is necessary to consider the relationship between the Haploscleridae and the Spongillidae, in which all other freshwater sponges must at present be placed. In individual specimens, and even in some cases in species and genera, it is often extremely difficult, if not impossible, to find any definite character that would separate a Spongillid from a Haplosclerid. In both families we find sponges totally devoid of microscleres and having a somewhat amorphous skeleton composed of amphioxi held together by a greater or less amount of chitinoid substance.

The typical microsclere of the Haploscleridae is a C-shaped spicule (sigma), which may be modified in different ways but never assumes the complicated form of the chela or of the anchora and rarely becomes straight and rod-like. Microscleres are in

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[1] Lundbeck, *Ingolf' Exp.* VI, pt. 1, p. 6, footnote (1902).

[2] Herdman's *Rep. Pearl Oyster Fisheries* (Roy. Soc. London), III (1905).

[3] *Mem. Soc. Zool. France* VII, p. 5 (1894).

[4] *'Challenger' Rep. Zool.* XX (Monaxonida) (1887).

some genera completely lost by degeneration. The skeleton consists of a more or less well defined network in the structure of which diactinial or occasionally tylote spicules take an important part, if they do not compose it altogether. In cases in which the spicules form definite fibres they either lie parallel or nearly parallel to one another in the core of these fibres, the chitinoid covering of which varies greatly in strength and thickness (if it exists at all), or else are connected together in a chain-like formation by means of small patches of a similar substance. In some species no spicule-fibres can be detected and the skeletal network is constructed entirely of single spicules either joined together by patches of chitinoid substance and each encased in a thin film of the same substance so as to form a lattice-like reticulation, or else merely massed in the parenchyma without any definite arrangement.

In many genera of Haploscleridae the life-history is unknown, but in those in which it has been investigated a free-swimming larva is produced that is covered externally (except at the broader end) with cilia and has a *solid* body. In many cases the larval ciliated cells exhibit distinct signs of specialization in certain regions, but a pigment-spot is not present.

In the Spongillidae, which are closely related to the Haploscleridae and by some authors given only subfamily rank, the typical microsclere is a small amphioxous spicule covered with minute spines, which are evenly disposed on its surface. That this spicule may be convergent towards the sigma is proved by a study of the gemmule-spicules of *Spongilla*, the most primitive genus of the family, and *Pectispongilla*, in both of which certain microscleres have a distinctly C-like outline. The evolution of the microscleres takes, however, a very characteristic course in the family as a whole. In the first place a tendency for the differentiation of the minute spicules that have no part in the formation of the skeleton into two distinct, but not widely divergent types makes its appearance in the most primitive forms. In *Spongilla* it is already well established; we find simple spiny amphioxi, which are never strongly curved, lying free in the dermal membrane and the parenchyma, and also other amphioxi of stouter build and slightly more complicated structure associated only with the gemmules. Although the latter spicules often approach the sigma-type in outline more closely than the " flesh-spicules " do, they are more highly specialized as regards the spines that cover them, in that these spines are often distinctly longer and more recurved at the extremities of the spicule than on the middle part. Unimportant as this specialization usually is in *Spongilla* (it is much more strongly marked in *Pectispongilla*, an offshoot from the direct line of evolution in the family), it has a well-defined significance in other, more highly developed genera. In *Ephydatia*,[1] a genus closely resembling *Spongilla* in general

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[1] In the genus *Iotrochota* of the family Desmacidonidae, which as a family is characterized by the presence of the chela or its derivatives, and again in certain

structure, the terminal or subterminal spines of the gemmule-spicule form a regular crown or rotule at both extremities; in *Pectispongilla* they fuse together at both ends of the spicule to form smooth-edged disks; in *Tubella* one of the rotules begins to disappear and a trumpet-shaped spicule is the result, while in *Parmula* this rotule has vanished together with the greater part of the shaft of the spicule, which takes the form of a flat plate (representing the other rotule) with a spine (all that is left of the shaft) projecting upwards from its centre

The evolutionary development of the free microscleres or flesh-spicules of the Spongillidae is much less striking than that of the gemmule-spicules and need not be considered here. In several genera and many species these free microscleres disappear altogether; whereas this is the case with the gemmule-spicules only in a few degenerate forms.

The skeleton of the Spongillidae differs in no essential feature from that of the Haploscleridae; but the chitinoid sheath of the spicule-fibres, if it exists at all, is never so stout as it is in some Haploscleridae, notably in those of the subfamily Chalininae, and the lattice-like network of single spicules characteristic of *Reniera* among the Haploscleridae is never found in its full development.

The free-swimming larva of the Spongillidae has a very characteristic structure, consisting of a *hollow*, bladder-like body, entirely covered externally with homogeneous cilia and invariably without a pigment-spot.

The most characteristic feature of the Spongillidae has, however, as yet been mentioned only incidentally, *viz.* the elaboration of the gemmule.

Gemmules are produced by many Haploscleridae, but consist merely of masses of cells stored with food-material and enclosed in a simple chitinoid case without specialized spicules or a pneumatic covering. In the Spongillidae on the other hand both these structures are commonly associated with the gemmule; in the subfamily Spongillinae the one critical character of most of the genera is the form of the microscleres with which the gemmule is armed, a foraminal tubule or cup (or at any rate a very definite depression in the covering at which the contents of the gemmules may escape on germination) is found in all but a few cases, while in most instances there is a special coat of chitinoid substance containing air-spaces of one kind or another. In the subfamily Potamolepidinae, in which microscleres of all kinds are absent, the gemmule, if it exists at all, is of a much simplified nature and resembles in many respects that of the Haploscleridae: that this is the result of convergence rather than of genetic relationship is proved by the very close structural resemblance between certain Potamolepidinae and certain Spongillinae not of a primitive type.

Hexactinellida, free microscleres very similar superficially to the gemmule-spicules of *Ephydatia* have been produced in totally different lines of evolution.

There is one anatomical feature of the Spongillidae which I have left to the last in considering the distinctive features of the family, because I am not sure of its precise significance; I mean the well developed subdermal cavities Under this term two quite distinct structures or rather systems have sometimes been confused, *viz.* (*a*) the cavity between the derma and the parenchyma into which water is drawn through the dermal pores on its way into the inhalent or afferent channels of the sponge, and (*b*) the superficial exhalent or efferent channels that extend along the surface of the parenchyma immediately beneath the derma and open into the oscula direct. Both these systems may be traced in all Spongillinae and in *Nudospongilla* among the Potamolepidinae, although the actual dimensions of the channels differ in different species. In *Cortispongilla* and *Pachydictyum* they can also be detected, but not so easily. I have examined only dry specimens of *Potamolepis*, but the structure of the skeleton certainly suggests their presence in this genus also.

In the Haploscleridae (as also in many other marine Monaxon sponges) many genera and species have both systems well developed. This is the case in many of the Renierinae, the subfamily most nearly related to the Spongillidae. It is not the case, however, in the Chalininae. In this subfamily (or at any rate in all its representatives I have examined) there is practically no subdermal inhalent cavity and the main exhalent channels run up vertical or obliquely to the surface of the sponge, on which they open as a rule in groups.

In all the Baikal sponges I have examined, or of which suitable figures have been published—I have not seen the forms of *Spongilla* and *Ephydatia* described by Swartschevski (1901), whose figures do not illustrate this point—both subdermal systems appear to be absent and the structure of the sponge is in this respect exactly like that of the Chalininae, the distal part of the vertical or radial fibres of the skeleton being buried in the parenchyma to their tips, instead of standing out above the parenchyma and supporting the dermal membrane as a tent-pole supports a tent. Stress has been laid by Dybowski and others on the "grouped" nature of the oscula in the Baikal sponges, and this would seem to be a character usually correlated with the absence of an exhalent subdermal sytem. In the Potamolepidine sponge *Nudospongilla aster* from Palestine, however, it is not so.

Family HAPLOSCLERIDAE.

Subfamily *CHALININAE*.

Genus **Lubomirskia**, Dybowski.

This genus may be defined as follows :—

Sponge massive, consisting of upright cylindrical stems or flabelliform, tough, elastic, not at all friable, with shallow oscula scattered, as a rule in groups, on the surface ; main exhalent channels never running in a horizontal direction immediately below the dermal membrane; inhalent subdermal cavity absent.

Skeleton consisting of a network of well-defined, compact, strongly coherent series of spicules lying parallel or nearly parallel to one another in a thick sheath of chitinoid substance. The vertical fibres branch dichotomously especially in the outer part of the sponge, and are joined together by transverse fibres containing fewer spicules than themselves. On the surface branching becomes more vigorous and more irregular, so that the external extremities of the vertical fibres form broom like bunches of slender fibres the central part of which is as a rule hollow and forms a nursery for the young embryos. Together these bunches of fine vertical fibres constitute a skeletal cortex (pl. ix, figs. 1, 1*a*).

Spicules.—There are no true microscleres. The skeleton spicules are amphioxous and spiny, the spines being sometimes concentrated at or near the extremities. Smooth slender amphioxi also occur occasionally in the parenchyma.

Type species: *Spongia baicalensis*, Pallas.

No gemmules have been described in this genus and the form of the free-swimming larva is unknown. Embryos in an early stage of development are frequently present in large numbers; they appear to migrate to the cavities in the terminal bunches of the spicule-fibres and probably escape thence on reaching the larval stage.

The only species that can be assigned to the genus are *L. baicalensis* (Pallas) and *L. abietina* (Swartschevski). The latter has been found only in Lake Baikal, but the former occurs also in Arctic seas.[1]

Dybowski has described (1880) several well-defined varieties of *L. baicalensis*, but Soukatschoff's[2] *L. baicalensis* var. *e* cannot belong either to the species or the genus. It is probably a form of *Baikalospongia bacillifera* (Dybowski). A phase to which no name or letter has been assigned was submitted to me by the authorities of the St. Petersburg Academy. In it the upright part of the sponge, instead of consisting as in the typical form of cylindrical systems, is fan-like, the broad, compressed growths usually being curved in horizontal section and sometimes forming incomplete cups. This form evidently reaches a considerable size. Its spicules agree with those of the typical form.

L. baicalensis and *L. abietina* differ mainly in the structure of the skeleton; in the latter the vertical fibres branch much less freely, the skeletal cortex is less well developed and the transverse fibres are fewer and more slender than in the former. *L. abietina* never produces upright growths like those characteristic of the typical form or the phase described above of *L. baicalensis*, but the formation of such growths does not take place in all varieties of the latter species.

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[1] Dybowski, *Sitzb. Nat. Gesellsch. Dorpat*, 1884, p. 44.

[2] *Trav. Soc. Nat. St. Pétersb.* XXV, p. 11 (1895).

The affinities of *Lubomirskia* are, in my opinion, with *Pachychalina*, Schmidt, from which the genus differs in its spiny spicules and in the peculiar structure of the terminal part of the vertical fibres, and, with *Veluspa*, Miklucho-Maclay, which has smooth tylote spicules. The structure of the skeleton-fibre appears to have been misunderstood by Dybowski and by most subsequent writers owing to the facts that the section figured by him (1880 ; pl. II, fig. 5) was too thin to show the real structure, and that the precaution of staining preparations of this genus with some reagent that would display the chitinoid sheath of the fibre has not hitherto been adopted.

The method I have myself used in making the preparations of *L. baicalensis* figured on plate ix is a very simple one. After cutting a thick hand-section of the dried sponge I dissected out a few fibres with their attachments under a binocular microscope and washed them in running water, brushing them at intervals with a camel's-hair brush, until the cellular debris was removed. I then placed them for about ten minutes in a strong aqueous solution of pyrogallic acid. This solution of course stained both the sheath and any remains of cells that still adhered to it, but the former were easily distinguished by their apparently granular nature and removed by further brushing in water. This method is naturally applicable only to skeleton-fibres that have a definite horny sheath.

It will be noted that in fig. 1*a* on plate ix that the horny or chitinoid substance is deposited in the interstices between the smaller twigs of the fibres in concentric layers and that these interstices are often almost completely filled up in this manner.

Subfamily *RENIERINAE.*

Baikalospongia, gen. nov.

Sponge massive or encrusting, resembling *Lubomirskia* in general structure but friable (though hard) and not at all elastic. A stout basal membrane of a horny nature is present.

Skeleton superficially resembling that of *Lubomirskia, except that there is no horny sheath to the fibres and that the vertical fibres do not form definite brush-like tufts at their distal extremity* but are more or less distinctly splayed out to form a horizontal skeletal reticulation

Spicules.—There are no true microscleres. The skeleton-spicules as a rule resemble those of *Lubomirskia*, but the spines at their extremities are usually differentiated more distinctly. In one species (*B. irregularis* (Swart.)) the macroscleres are smooth and blunt at both ends.

Gemmules.—These bodies have been discovered as yet only in one species (*B. bacillifera*), in which they are ovoid or pear-shaped structures with a simple horny covering which is distinctly depressed in a crateriform manner at the narrower end (pl. ix, fig. 3*b*). They lie in the stout basal membrane of the sponge with their long axis parallel to it.

Type-species: *Lubomirskia bacillifera*, Dybowski.

The embryos, which are often abundant in *B. bacillifera*, resemble those of *Lubomirskia*, but the free-swimming larva is unknown.

The following species must be assigned to this genus:— *Lubomirskia bacillifera, L. papyracea* and *L. intermedia*, Dybowski, *L. tscherskii, L. fusifera* and (probably) *L. baikalensis* var. *e*, Soukatschoff. and *L. irregularis*, Swartschevski. All these sponges are, so far as is known, found only in Lake Baikal.

I have examined numerous specimens of *B. bacillifera* and *B. intermedia*, both of which I assigned in 1913 (or rather in 1911) to the same genus as *Lubomirskia baicalensis*. This was, however, before I had attempted to dissect out individual fibres from the skeleton or to use pyrogallic acid as a stain in their examination. When I attempted to isolate the fibres an essential difference at once became apparent: it was impossible to disassociate them without breaking them into fragments, and they had none of the springiness and elasticity of those of *Lubomirskia*. They were moreover, so fragile that attempts to brush them clean always ended in disaster. Fragments of the skeleton, cleaned as far as possible in running water, were then stained in pyrogallic solution, and the difference in the structure of the skeleton-fibres of the two genera at once became clear. *There is in* Baikalospongia *no horny fibre-sheath*, but the fibres are built up in a ladder-like formation of groups of spicules, which adhere together in bunches and series of bunches by means of thin veil-like films of horny or chitinoid substance secreted at the points at which they are actually in contact. This formation is identical with that found in the skeleton of the harder species of Spongillidae (*cf.* plate ix, figs. 3*a* and 4) and also in many sponges of the subfamily Renierinae.

In assigning *B. bacillifera* and its allies to this subfamily I rely rather on negative than on positive evidence, placing them there rather because they are neither Spongillidæ (having no subdermal cavities) nor Chalininae (having no horny sheath to their skeleton-fibres) than on account of any definite character they possess. There are two genera *Nudospongilla* (Spongillidae of the subfamily Potamolepidinae) and *Metschnikowia* (probably Renierinae) to which they bear a very close resemblance in many characters, but both of these genera occupy an anomalous and somewhat unsatisfactory position.

Nudospongilla,[1] a genus of my own, is confessedly no more than a convenient generic appellation for those freshwater sponges in which the microscleres have disappeared but the skeleton has not the hardness or compactness of *Potamolepis*, Marshall. The skeleton-spicules may be either smooth or spiny and in the type-species (*N coggini*, pl ix, fig. 5) have a form not unlike those of some varieties of *B. bacillifera*; they are invariably amphioxous or practically so, whereas those of *Potamolepis* are amphistrongylous.

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[1] *Journ. As. Soc. Bengal* 1913, p. 62.

The genus only differs from the subgenus *Stratospongilla* of the genus *Spongilla* in being devoid, apparently in all circumstances, of true microscleres. The skeleton of most species [1] resembles that of *Baikalospongia*, except that the reticulation is never quite so dense and the sponge is therefore even more fragile. *B. intermedia* is, however, a connecting link in this respect. In all the species of *Nudospongilla* I have examined both subdermal cavities can be traced, but in one Syrian form (*N aster*) the disposition of the oscula somewhat resembles that characteristic of both *Lubomirskia* and *Baikalospongia*.

The genus *Metschnikowia* was described by Grimm from the Caspian Sea. His paper, which is apparently in Russian and was published in 1876 or 1877, is not available to me. Dybowski (1880); pp. 52-59) has redescribed three species, as well as redefining the genus, from the same inland waters. Topsent [2] and Lundbeck [3] refer to *Metschnikowia* Carter's *Isodictya spinispiculum* and also the species originally described by Topsent himself as *Reniera filholi*; both these sponges being found in the Atlantic. But it does not appear that either author had had an opportunity of examining material from the type-locality of *M tuberculata*, the type-species of the genus, and I would prefer to compare Caspian specimens with true marine ones before expressing an opinion on this point. Dybowski's figures of the skeleton of *M tuberculata* and *M. flava* (1879 ; pl iii, figs. 5 and 6) are detailed and clear, but I have seen no similar figures of that of the marine species placed in the genus by the two authors just named. In any case, Dybowski's figures show that there is a somewhat thin and irregular fibre sheath present in the sponges he illustrated, and that this sheath is strictly comparable to that of some species of *Reniera*. His figure of *M flava* (*op. cit.* pl. i, fig. 8) proves the existence in that species of well-defined subdermal exhalent channels.

On the whole, keeping in view the close similarity between some species of *Stratospongilla* and some of *Nudospongilla*, and also the biological conditions in which those of the latter genus are found, I am inclined to regard the indubitable resemblance between *Nudospongilla* and *Baikalospongia* as due to convergence, but to accept as probable the view that *Baikalospongia* is closely related to *Metschnikowia*. Until, however, the larval history of the different species assigned to all these genera is more fully known, it is impossible to express with any confidence a dogmatic opinion as to their mutual relationships.

Of the nominal species assigned to *Baikalospongia* on a preceding page I have examined only two, *B. bacillifera* and *B. inter-*

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[1] Evans, *Quart. Journ. Micro. Sci.* XLI, p. 425, pl. 38, figs. 6-8 (1899) has, however, described a well-defined fibre-sheath in one species (*N. moorei*) which I assign provisionally to *Nudospongilla*. The systematic position of this sponge is problematical.

[2] *Mém. Soc. zool. France* XI, p. 226 (1898) and *Res. Camp. Sci. Monaco* XXV (Sponge. Açores), p. 243 (1904).

[3] *'Ingolf' Exp.* VI (1), p. 52 (1902).

media. Of the former Dybowski and others have described varieties; these I have experienced great difficulty, owing to the existence of intermediate forms, in distinguishing. Soukatschoff's *Lubomirskia tscherskii* and *L. fusifera* are possibly no more than varieties of *L. bacillifera*, but *L. papyracea*, Dybowski and *L. irregularis*, Swart., appear to be specifically distinct.

Family SPONGILLIDAE

Subfamily *SPONGILLINAE*.

Swartschevski (1901; pls. iv (figs. 13-15) and v), in a paper written throughout in Russian, has described a *Spongilla* and two forms of *Ephydatia* from Lake Baikal; it should be possible to recognize all of them from his figures, if not from Korotneff's German descriptions (1901; p. 307). He has named them *Spongilla microgemmata*, *Ephydatia olchonensis* and *E. goriaëvii*.

All these sponges are remarkable for the abnormal character of their microscleres and I am inclined to think that they represent merely abortive varieties or phases, respectively of *Spongilla lacustris*, auct., *Ephydatia mulleri*, Liebk. and *E. fluviatilis*, auct. Without examining specimens it is, however, impossible to insist on this opinion.

2.—GEOGRAPHICAL.

In view of the foregoing observations it seems to be possible to consider the sponges of Lake Baikal from a geographical point of view under three headings, (1) sponges of marine origin, (2) sponges of uncertain origin, and (3) undoubted freshwater forms.

(1) In the first of these categories belong the two species assigned here to the genus *Lubomirskia*. The better-known of these (*L. baicalensis*) has actually been found in Behring's Straits, while the other is very closely allied to it. All other Chalininae are marine, but several species occur in semi-detached bodies of water such as the Black Sea.

(2) Although the affinities of *Baikalospongia* are doubtful, it seems probable that its species are derived from a marine stock.

(3) The true Spongillidae that occur in Lake Baikal are all abnormal forms.

The evidence therefore, such as it is, points to a marine origin for the greater part of the sponge-fauna of the lake. There is nothing definite to connect it with any other sponge-fauna but that of the Arctic Sea, but possibly a remote relationship other than convergent may exist between *Lubomirskia* and the species described from Lake Tanganyika by Evans as *Spongilla moorei*. Personally I am of the opinion that the resemblance is merely another instance of convergence, a phenomenon of constant re-occurrence in the Monaxon sponges. But here again, in the absence of embryological evidence, dogmatism is impossible.

The species *Lubomirskia baicalensis*, existing as it does both in the Arctic Sea and in Lake Baikal, and, moreover, being devoid of reproductive bodies that would be easily transported by external agencies, affords, in any case, strong support for the view that the fauna of the lake includes a real marine element derived from northern waters; while the prolific evolution of species in the apparently endemic genus *Baikalospongia* is exactly parallel to the state of affairs found in the Amphipoda[1] and the Gastropoda[2] of the lake and points to isolation for a considerable period.

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[1] Dybowski, " Beitr. der in dem Baikal-See vorkommenden Gammariden, " *Horae Soc. Ent. Russ.* X (1874).

[2] Lindholm, *Wiss. Ergebn. Zool. Exp. Baikal-See, Die Mollusken* (1909).

ADDENDUM.

When this paper went to the press I had not seen Topsent's paper on the classification of the Halichondrine sponges on larval characters (*Arch. Zool.* (5) VII, pp. i–xv). He points out (p. xiv) that the larvae of the Haploscleridae (*s.s.*) possess a coloured cap or collar at the posterior, non-ciliated extremity.—*April 24th, 1914.*

EXPLANATION OF PLATE IX

FIG. 1. *Lubomirskia baicalensis* (Pallas).

Fig. 1. Spicule-fibres dissected out of the external part of the sponge; photographed by reflected light and magnified by about 6 diameters. *Fig.* 1*a*. A fragment of the same dissection stained with pyrogallic acid and viewed by transmitted light; × 50. *c.s.* = sheath of spicule-fibre.

FIG. 2. *Baikalospongia intermedia* (Dybowski).

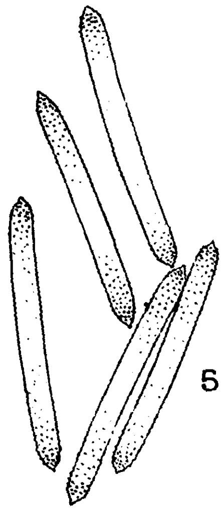
Fig. 2. A hand section (vertical) from the external region of the sponge, showing its compact nature and the absence of a subdermal cavity; photographed by reflected light and magnified by about 6 diameters. *Fig.* 2*a*. Thinner section of the skeleton in the same region; × 50. *e.m.* = dermal membrane; *g.l.* = growth-line.

FIG. 3. *Baikalospongia bacillifera* (Dybowski).

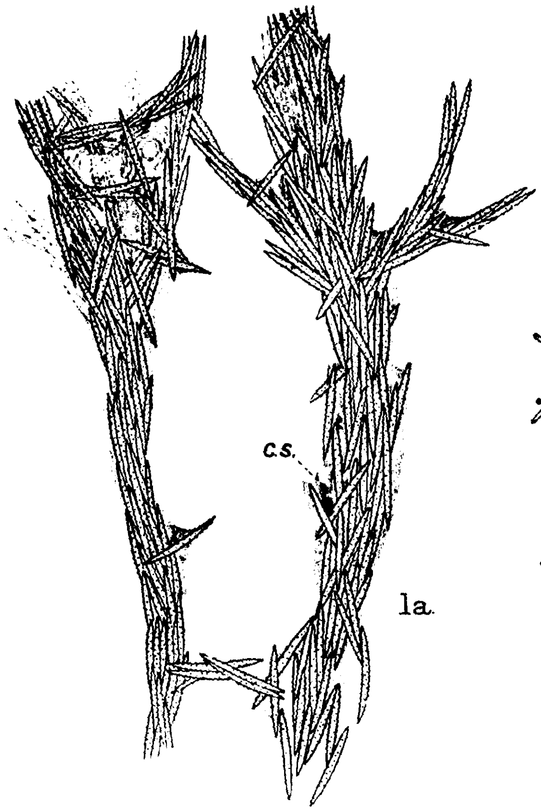
Fig. 3. Fragment of the skeleton (unstained); × 20. *Fig.* 3*a*. Portion of the same stained with pyrogallic acid; × 100. *Fig.* 3*b*. Gemmule, × 20.

FIG. 4. Fragment of the skeleton of *Corvospongilla ultima* var. *spinosa* similarly treated (for comparison); × 100.

FIG. 5. Spicules of *Nudospongilla coggini* (for comparison with those of *B. bacillifera*); × 100.

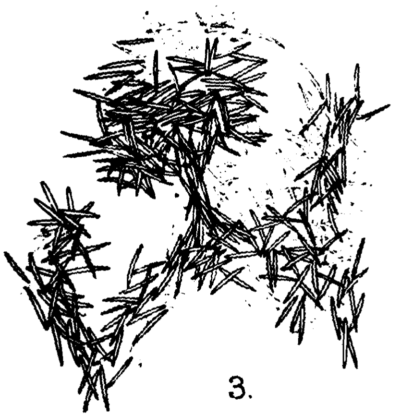


5.



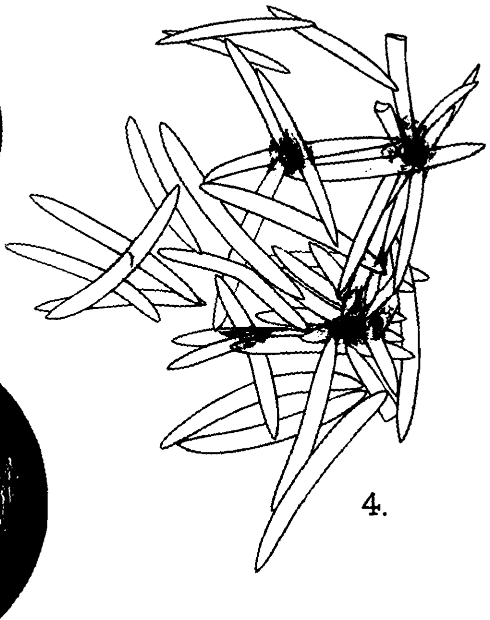
1a.

3b.



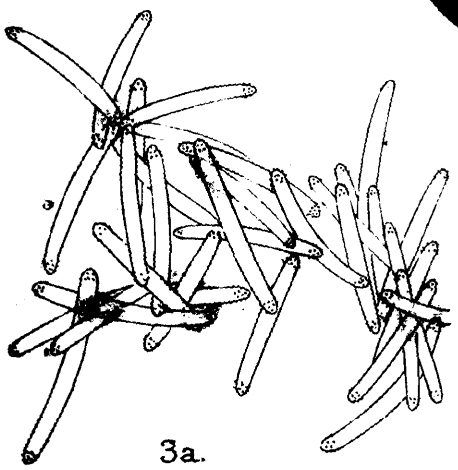
3.

2.

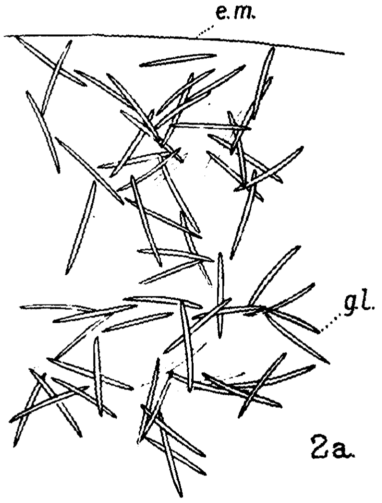


4.

1.



3a.



2a.

A.C. Chowdhary, del.

Bemrose, Collo. Derby.

SPONGES OF LAKE BAIKAL.

VII FAUNA SYMBIOTICA INDICA

No. 5.—Some Sponges commonly associated with Oysters and Mussels in Madras Harbour and the Chilka Lake.

By N. Annandale, *D.Sc., F.A.S.B., Superintendent, Indian Museum.*

(Plates X, XI.)

The sponges described in this paper all occur commonly on living shells of *Ostrea* and *Mytilus* either in the harbour of Madras or in lagoons of brackish water on the east coast of India. There is no evidence that any one of them is invariably associated with any one genus or species of mollusc, or with molluscs at all. Indeed, we know that one of them (*Suberites aquaedulcioris*) is not always associated with molluscs. But the fact that an association of the kind is common, although it is not exclusive, is of considerable interest, and, as I stated in the introduction to this series of papers (*Rec. Ind. Mus.* V, p. 123), I propose to deal in it with associations of varying degrees of intimacy.

From the systematic and geographical point of view the interest of the sponges lies in the fact that they are from a region hitherto practically unexplored so far as the Porifera are concerned. The multitudinous species that are found in the Gulf of Manaar have been described in a series of papers by Bowerbank,[1] by Carter[2] and by Dendy[3] and the marine sponges of Ceylon are now at least as well known as those of any other tropical country; but those that form a part of the much less luxuriant fauna of the littoral zone north of Palk Straits have hitherto almost escaped the notice of zoologists.

The biological differences between the portions of the east coast of India that lie respectively north and south of Palk Straits are much greater than is perhaps as a rule realized. In the one we have a sea full of coral reefs; in the other an almost uninterrupted stretch of barren sand and mud. It is only at a few places, notably in the harbour of Madras, that any solid support for fixed sedentary organisms exists, and there it is mostly artificial.

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[1] *Proc. Zool. Soc. London*, 1873, p. 25.

[2] *Ann. Mag. Nat. Hist.* (5) V p. 437; VI, pp. 35 and 129 (1880) and VII, p. 361 (1881).

[3] *Ann. Mag. Nat. Hist.* (5) XX, p. 153 (1887) and (6) III, p. 73 (1889); *Herdman's Pearl Oyster Fisheries* III, p. 57 (1905).

South of the estuaries of the Mahanaddi, north of which mud prevails, the coast is sandy and the sand extends outwards from the shore for some miles. Off the northern part of this coast, in from 15 to 30 fathoms of water, there are areas in which the sea-bottom is coated with a recent conglomerate of sand and partially dissolved shells,[1] while in the southern part solid masses are produced at about the same depth by the growth of gregarious gastropods and stony sponges.[2] These harder areas are, however, restricted to water which, although shallow as compared with the abysses of the central region of the Bay of Bengal, is deep as compared with the strictly marginal zone, from which the species to be considered here were obtained.

The sponges described below are all encrusting species, dependent, therefore, for their existence on comparatively hard areas on which to spread. These areas they find on the surface of the shells of oysters and mussels.

The general absence of algae of any considerable size from the Indian coast north of Palk Straits is one of its most striking biological features; it is one that naturally restricts the space suitable for the growth of small encrusting sponges, which in other seas are frequently found on the stems and fronds of seaweeds.

A.—Sponges from Madras Harbour.

The stonework of Madras harbour affords a support for large numbers of mussels (*Mytilus latus*, Lam.) which in their turn are usually coated with various encrusting organisms. During a recent visit to Madras I was indebted to the assistance of Prof. K. Ramunni Menon of the Presidency College of that city in obtaining a large supply of these mussels in a living condition. The majority of them bore on their surface, mingled with compound ascidians, branching Cheilostomatous polyzoa, barnacles (*Balanus amphitrite*), etc., specimens of one or more of the sponges here described.

The largest shell measures 11 cm. in length and 5·6 cm. in breadth.

The list of the encrusting sponges found on the mussel-shells is as follows :—

Family DESMACIODONIDAE.

Mycale aegagropila (Johnston) var. *militaris*, nov.
Mycale mytilorum, sp. nov.
Mycale madraspatana, sp. nov.
Lissodendoryx balanophilus, sp. nov.

In addition to these encrusting forms a small and poorly developed specimen of the widely distributed and well characterized

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[1] Jenkins, *Rec. Ind. Mus.* VII, p. 51 (1912).
[2] Annandale, *ibid.*, VI, p. 47 (1911).

tubular Haplosclerid *Reniera implexa*, Schmidt, was found on a shell of the same mussel. This sponge will probably be discovered in all warm and tropical seas; it has been recorded from the Adriatic, the West Indies, Ceylon and the Red Sea, and I have examined specimens from a rock-pool on the island of Bombay. Its bathymetrical range is also great:—from between tide-marks to at least 450 fathoms.

No burrowing sponge was found in oysters or mussels in the Madras harbour, but I have a specimen of *Cliona celata*, Hancock, in a chank shell (*Turbinella pyrum*, L) from the immediate neighbourhood of the town; it was presented to me by Professor Ramunni Menon.

Genus **Mycale**, Gray.

Mycale, Gray, *Proc. Zool. Soc.*, 1867, p. 533; Thiele, *Abh. Senckenb. Nat. Gesellsch.* XXV, p. 949 (1903); Lundbeck, *Dan. "Ingolf"-Exp.* VI, pt. 2, pp. 7, 23 (1905).

Esperia, Nardo, *Isis*, 1833, p. 522.

Esperella, Vosmaer, *Bronn's Thierreichs, Porifera*, p. 353 (1885); Ridley, *Rep. Zool. 'Challenger'* XXII (LIX) (Monaxonida), p. 62 (1887); Dendy, *Herdman's Ceylon Pearl Fish.* III, p. 159 (1905); Row, *Journ. Linn. Soc.* (Zool.) XXXI, p. 33 (1911).

Mycale aegagropila (Johnston).

Esperella aegagropila, Vosmaer and Pekelharing, *Verh. K. Akad. Wet. Amsterdam* VI (2), p. 17 (1897).

var. **militaris**, nov.

(Plate x, fig. 2.)

In the structure of their skeleton and soft parts and in the general form of their spicules my specimens from mussel-shells in Madras harbour agree well with Vosmaer and Pekelhering's description.

The sponge in these specimens forms a film not more than 2 mm. thick. In life it is of a bright scarlet colour owing to the presence of symbiotic algae in the parenchyma. In spirit these minute organisms turn of a dull green colour. The lengths of the spicules of my specimens are as follows; their forms are shown in figs. 2, 2*a*, pl. x:—

Megascleres, 0·257 mm. (average): 0·24 to 0·27 (extremes).
Anisoschelae, 0·044 mm. (very uniform).
Sigmata, about 0·095 mm.
Toxa, 0·148 to 0·2 mm.

The microscleres of all forms are somewhat scarce.

Type No. Z.E.V. $\frac{6152}{7}$ Ind. Mus.

Locality.—Madras harbour in 4 to 6 feet of water; on living shells of *Mytilus latus*, Lam.

The spicules do not agree precisely with those of any of the forms included in the synonomy of *M. aegagropila* by Vosmaer and Pekelharing, who have discussed the species in an exhaustive manner. I, therefore, describe my specimens as the type of a new "variety." Whether it is a true variety or a geographical race (subspecies) cannot of course be settled until more is known of the smaller and more delicate sponges of Indian seas.

The authors mentioned in the preceding paragraph found *M aegagropila* only on young oysters (*op. cit.*, p. 29). They describe the method of growth as follows: "They [the sponges] formed their crusts, generally not more than 0·5 or 1 mm. thick. They often covered the shells entirely, growing over the free borders. If new layers of shell are formed, the sponge immediately covers them. Hence in sections there can be found shell-layers in the middle of the sponge body." Nothing of the kind occurred in the case of sponges growing on mussel-shells at Madras, but these shells are of course much smoother than oyster-shells and the layers of calcareous matter of which they consist are much more closely compacted. No sponge that I saw grew over the edge of a shell, although in some cases the exposed surface of one valve was almost completely covered.

Mycale mytilorum, sp. nov.

(Plates x, fig. 1 and xi, figs. 2, 3.)

The *sponge* forms a delicate film not more than 2 mm. thick and of a bright brick-red colour; it sometimes covers the whole of a large mussel-shell. In spirit the colour, which is apparently not due to the presence of symbiotic algae, disappears rapidly. The external surface is smooth except for the presence of angular and apparently (not actually) spiny ridges on the central parts, often interrupted and never as much as 1 mm. high. These are largely artifects, not being visible in the living sponge; they occupy the spaces between the superficial exhalent canals.

Both *dermal pores* and *oscula* are minute and inconspicuous. The latter are situated in the central, thicker parts of the sponge; their position is indicated by the course of the superficial canals that converge towards them. The dermal pores, when not entirely obliterated by contraction, are oval in outline and of variable size; they are scattered on the peripheral parts of the sponge. Their position can be dicovered readily by the aid of a hand-lens, because they open, either directly or by short passages partly closed by diaphragms, into larger circular lacunae belonging to the inhalent system. These extend downwards nearly to the base of the sponge and the finer inhalent canals lead from them to the ciliated chambers. The finer exhalent canals open into broader ones which run obliquely upwards through the sponge and, long before reaching the oscula, form branching grooves on the surface of the parenchyma easily seen through the colourless dermal membrane that forms their roof.

The *skeleton* is composed of single fibres which ramify feebly or not at all. Its exact structure differs considerably in different parts of the sponge. Towards the periphery (pl. xi, fig. 3) the spicule-fibres are short, slender and simple; their course is almost vertical; they are somewhat sparsely scattered and they never branch; their upper extremities form comparatively small brushes that support the dermal membrane, hardly penetrating it. The sponge contains numerous tubes made by polychaete worms and in their intermediate vicinity the fibres, which to some extent radiate out from them take on a somewhat different character, becoming longer, branching dichotomously or even trichotomously at the upper end and adopting a more nearly horizontal course. It is, however, in the central parts of the sponge that the fibres are best developed, especially at the sides of the superficial exhalent channels. Here they assume a contorted but mainly horizontal course, are greatly elongated and densely crowded together. Their upper extremities, indicated by the fact that the pointed ends of the skeleton-spicules are directed towards them, are arranged in parallel lines of fan-like brushes along the sides of these channels, one row on each side, and thus forms a support for the floor of the channels (pl. xi, fig. 2).

Towards the periphery of the sponge there is no dermal skeleton except a fairly dense layer of sigmata, but in the central parts numerous macroscleres lie scattered, without fasciculation, in the dermal membrane.

Spicules : Megascleres.—The megascleres are slender, smooth, sharply pointed, straight or nearly straight tylostyles with well-defined, narrowly oval heads. The axial tubule is well developed in them, extending into the head. The average length of the whole spicule is about 0·216 mm. and the average diameter 0·0047 mm., the corresponding measurements of the heads being 0·008 mm., and 0·0047 mm.; but considerable variation in size and proportions occurs, the total length varying from 0·18 to 0·26 mm. and the diameter of the shaft from 0·004 to 0·0054 mm.

Microscleres.—There are no toxa. The sigmata, which are most numerous in the dermal membrane but also occur singly in the parenchyma, are not grouped in any definite manner. They are smooth and slender and as a rule somewhat twisted in their long axis; the average sector of their arc is about 0·04 and the average thickness of their shaft 0·0027 mm. The anisochelae are found scattered sparingly in the dermal membrane and parenchyma; they are very minute. Their form, in which they differ from those of *Mycale aegagropila* (Johnston), is best shown by figures (figs. 1, 1*a*, pl. x); their average length is about 0·0189 mm.; they are the most uniform in size of the spicules and by far the smallest in numbers as well as size.

Habitat.—Madras harbour in from 4 to 6 feet of water; on shells of living *Mytilus latus*, Lam.

Type No. Z.E.V. $\frac{0151}{7}$ Ind. Mus.

This sponge is closely allied to *Mycale aegagropila*. The size and proportions of the spicules are, however, different; the skeleton, at any rate in the central parts of the sponge, is much denser, and the complete absence of toxa, substantiated by an examination of many fragments mounted whole as well as by preparations of cleaned spicules, is apparently a distinctive character.

Gemmules closely resembling those of *M aegagropila* as figured by Vosmaer and Pekelharing (*op. cit.*, p. 30, pl. 1, fig. 3) occur in specimens collected in October.

Mycale madraspatana, sp. nov.

(Plates x, fig. 3 and xi, fig. 4.)

In the structure of its soft parts, in dimensions and in the form of its spicules this species closely resembles *M. aegagropila*, but the chelae are arranged in rosettes and the skeleton is much more highly organized: the colour in life is that of *M. mytilorum*.

Skeleton.—Two distinct kinds of spicule-fibres can be recognized. On the external surface, partly in the dermal membrane and partly in the parenchyma immediately below it, run comparatively stout, sinuous, non-anastomosing fibres, which cross one another occasionally but branch sparingly and do not fuse together. They are a little splayed out and occasionally fork at both extremities, but form regular brushes at neither; in optical section as many as 12 spicules abreast can sometimes be detected. These broad fibres are best developed round the oscula. In the lower part of the parenchyma thinner fibres, 2 (or even 1) to 7 spicules abreast in optical section form a regular horizontal network, branching freely and anastomosing. Transitionary forms between the two kinds of fibres occur very sparingly. In addition to the fibres there are many macroscleres scattered horizontally in the parenchyma. These are not shown in figure 4, pl. xi.

Spicules: Macroscleres.—The majority of the macroscleres closely resemble those of *M. aegagropila* except that the shaft tapers more distinctly towards the blunt extremity; the heads, if they can be distinguished, are narrowly oval. Together with macroscleres of this type very much more slender styli of approximately the same length occur sparingly. The average length of the typical macroscleres is 0·279 mm., the extremes being 0·265 and 0·296 mm.

Microscleres.—Anisochelae, sigmata and toxa are found. The anisochelae are arranged in rosettes, but the size and regularity of these groups varies, together with the number of anisochelae present in the sponge, in different specimens from the same locality. The form of the spicule closely resembles that of the spicule of the same type in *M. aegagropila*, but there are certain differences (best shown in figs. 2*a* and 3*a* on pl. x) in the structure of the extremities and the size is a little greater, the average length being 0·0473 mm. (extremes 0·043 and 0·0516 mm.). Sigmata are very scarce; they are a little more contorted as a rule than those of *M aegagropila* from the same locality. The toxa, which are fairly abundant, are extraordinarily variable in size: 0·140 to 0·352 mm. in length. Most of them fall into one of two series characterized by size. In the smaller toxa the central curve is as a rule more compressed than in the larger ones, which are actually longer than the macroscleres.

Type No. Z.E.V $\frac{6118}{7}$ Ind. Mus.

Locality.—Madras harbour in 4 to 6 feet of water; on living shells of *Mytilus latus*, Lam.

The degree of development reached by the skeleton in this species is probably somewhat variable, but it is only in well-preserved specimens on which no artificial pressure has been exerted that the double system of spicule-fibres can be adequately observed.

Specimens of this species collected in October are full of gemmules in early stages of development. Indeed, parts of the sponge appear to consist of little else but morula-like masses of cells evidently of this nature.

Genus **Lissodendoryx** (Topsent) Lundbeck.

Topsent, *Mem. Soc. Zool. France* IV, p. 457 (1897); *Rés. Camp. Sci. Monaco*, fasc. II, p. 173 (1907); Lundbeck, *Dan. 'Ingolf'-Exp. VI* (2), p. 153 (1905).

Lissodendoryx balanophilus, sp. nov.

(Plates x, fig. 4 and xi, fig. 5.)

The *sponge* forms a crust not more than 4 mm. thick on the shells of Lamellibranchs, often occurring together with *Balanus amphitrite*, Darwin. It fills up the interstices between individual barnacles as well as growing over their shells in a thin film. The external surface is irregular, but not spiny and without definite projections. The colour is pale yellowish green and fades little in spirit. The structure is somewhat cavernous owing to the comparatively great calibre of the main exhalent channels, which run obliquely upwards through the sponge and do not form branching grooves on the surface of the parenchyma. The oscula are rather larger than those of the species of *Mycale* described above, but the pores are minute and difficult to detect. The whole sponge is very fragile, but rather less so than the others found with it.

The *skeleton* contains little binding substance. The dermal macroscleres form short, somewhat plumose fibres in which as many as 12 spicules abreast can sometimes be seen in optical section. These fibres branch dichotomously or irregularly at their extremities, or at any rate at the extremity nearest the surface. They are usually somewhat contorted, but they do not anastomose; their course is mainly horizontal but as a rule dips down into the sponge more or less deeply; they are connected together to form a somewhat loose reticulation by single tornote spicules. The styli and tylostyl form in the parenchyma a fairly regular reticulation for the most part composed of single spicules and comparable with the typical skeleton of *Reniera*; but traces of fasciculation can be detected at some points.

Spicules: Macroscleres.—The majority of the dermal macroscleres are tornota with well-defined smooth oval extremities of comparatively large size. Their shafts are as a rule smooth, slender and straight. Both amphioxi and amphistrongyli occur, however, among them, always sparingly. These spicules, which must be regarded as abnormalities, invariably have their shafts irregular in outline and as a rule are inflated at several or many points. The skeleton-spicules are as a rule a little shorter and stouter than the tornota; their shafts are usually smooth, but occasionally bear a few scattered spines near the blunt end; this end, which is in most cases distinctly globular and well differentiated from the shaft, is rarely or never quite smooth, but as a rule may be called irregular in outline rather than actually spiny. The other extremity is sharply and gradually pointed. These spicules are from 0·124 mm. to 0·16 mm. long. Sometimes much shorter and stouter tylostyles of very irregular form occur in small numbers, and even what may be called normal spicules of the type vary considerably both in proportions and in outline. Typical tornota are on an average about 0·167 mm. in length (0·166 to 0·176 mm.).

Microscleres.—The microscleres include minute and very slender C- and S-shaped sigmata as well as isanchorae. In the latter the shaft is stout, somewhat compressed laterally and feebly curved; the three teeth at either end are subequal, narrow and sharply pointed; those at the sides project outwards in such a way that it is hardly possible for the spicule to rest on its dorsal surface. (This makes it impossible to obtain an accurate *camera lucida* drawing of the front view).

Type No. Z.E.V $\frac{9070}{7}$ Ind. Mus.

Locality.—Madras harbour in 4 or 5 feet of water; on living shells of *Mytilus latus*, Lam. (together with *Balanus amphitrite*, Darwin) and also on those of *Ostrea* sp.

This sponge would not fall within the genus *Lissodendoryx* as originally defined by Topsent, for all the parenchymal macroscleres are not smooth, although most of them are nearly so. Lundbeck has, however, pointed out that the critical character lies not in the form of the macroscleres, but in that of the hooded microscleres. These belong to the type known to him and to some other writers as iso-anchorae, whereas the corresponding spicules in *Myxilla* are true iso-chelae. The distinction may be accepted as convenient; but it should be noted that the importance thus attributed to the difference between the two types of microscleres is not accepted by all spongologists.

B.—A Sponge common on Oyster-shells in Brackish Water.

Fam. SUBERITIDAE.

Suberites aquae-dulcioris, sp. nov.

Sponge.—The sponge forms a film not more than 2 mm. thick, in most places quite flat but slightly raised in the neighbourhood of the oscula, which are sparsely scattered on the surface. The oscula are very small and can be closed completely; each is connected with a branching and occasionally anastomosing system of superficial exhalent channels the roof of which is formed by the dermal membrane. Except over these channels, the external surface is minutely hispid. The dermal pores are minute and occur in considerable numbers all over the membrane except where it forms the roof of the exhalent channels. The subdermal cavity is ample, being supported by bunches of spicules. The inhalent canals run vertically downwards below the pores. The colour of the living sponge varies from leaf-green to orange-yellow; in specimens in spirit or dry it is dirty white. The superficial area of the largest specimen seen did not exceed that of a moderate-sized oyster-shell.

Skeleton.—In living or carefully preserved sponges the skeleton consists of numerous plumose spicule-fibres which radiate outwards and obliquely upwards through the sponge, their general course being directed away from the oscula, towards which their blunt ends point. At their external extremity, as they approach the surface of the sponge, each fibre bears a large bunch of vertical spicules with their sharp ends pointing upwards and outwards. It is these bunches of spicules that support the dermal membrane over the dermal cavity; only their tips protrude through it. The floor of the superficial exhalent channels, in which there are no bunches of spicules, is supported by single spicules, which are directed outwards from the oscula and never project vertically upwards. There are numerous loose spicules lying parallel to the base of the sponge, especially in its lower parts. The spicule-fibres are devoid of any binding substance and the regular arrangement just described is apt to break down if specimens are not carefully preserved. In this case the skeleton-fibres often disappear almost completely, but the terminal bunches are more consistent.

Spicules.—The only spicules proper to the sponge are macroscleres, but if, as is often the case, it is growing in close contact with *Cliona vastifica*, Hancock, the zigzag microscleres of that sponge are apt to intrude into it. The macroscleres are of two sorts, amphioxi and tylostyles; the former are, however, extremely scarce and should be regarded as abnormalities. They are slender and always more or less distorted. With few exceptions, therefore, the skeleton is composed of slender tylostyles of very variable size and proportions. One extremity is sharply and gradually pointed, while the other forms a distinct head, which usually bears some resemblance to an acorn, being divided into a rounded terminal portion, as a rule longer than broad, and an enlarged ring-like base. The differentiation is, however, not always distinct and the exact form of the whole head is very variable. The largest macroscleres are about 0·033 mm. in length and their stem nowhere exceeds 0·0056 mm. in thickness. The curvature of the spicules is usually slight and regular, if they are not absolutely straight; but some are a little sinuous and a few are always to be found in which the stem is curved or angularly bent at one point. The head is relatively small, as a rule distinctly longer than broad.

Type No. Z.E.V $\frac{6039}{7}$ Ind. Mus.

Habitat.—Chilka Lake, Orissa, near the east coast of India, in brackish water on leaves of *Halophila* and shells of *Ostrea*; also on the latter in the backwater at Ennur near Madras. This sponge has been found at two places in the Chilka Lake, namely about a mile off Burkul near the inner shore and at Manikpatna in the outer channel a few miles from the mouth.[1] At the former place several very young specimens were found in July on the leaves of a plant actually floating on the surface but probably detached from the bottom in about 6 feet of water. The specimens from Manikpatna are larger and were found in September on the external surface of the valves of oysters (*Ostrea* sp.) living in about 4 feet of water.

In its form and method of growth this sponge approaches *Prosuberites*, Topsent, but the possession of horizontal spicule-fibres distinguishes it from the species of that genus.

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[1] Further particulars about the distribution, etc., of this sponge will be given in a subsequent paper on the fauna of the Chilka Lake. *Feb.* 24th, 1914.

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EXPLANATION OF PLATE X.

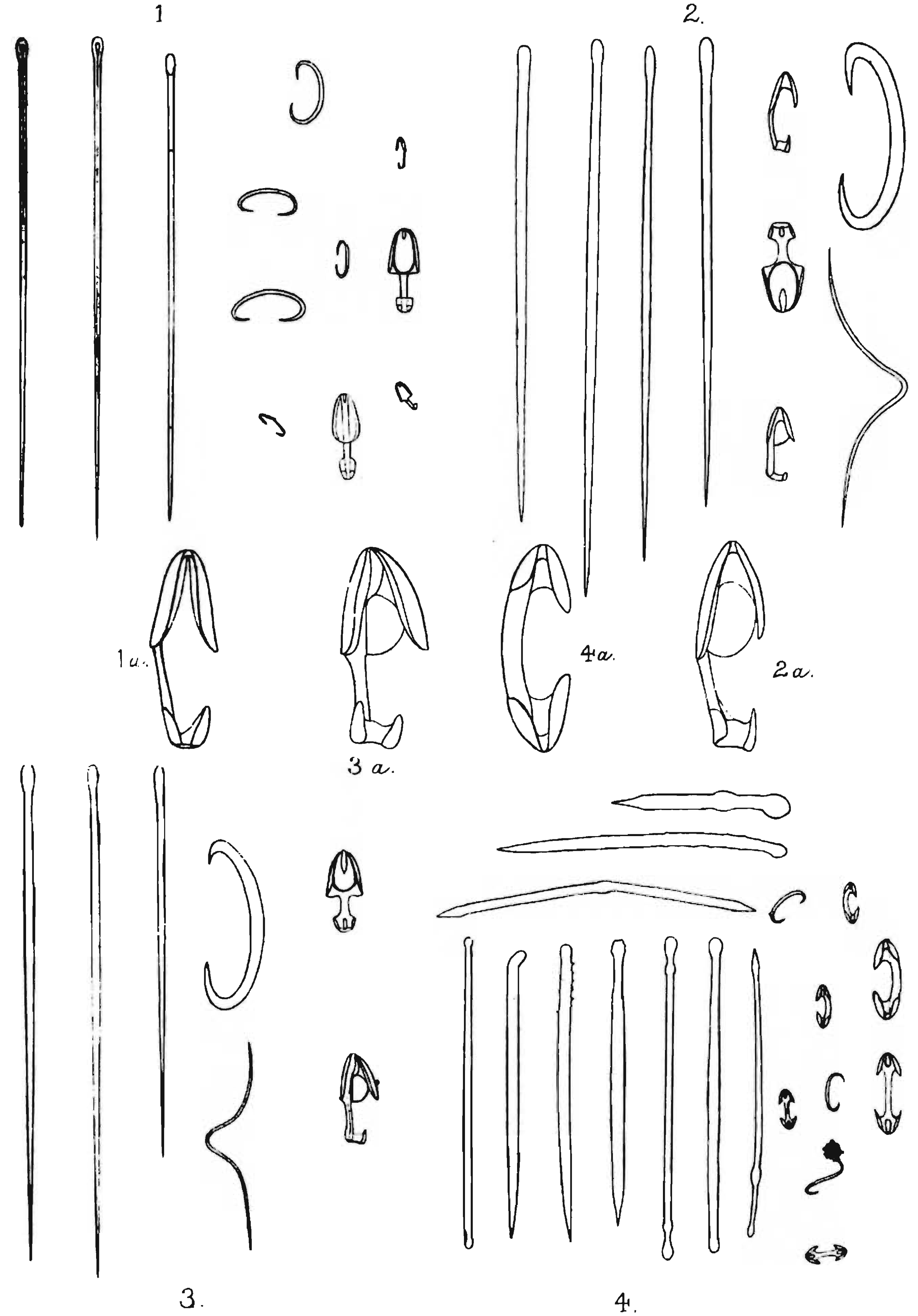
FIGS. 1, 1*a*. *Mycale mytilorum*, sp. nov.
1.—Spicules, × 300 1*a*.—Anisochela, × 1800.

FIGS. 2, 2*a*. *Mycale aegagropila* var. *militaris*, var. nov.
2.—Spicules, × 300. 2*a*.—Anisochela, × 750.

FIGS. 3, 3*a*. *Mycale madraspatana*, sp. nov.
3.—Spicules, × 300. 3*a*.—Anisochela, × 1350.

FIGS. 4, 4*a*. *Lissodendoryx balanophilus*, sp. nov.
4.—Spicules, × 300. 4*a*.—Isanchora, × 1350.

In figures 1 and 4 two of the chelae are represented on a larger scale than the rest of the spicules. In figure 4 the drawing of the **S**-shaped sigma has been blotted in reproduction.



A C. Chowdhary, del & lith

SPONGES FROM MADRAS HARBOUR

EXPLANATION OF PLATE XI.

FIG. 1. *Suberites aquae-dulcioris*, sp. nov.

Portion of skeleton supporting subdermal exhalent channels, as seen from above, × 75.

FIGS. 2, 2*a*, 3. *Mycale mytilorum*, sp. nov.

2.—Portion of skeleton supporting a subdermal exhalent channel, as seen from above, × 20. 2*a*.—Terminal part of a single spicule-fibre, × 75.

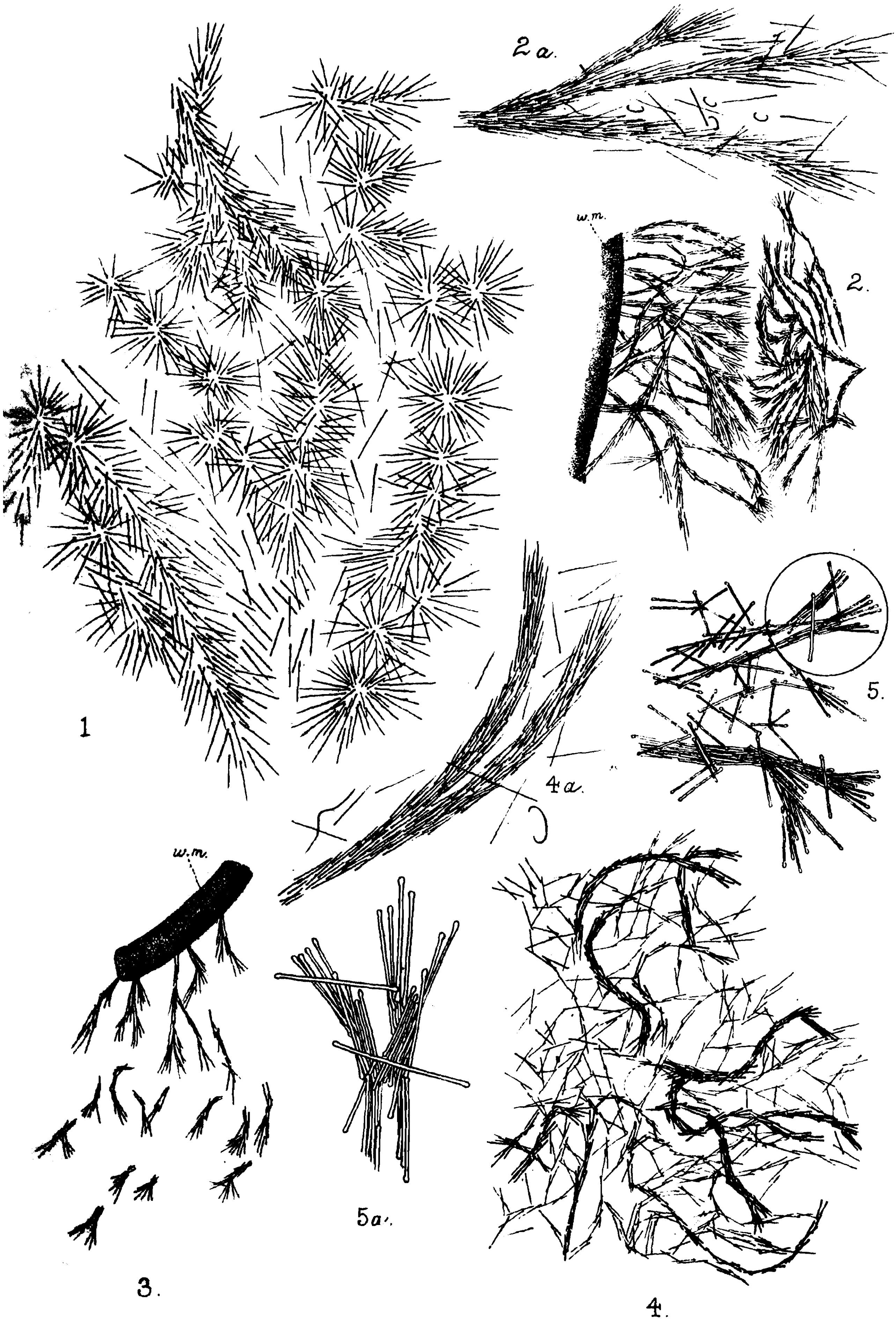
3.—Scattered spicule-fibres at periphery of sponge, as seen from above, × 20. *w.m.* = worm-tube.

FIGS. 4, 4*a*. *Mycale madraspatana*, sp. nov.

4.—Portion of skeleton surrounding an osculum, as seen from above, × 20. 4*a*.—Terminal part of one of the stouter spicule-fibres, × 75.

FIGS. 5, 5*a*. *Lissodendoryx balanophilus*, sp. nov.

5.—Superficial spicule-fibres, × 75. 5*a*. Part of the same preparation, × 225. The part further enlarged in fig. 4*a* is indicated by a circle in fig. 4.



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SPONGES FROM MADRAS & ORISSA.