

RECORDS

of the

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MISCELLANEA (pp. 81, 82).

Notes on the occurrence of *Vultur monachus* in Calcutta—*E. C. Stuart-Baker*. An albino Owl—*N. Annandale*. "*Matla bengalensis*": a correction—*J. Stephenson*.

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I. THE HYDROIDS OF THE INDIAN MUSEUM

I.—THE DEEP-SEA COLLECTION.

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INTRODUCTORY

This paper contains a first instalment of the description of the extensive collection of Indo-Malayan Hydroïds in the Indian Museum, Calcutta. To the Trustees of the Museum, represented by Dr. Nelson Annandale, Superintendent of the Museum, I desire to tender my thanks for his kindness in entrusting to me the identification of the collection.

Notwithstanding the unadvisedness of adopting a bathymetrical line of demarcation in dealing with so mobile a group as the Hydroïda, in which many species occur at exceedingly variable depths, this instalment confines itself to those forms which have been found in the deeper waters of the Indian seas, and for these reasons: Few littoral specimens were present in the collections received from the Indian Museum, and it is deemed better to leave over the description of such forms until additional shore and estuarine collecting—undertaken by Dr. Annandale—shall have made this section of the collection more representative. On the other hand the deep-sea collection seems to be already fairly complete.

Along with the deep water species I have recorded a few specimens, chiefly from the neighbourhood of the Andaman Islands, regarding which no indication as to the depth at which they were obtained was given. But it appeared more fitting, since they belong to the same series of collections as the deep Andaman specimens, to consider them here rather than with the shallow water forms.

GENERAL NOTES ON THE COLLECTION.

Morphological.—Under this head little of special interest has to be recorded. I must note, however, the occurrence, in the only species of *Aglaophenia* found in the collection, of a peculiar and distinctive gonosome. This appears to be a modified type of corbula in which the protective leaflets, which are arranged in two tiers, bristle outwards from the body of the gonosome, while the gonangia are covered in and protected by delicate plates of chitin (see p. 16, pl. iv, fig. 7).

Notice has been taken of the more patent minimal variations which occur in the various forms, in the hope that the more stable defining of species may be thus forwarded.

In describing the parts of the Plumularidæ I have adopted in addition to the general term 'nematophore,' originally used to signify the organ as a whole, the Hincksian names sarcotheca and sarcostyle to differentiate the chitinous protection from its fleshy content. Since 'nematophore' has been and still is used in the wide sense indicated above, it seems to me impracticable to restrict its meaning to the perisarc of the organ only, as advocated by Nutting (1900, p. 13), in spite of the fact that it has been loosely used in this way by systematists. There is the less reason to regret the impossibility, on account of the inappropriateness of the name as applied to a chitinous protection. Nor does it seem wise to complicate the terminology of the subject by the introduction of such terms as nematotheca and dactylothèque for a portion already sufficiently and excellently designated sarcotheca.

Distribution.—From the bathymetrical point of view the collection is interesting as indicating for the first time the aspect of the Hydroid fauna of the deeper Indian waters. A Sertularian and an epizoic Campanularian share the honour of having been dredged at the greatest depth, 1,343 fathoms, from beyond which exceedingly few Hydroids have ever been obtained. As they have already been recognised in shallow water—the former, *Idia pristis*, from 5 fathoms (Jäderholm, 1903) to 38 fathoms (Borradaile, 1905), the latter, *Campanularia corrugata*, from 7 fathoms (Thornely, 1904) to 40 fathoms (Campenhausen, 1896)—their bathymetrical range is an extraordinarily wide one, comparable to that of *Sertularella tricuspidata*, which occurs from almost the shore to 1,375 fathoms (Bonnievie, 1899).

As to geographical distribution, the collection increases the recognised Hydroid fauna of Indian seas by eleven species and that of Malaysia by two. Four of these are described as new to science¹; while the remainder of the new Indian records show, in the main, extensions in the range of Malaysian or Australasian species. Of the total of twenty-four species and varieties recorded, four occurred in the Malay Archipelago; while of the twenty from Indian waters, twelve of the species have been previously found in the Australo-Malayan region.

So far as can be judged from a very limited collection, the affinity of the deep-sea Indian hydroid fauna is, as one would expect from general considerations of faunal distribution, most markedly with that of the South Pacific.

¹ A preliminary note on these new forms has appeared in the *Ann. Mag. Nat. Hist.* (8), vol. iii, pp. 524—528 (1909).

Table showing the species recorded in this paper, with their distribution.

	Indian Ocean.	Madagascar to Cape Colony.	Malaysia.	Australasia.	N. Pacific.	Atlantic.
Eudendridæ—						
<i>Eudendrium</i> sp. (p. 3)		..	x			:
Bougainvillidæ—						
<i>Bougainvillea</i> sp. (p. 4) ..		..	x			
Campanularidæ—						
<i>Campanularia corrugata</i> , Thornely (p. 4) ..	x	x	*x		:	x
„ (?) <i>spinulosa</i> , Bale (p. 5)	..	..	*x	x	x	..
„ sp. (p. 6) ..	x			..		..
<i>Hebella crateroides</i> , Ritchie (p. 6)	*			..		..
<i>Thyroscyphus vitiensis</i> , M.-Turner. (p. 7) ..	x	x	x	..		
Lafoëidæ—						
<i>Lafoëa gracillima</i> (Alder) (p. 8) ..	*	..		x	x	x
„ <i>serrata</i> , Clarke (p. 9)	x	x				x
Sertularidæ—						
<i>Cryptolaria operculata</i> , Nutting (p. 9) ..			*	..	x	..
<i>Sertularella polyzonias</i> , v. <i>cornuta</i> , Ritchie (p. 10)	*	x		x		x
<i>Idia pristis</i> , Lamx. (p. 11) ..	x	..	x	x		x
<i>Diphasia mutulata</i> (Busk) (p. 12) .	x	..	..	x		
„ <i>thornelyi</i> , Ritchie (p. 13)	*	..		..
Plumularidæ—						
<i>Antenella secundaria</i> (Linn.) (p. 14)	*	x	x	x		x
<i>Aglaophenia septata</i> , Ritchie (p. 15)	*					
<i>Lytocarpus annandalei</i> , Ritchie (p. 17) ..	*		..			
„ <i>pennarius</i> (Linn.) (p. 19) ..	*		x		x	
„ <i>philippinus</i> (Kirchen) (p. 20)	x		x	x		x
„ <i>phœniceus</i> (Busk) (p. 21) .	x		x	x	x	
<i>Halicornaria halei</i> (M.-Turn.) (p. 22)	x					
v. <i>flava</i> , Nutting (?) (p. 23)	*				x	
„ <i>gracilicaulis</i> (Jäderh.) (p. 23)	*	x	x		x	
„ <i>hians</i> , v. <i>profunda</i> , Ritchie (p. 24)	*		..	x		

N.B.—(1) A * indicates a new record for region.

(2) Where varieties only are recorded the distribution of the species as a whole is shown.

SYSTEMATIC ACCOUNT OF THE COLLECTION.

GYMNOBLASTEÆ.

Family EUDENDRIDÆ.

Eudendrium, sp. indet.

A few small and dilapidated specimens little over 1 cm. high, with no trace of hydranths. While the trophosome might very

well be that of *E. ramosum* (Linn.), we prefer, considering the absence of the hydranths, to leave it unnamed.

LOCALITY: On *Epizoanthus* sp. from the Malay Archipelago; depth 160 fathoms.

Family BOUGAINVILLIDÆ.

Bougainvillea, sp. indet.

A single colony occurs in the collection, and as it is probably a young form (it is only 7 mm. high) it cannot be specifically identified. It agrees with *B. ramosa* (Van Beneden) in several points, for its hydrocaulus is fascicled at the base, is not simple, and has been attached by a delicate hydrorhiza, while the hydranths bear from 9 to 13 tentacles. No ringing is present on the hydranth-bearing branches, but a definite kink occurs just where they leave the stem. From *B. ramosa*, however, the specimen differs greatly in size and in the fact that the hypostome of the hydranth is flattened rather than sharply conical.

A single very immature gonosome arises from one of the branches.

LOCALITY: Growing on the type specimen of *Scalpellum sociabile*, Annandale, from Bali Straits (Java), Malay Archipelago; depth 120 fathoms.

CALYPTOBLASTEÆ.

Family CAMPANULARIDÆ.

Campanularia corrugata, Thornely.

Thornely, L. R., 1904, p. 114, pl. i, fig. 2.

Billard, A., 1907 (2), p. 341, fig. 1.

Many calyces of this species spring from stolons creeping on specimens of *Idia pristis*. In all respects they agree with Miss Thornely's description and figures, except that, like Dr. Billard's examples, they are of much smaller growth, and possess in some cases a more corrugated hydranthophore. In well-preserved specimens a very delicate partition exists beneath the base of the hydranth, separating the cavity of the hydrotheca from that of the stalk.

Detailed measurements show that these Indian specimens are on the whole somewhat smaller than those recorded from Madagascar and Natal (see references below):—

Hydranthophore, length	0.25—0.63 mm.
Hydrotheca, length	0.91—1.22 ,,
,, diameter	0.49—0.53 ,,

Considering the variations which occur in these Indian examples as regards the size and shape, the ringed or smooth condition of the hydrotheca, and the presence of corrugations on the peduncle, I am of opinion that the characters relied on by myself in distinguishing *C. mutabilis*, Ritchie (1907 (2), p. 504), from this

species are untrustworthy, and that the two forms are specifically identical. Nor is there any point by which *Lafoëa magna*, Warren (1908, p. 343), can be separated from Miss Thornely's species. These names therefore, *Lafoëa magna*, Warren, and *C. mutabilis*, Ritchie, must be regarded as synonyms of *C. corrugata*, Thornely.

LOCALITY: Climbing on *Idia pristis* obtained by the R.I.M.S. "Investigator," at Station 312, lat. 16° 56' 15" N., long. 92° 35' 00" E. (off Lower Burma); depth 1,343 fathoms.

Distribution.—Recorded from the Indian Ocean: Ceylon (Thornely, 1904), Madagascar (Billard, 1907 (2)), Natal (Warren, 1908); and from the tropical Atlantic: Cape Verde Islands (Ritchie, 1907 (2)).

C. corrugata has been found at other localities from which, however, it has not been recorded as such. Armstrong (1879, p. 101, pl. xi) figures what is undoubtedly a colony of this species climbing over *Halicornaria plumosa*, and he describes the hydrotheca as the gonosome of the Plumularian. His specimens were found in "30 to 40 fathoms, Cape Comorin, S. of India, and in 10 to 15 fathoms, off Cheduba Island, coast of Arrakan." Campenhausen (1896, pl. xv, fig. 3) figures, without mentioning, hydrothecæ of this species on an unidentified Plumularian (apparently *Halicornaria gracilicaulis* (Jäderholm)) which was found in the littoral zone off Ternate. This occurrence extends the distribution of *C. corrugata* into the South Pacific.

Campanularia (?) *spinulosa*, Bale.

Bale, W. M., 1888, p. 756, pl. xii, figs. 5—7.

Two minute colonies, each 6 mm. high, have been assigned to this species. The stem of one shows a trace of fasciculation of the type figured by Bale for this species, an offshoot from the base of one of the branches growing downwards along the original stem. The hydrothecæ are exceedingly delicate and have in most cases collapsed so completely that the character of the margin is altogether obscured. In the cases where the bicuspid teeth were visible they seemed to be somewhat less pointed than in Bale's figure. The pedicels taper slightly upwards and are generally annulated throughout, bearing from 6 to 16 rings; but sometimes a long pedicel occurs with rings only at top and bottom. The hydranth has about 14 long tentacles.

Measurements.

Hydrotheca, length	0.77—0.84 mm.
,, diameter	0.28 ,,
Stem, diameter of single tube	0.13 ,,

As it is impossible in the absence of the gonosome to determine with precision the generic position of this species, I have retained for it the name given it by Bale. It seems probable, however, that it is either an *Obelia* or a *Gonothyræa*, for its trophosome is scarcely distinguishable from that of gonosome-bearing specimens

from New Britain, recorded by Miss Thornely (1899, p. 454) as *Gonothyræa longicyatha*.

LOCALITY: Found growing on the type specimen of *Scalpellum sociabile*, Annandale, from Bali Straits (Java), Malay Archipelago; depth 120 fathoms.

Distribution.—Bale's specimens were found at Port Jackson, East Australia; Nutting has recorded the species from Maui, one of the Hawaiian Islands (Nutting, 1905, p. 943).

Campanularia, sp. indet.

A few specimens growing upon a type specimen of *Scalpellum squamuliferum* were in so poor condition that I have not ventured to name them. They are Campanularians with stems (up to 12 mm. high) which are generally unbranched, although occasionally smaller replicas of the main stem spring from it. The stem is topped by a hydrotheca with exceedingly delicate walls which have collapsed so thoroughly that nowhere was the margin visible. On this account the structure of the rim, an important diagnostic character, could not be observed.

The general structure of the recognisable portions of the specimens is similar to that of a gigantic *Clytia johnstoni*, Alder: stems with about 15 rings at the base, and about 3 below the hydrotheca, the median portions being smooth except where regeneration has occurred. Hydrothecæ similar to those of *Clytia johnstoni* in shape, and in the minute structure of the base, remainder unrecognisable. No gonosome is present.

Measurements.

Stem, diameter	0·11—0·17 mm.
Hydrotheca, depth, <i>circ.</i>	0·98—1·19 ,,
,, maximum diameter, <i>circ.</i>	0·70 ,,

LOCALITY: Growing on *Scalpellum squamuliferum*, Weltner, from the Andaman Islands; depth 271 fathoms. Marine Survey collection. Reg. No. 1197/10.

Hebella crateroides,¹ Ritchie.

(Pl. iv, fig. 1.)

Ritchie, J., 1909 (2), p. 524.

This form occurs in abundance on specimens of *Lytocarpus phæniceus*. A creeping hydrorhiza meanders over the posterior portions of the stem and branches of the Plumularian, sending off here and there a hydrotheca or gonotheca. The hydrothecæ are small and colourless, often asymmetrical in shape, with firm walls, marked in some cases by exceedingly faint corrugations, and gracefully everted round the margin. The hydranthophore is not distinctly indicated, for the hydrotheca gradually diminishes in diameter from the margin until the hydrorhiza is reached, except for a slight bulging about the middle. In some cases (as in pl. iv,

¹ κρᾶτηρ = a cup.

fig. 1) a single joint traverses the stalk, but this is due to fracture and subsequent regeneration; in normal specimens no joint occurs, and only a delicate film separates the cavity of the hydrotheca from the common cavity of the colony. The hydranth has about 6 to 8 tentacles.

Gonosome.—The gonangia are borne on short and indefinite stalks, and are at least three times as large as a hydrotheca. They are roughly cylindrical in shape, and have walls circled by faint and irregular corrugations. In the earlier stages of development an opercular plate ("deckenplatte") at the end of the blastostyle, closes in the top of the gonangium, but, as development proceeds, this disappears and the perisarc folds outwards, forming a gracefully everted margin. The developing medusæ, three in number in each gonangium, are roughly spherical, but the state of preservation was so imperfect that details could not be observed. The manubrium is large, and four stout tentacles are present ere the medusa is set free.

Measurements.

Hydrotheca, length ..	0·36—0·39 mm.
,, diameter at mouth	0·18—0·21 ,,
Gonangium, length	1·01—1·23 ,,
,, maximum diameter	0·36—0·43 ,,

From *Hebella calcarata* (A. Agassiz), which it approaches, this species differs in its hydranth, which has only seven instead of about sixteen tentacles, and in its hydrotheca, which has neither the cylindrical shape nor the marked bulging towards the base characteristic of the other species, and which, moreover, shows no traces of a strong chitinous septum at the base. From *H. lata*, Pictet (1893, p. 40, pl. ii, figs. 34, 35), it is distinguished by having fewer tentacles, by its much smaller size, and by the more obconical shape and everted margin of its hydrotheca.

LOCALITY: Growing on *Lytocarpus phæniceus*, dredged 8 miles west of Interview Island, Andaman Islands, depth 270—45 fathoms.

Type in the Indian Museum, Calcutta.

Thyroscyphus vitiensis, Marktanner-Turneretscher.

Markt-Turner., G., 1890, p. 210, pl. iii, fig. 10.

Two small fragments which appear to me to represent this species occurred with other odd colonies from the Andamans. They are only 12 mm. high, portions of young colonies, but even so they show considerable variation in the length and diameter of the internodes. In one fragment, which is strongly geniculate, they are from 1·5 to 1·9 mm. long, and 0·15 mm. in diameter; in the other, while the length remains similar, the diameter is 0·32 mm. The hydrothecæ measure from 0·98 to 1·12 mm. in height, and 0·66 mm. in diameter at the mouth. The hydranths, which are exceedingly dumpy when contracted, appear to have about 26 to 30 tentacles.

The colonies described by Miss Thornely (1904, p. 113) as young specimens of *Campanularia juncea* seem to me, as to Dr. Billard, indistinguishable from this species.

LOCALITY: Andaman Islands, 1899; 60 fathoms.

Distribution.—*Thyroscyphus vitiensis* is an Indo-Pacific species, recorded from the Malay Archipelago (Markt.-Turn., 1890), from various localities in the neighbourhood of Madagascar (Billard, 1907 (2)), from Ceylon (Thornely, 1904), and from the Andamans (present record).

Family LAFOEIDÆ.

Lafoëa gracillima (Alder).

Alder, J., 1857, p. 39, pl. vi, figs. 5, 6; as *Campanularia gracillima*.
Allman, J. G., 1888, p. 34, pl. xvi, figs. 2, 2a; as *Lafoëa fruticosa*.
Bonnievie, C., 1899, p. 64, 65, pl. v, fig. 2a.

Three small colonies were found growing on the spine of a Cidarid Sea-Urchin. The colonies are less complex and less bushy than are normal specimens, and the largest is only 15 mm. high, without a single branch; but it was not to be expected that colonies placed on so movable a foundation should attain typical robustness of development. The compound stem is of the rhizocaulom type, and the structure of a hydrotheca is typical, a solitary twist separating it from the stem, while the upper surface is strongly convex and the lower, although it is considerably straighter than in British specimens, also tends to curve parallel to the upper profile. These characters make certain the identity of the specimens with *L. gracillima*, notwithstanding that the dimensions of the hydrothecæ are much greater, and the minute structure as a whole is more robust, than in typical examples of that species. In those respects the Indian examples approach a variety, *benthophila*, collected by the Scottish National Antarctic Expedition, south of the South Orkneys, at a depth of 1,775 fathoms (Ritchie, 1909 (1), p. 76); and since the present examples also have been dredged from deep water it may be that the unusual robustness in minute structure is correlated with the unusual depth at which the specimens existed.

For comparison the sizes of var. *benthophila* and of a typical form are given alongside those of the Indian specimens:—

	Indian Museum specimen.	Antarctic var. <i>benthophila</i> . ¹	North Sea typical specimen. ²
Hydrotheca, length including hydranthophore	0·87—0·95 mm.	0·87—1·01 mm.	0·57—0·76 mm.
Hydrotheca, diameter at mouth	0·20—0·24 ,,	0·21—0·25 ,,	0·11 ,,
Diameter of a single tube of stem	0·11 ,,	0·16 ,,	0·10 ,,

¹ Mentioned in the table in the *Supplementary Report on the Scotia Hydroïds* as a "Coat's Land specimen." The locality, as shown by the bearings, is considerably nearer to the South Orkneys than to Coat's Land.

² Specimen from lat. 58° 34' N., long. 0° 47' E., in my collection.

LOCALITY: Growing on the spine of a Cidarid Sea-Urchin dredged from Station 358 of the R.I.M.S. "Investigator," lat. $15^{\circ} 55' 30''$ N., long. $52^{\circ} 38' 30''$ E. (Arabian Sea, near the Gulf of Aden); depth 585 fathoms.

Distribution.—(See Hartlaub, 1905, p. 594.) A species of world-wide range recorded from the North Pacific (Marktanner-Turneretscher, 1890; Nutting, 1899; Torrey, 1902); the North Atlantic Ocean (Hincks, 1868, etc.); the South Atlantic Ocean (Allman, 1888; Hartlaub, 1905; Jäderholm, 1905; Ritchie, 1907 (1)); the Arctic Ocean (Bergh, 1887); the Antarctic Ocean (Ritchie, 1909 (1)); South Australia (Bale, 1884). The species has not hitherto been recorded from Indian seas.

Lajoëa serrata, Clarke.

Clarke, S. F., 1879, p. 242, pl. iv, fig. 25.

Hartlaub, C., 1905, p. 595, fig. Q².

Represented in the collection by only a few specimens which agree in dimensions with the typical examples recorded by Billard from the coasts of Spain.

Measurements.

Hydrotheca, length of adnate portion	0.22—0.27 mm.
„ „ free „	0.25—0.29 „
„ diameter at mouth	0.063—0.077 „

LOCALITY: Creeping on *Sertularella polyzonias* var. *cornuta*, from 8 miles west of Interview Island, Andaman Islands; depth 270—45 fathoms.

Distribution.—A widely distributed species recorded from the east and west sides of the North Atlantic (Billard, 1907 (1); Clarke, 1879); from the Straits of Magellan (Hartlaub, 1905); and from the Indian Ocean (Zanzibar, Billard, 1907; Gulf of Manaar, Thornely, 1904; Andamans, present record).

Family SERTULARIDÆ.

Cryptolaria operculata, Nutting.

Nutting, C. C., 1905, p. 947, pl. iii, fig. 4; pl. x, 12—14.

Colonies of this species much more complete than those found by Professor Nutting occur in the collection. Although now somewhat broken, the largest colony when pieced together reaches a height of about 20 cm. It has a thick fascicled stem, 3 mm. in diameter at the base, of a pale brown colour, and terminating in a flattened basal expansion. From the stem arise strongly fascicled, gnarled branches (2 mm. in diameter), which bear off-shoots to the fifth or sixth degree. Although they lie roughly in one plane, little regularity pervades the arrangement or structure of the

branches, and, especially in the older parts of the colony, anastomosis between branches, or even between two neighbouring colonies occasionally takes place.

As regards the characters of the hydrotheca there is little to be added to Nutting's description. If the expansion at the base of the polyp be taken as indicating the bottom of the hydrotheca, since no perisarc structure marks the boundary between the hydrotheca and the common cavity, then about half of the hydrotheca is adnate to the branch, and about half free, at least on those portions where fascicling has not obscured the relations of parts. The operculum is, as Nutting surmised, similar in structure to that in the genus *Stegopoma*.

The hydranths are large and fusiform, similar in shape to Hincks's figures of those of *Halecium halecinum* (Hincks, 1868, pl. 42, fig. b). They are crowned by about eleven tentacles and are moored to the hydrotheca by strands of cœnosarc projecting from a basal expansion.

No gonosome was observed.

Measurements.

Hydrotheca, length adnate	0.50 mm.
„ „ free	0.49—0.56 „
„ diameter	0.17—0.21 „

LOCALITY: Malay Archipelago; depth 160 fathoms. Marine Survey collection. Reg. No. 8416/6.

Distribution.—*C. operculata* has been recorded hitherto only from "between the islands of Molokai and Maui, 138 fathoms," Hawaiian Islands (Nutting).

It is of interest to note that dwelling within the tubes of very many of the stems, even those in which the polyps are quite fresh, having apparently been alive when the specimen was obtained, are minute tentacled polychæte worms.

Sertularella polyzonias (Linnæus), var. *cornuta*, Ritchie.

(Pl. iv, fig. 2.)

Ritchie, J., 1909 (2), p. 525.

From two localities come colonies which I record as a variety of *S. polyzonias*. Their habit differs considerably from the lax growths of var. *gracilis*, Kirchenpauer, which occur on the coasts of Britain, for the stem is thicker and more definite, and the branches alternate more regularly. There is nothing however to distinguish the minute characters of the hydrothecæ from those of some of the many forms of *S. polyzonias*, their shape approaching most closely, perhaps, that figured by Hartlaub (1900, Taf. v, fig. 5) from Juan Fernandez. On the whole, the facies of the trophosome approaches

that of var. *robusta*, Kirchenpauer (1884), from the Cape of Good Hope.

The gonangia are characteristic. While they have the elongate-ovate shape and the strong corrugations of typical specimens, they are surmounted by four stout spines lying cross-wise, in a plane at right angles to the long axis of the gonangium. This character has given its designation to the variety.

Measurements.

Hydrotheca, length of adnate portion	0·25—0·39 mm.
,, ,, free portion	0·25—0·28 ,,
,, greatest diameter	0·22—0·28 ,,
,, diameter at mouth	0·17—0·20 ,,
Gonangium, length	1·37 ,,
,, greatest diameter	0·59 ,,
,, length of " horns "	0·22 ,,

LOCALITIES: (a) Andaman Islands; depth 490 fathoms; Reg. No. 64/7; (b) 8 miles west of Interview Island, Andaman Islands; depth 270—45 fathoms.

Type in the Indian Museum, Calcutta.

Distribution.—World-wide, but although the species has been recorded from the Red Sea (Kirchenp., 1884), from off Australia (Bale, 1884), and from Natal (Warren, 1908), it has not hitherto been found in Indian seas.

Idia pristis, Lamouroux.

Lamouroux, J V F., 1816, p. 200, pl. v, fig. 5.

Allman, J G., 1888, p. 85, pl. xxxix.

A clump of many colonies—the larger about 7 cm. high—alone represents this species. The clump is the centre of a life-association of much variety: about the base were corallines, and coral skeletons; intertwined with the hydroid stems were at least two species of Alcyonarians; while over the colonies themselves meander a creeping Polyzoon and a hydroid recorded above,—*Campanularia corrugata*.

My observations as to the structure of polyp and hydrocaulus confirm those of Billard (1907, p. 351), for, contrary to Allman's description (1888, p. 86), I can find no trace of an interior chamber containing a diverticulum of the base of the polyp.

LOCALITY: Collected by the R.I.M.S. "Investigator" at Station 312, lat. 16° 56' 15" N., long. 92° 35' 00" E., off Lower Burma; depth 1,343 fathoms.

Distribution.—The records of this species have been recently brought together by Billard (1907, p. 352). Its centre of distribution appears to be in the Indo-Pacific region, for it has been found on the east coast of Australia, among the East Indies, off the Malay Peninsula, and in the Indian Ocean. A solitary record—that

of the "Challenger"—from off Bahia, in Brazil, indicates its presence in the Atlantic Ocean.

Diphasia mutulata (Busk).

(Pl. iv, fig. 3.)

Busk, G., 1852, p. 391; as *Sertularia mutulata*.

Bale, W. M., 1884, p. 101, pl. ix, figs. 6—9.

A few small specimens of this species were growing on a sponge. They are only about 10 mm. in height and are unbranched, whereas Busk's type was 3 inches high and bore irregular branches; but the minute structure corresponds with Busk's rather meagre description. The colonies, which are of delicate texture, are faintly tinged with brown. The hydrothecæ are in pairs, sub-opposite on the proximal portion, but on the same level in the distal part of a colony. Occasionally too, nodes, though indistinguishable at the base of a specimen, are discernible towards its tip. The hydrothecæ are deep and narrow; their distal free portion projects at right angles to the stem, its length being equal to about $\frac{1}{3}$ that of the adnate portion. The aperture faces upwards and slightly outwards, is elliptical in shape, broader than deep, bounded on the adcauline side by a straight margin, on the abcauline by a gentle curve. An operculum is present, hinged to a thickening of perisarc on the free edge of the adcauline wall. Within the hydrotheca is a prominent intrathecal ridge, projecting from the mid portion of the abcauline wall and curving strongly upwards. The lateral portions of this partition can be traced for a considerable distance along the walls of the hydrotheca, but its general limit is strongly defined by a thickened edge.

No gonosome was present.

Measurements.

Hydrotheca, length of free portion ¹	0·15—0·21 mm.
" " adnate portion	0·45—0·52 "
" diameter of free portion	0·20 "
" " adnate portion	0·10 "
" breadth of aperture from side to side	0·27 "
Distance between hydrothecæ	0·08—0·14 "

LOCALITY: Growing on a sponge from the Andaman Islands, 1899; depth (?) 490 or 60 fathoms.

Distribution.—Previously recorded from Torres Straits (Busk, 1852); Port Molle (Bale, 1884); off Galle, off Negombo, and in the Gulf of Manaar (Thornely, 1904); Suez docks and Suez Bay (Thornely, 1908).

¹ Measured along adcauline wall.

Diphasia thornelyi,¹ Ritchie.

(Pl. iv, figs. 4, 5.)

Ritchie, J., 1909 (2), p. 525.

Several delicate, unbranched colonies, with non-fascicled stems were found growing about the "root"-masses of *Lytocarpus pennarius*. They are small (the largest only 16 mm. high), spring from a simple stolon, show no traces of nodes, and bear hydrothecæ from the base upwards. The hydrothecæ vary much in their position relative to one another. They are biserial and lie in the same plane, and although in most cases they are alternate or sub-alternate, rarely an opposite arrangement is simulated.

A hydrotheca is deep and narrow, with the inner edge adnate to the stem for practically its whole length, except for a short horizontal knobbed ledge upon which the adcauline operculum is hinged. The cavity of the hydrotheca is divided into two parts by a short upturned ridge which projects from the abcauline wall midway between the base and margin. Proximal to this hooked intrathecal ridge the wall of the hydrotheca suddenly becomes much thicker (up to 60 μ), and is continued thus till the next hydrotheca is reached. The outer wall of the distal half of the hydrotheca curves gently outwards and upwards, and almost parallel to the outer wall, and terminating at the base in a thickened ridge, runs the partition which separates the cavity of the hydrotheca from that of the stem. The margin is smooth and rimmed, a border being formed by a well-marked line which runs parallel to the lateral edges of the hydrotheca. The aperture, which faces somewhat towards the stem, forms an arc of a circle, its outer border being rounded, while its adcauline side, bounded by the horizontal ledge on which the operculum rests, is straight. The distal portion of the hydrotheca, as a whole, assumes the appearance of a bracket projecting from the stem. The operculum is a single, strong, adcauline disk, which rests on a thickened ledge.

Gonosome.—The gonothecæ arise from immediately beneath the hydrothecæ, and are without stalks. They are ovate in shape but are somewhat asymmetrical, a bulge occurring on the shoulder towards the stem. The aperture is cylindrical, placed on a short neck, and the distal half of the gonangium is ornamented with scattered but prominent spines.

Measurements.

Hydrotheca, length	0.38—0.45 mm.
„ breadth	0.11—0.14 „
„ diameter of aperture from side to side	0.21 „
Gonangium, length	0.64 „
„ maximum diameter	0.32 „

¹ This species has been named in honour of Miss Laura R. Thornely whose paper on the Hydroids collected by Professor W. A. Herdman off Ceylon has added much to our knowledge of the Indian members of the group.

A form of *D. mutulata* was figured by Miss Thornely (1904, pl. ii, figs. 6A, 6B, p. 118), and was described as having hydrothecæ which are "smaller and less prominent [than on other *D. mutulata* specimens] and sometimes sub-alternate, and the gonothecæ on these have only a few spines near the top and are of smaller size." This form appears to me to belong to the species described above. Miss Thornely's specimens were found in the neighbourhood of Ceylon.

LOCALITY: Growing on the root-like masses at the base of *Lytocarpus pennarius*, Andaman Islands. Collected by J Wood-Mason.

Type in the Indian Museum, Calcutta.

Family PLUMULARIDÆ.

Antenella secundaria (Linnæus).

Linnæus, C., 1788-1793, p. 3854; as *Sertularia secundaria*.

Pictet, C., and Bedot, M., 1900, p. 27, pl. vi, fig. 7; as *Plumularia secundaria*.

Only a few small colonies of this species occur in the collection. The characteristic minute sarcotheca which lies in the angle behind the hydrotheca is clearly present; the architecture differs in no detail from that of Atlantic specimens of this well-known species.

No gonangia are present.

It is not without considerable hesitation that I have transferred this well-known species from *Plumularia* to Allman's genus, *Antenella*. But, while it seems absurd to place in distinct genera, forms the minute structures of which are so similar as are those of *Plumularia catharina* and *Antenella secundaria*, yet it is sufficiently clear that the simple hydroclade-stem is characteristic of a considerable number of species, and therefore as a matter of systematic convenience it appears reasonable that *Antenella* should be retained as a separate genus, or at least as a sub-genus of *Plumularia*, until the classification of the Eleutheroplean Plumularians has been placed on a basis more satisfactory than that which at present holds.

Recent synonyms.—I am unable to find any character in Dr. E. Warren's description and figures of *Antenella natalensis*, Warren (1908, p. 318), which could separate it from the Linnean species recorded above. *A. natalensis* is obviously a synonym of *A. secundaria*.

In 1904 Miss Thornely described from Indian seas specimens of *Antenella gracilis*, Allman (1877), which "resemble the branches of *M[onostæchas] quadridens* exactly" (p. 121). These specimens, through the kindness of Miss Thornely and Professor W. A. Herdman, I have been allowed to examine. They differ from *A. gracilis*, as described and figured by Allman, in possessing an exceedingly minute postcalycine sarcotheca, while in Allman's species the superior median sarcotheca not only does not lie exactly in the angle between hydrotheca and internode, but it is equal in size to

the other median sarcothecæ. The specimens are examples of *Antenella secundaria*, not of *A. gracilis*.

LOCALITY: Climbing over *Sertularella polyzonias* var. *cornuta*, from 8 miles west of Interview Island, Andaman Islands; depth 270—45 fathoms.

Distribution.—*A. secundaria* is a widely distributed though rather uncommon species, recorded from the Mediterranean Sea (Heller, 1868; Mark-Turner, 1890); from the Atlantic Ocean, southwards from the shores of Britain (Hincks, 1868, as *Plumularia catharina* var.), and the Bay of Biscay (Pictet and Bedot, 1900; Billard, 1907 (1)) to the Azores (Billard, 1907), Madeira (Jäderholm, 1903), the north-west coast of Africa, and the Cape Verde Islands (Billard, 1907 (1)). Outside the Atlantic area it has been found in Indo-Pacific seas, from Natal (Warren, 1908, as *A. natalensis*), Ceylon (Thornely, 1904, as *A. gracilis*), Andaman Islands (present record), the Moluccas (Pictet, 1893), from Bass' Strait and Williamstown in Australia (Busk, 1852, and Bale, 1884, as *Plumularia campanula* var.¹), and from Japan (Stechow, 1907 and 1909).

Aglaophenia septata,² Ritchie.

(Pl. iv, figs. 6, 7.)

Ritchie, J., 1909 (2), p. 526.

A single imperfect colony, 65 mm. high, with a straight, fascicled, unbranched stem, was obtained at a great depth near the Andamans. The anterior tube of the fascicle is alone divided into internodes, which are separated by faint nodes, are of uniform lengths, and bear each a process upon which a hydroclade is set.

The hydroclades are biserial, lying in two planes which meet at an acute angle on the anterior side of the stem. They are alternate, project from the stem at an angle of 40°—45°, and are about 8 mm. long (the longest being 11 mm.). The hydroclades are divided into regular thecate internodes each of which is partitioned by numerous strongly marked septa. Four septa generally spring from the posterior wall of the hydrotheca: a small one near the base of the supracalycine sarcothecæ, two from the middle of the hydrotheca, and the fourth from a postero-basal position. In addition, three project from the anterior wall of the internode proximal to the hydrotheca: of these the distal is very characteristic for it is tilted upwards, and, as in *Lytocarpus annandalei* of this report, traverses the base of the median sarcotheca, cutting off its cavity from that of the internode, but for a hole which allows of the passage of the cœnosarc.

The hydrothecæ are rather distant, almost triangular in lateral aspect, very narrow at their base, and widening greatly towards

¹ The identification of *P. campanula* var. with the above species is due to the researches of Dr. Billard who has examined Busk's type specimens in the British Museum (Billard, 1909).

² *Septata*—referring to the specific characters shown by the number and arrangement of the internodal septa.

the top. The margin has a prominent anterior tooth flanked by four distinct sinuations on each side. No intrathecal ridge exists, but the posterior wall bends inwards forming a rectangular bracket just above the base of the hydrotheca. The supracalycine sarcothecæ are large, almost cylindrical in shape, with a wide aperture, and an internal ridge projecting from a fold in their posterior wall. They slightly overtop the margin of the hydrotheca. The mesial sarcotheca is short, only about two-fifths the length of the anterior profile of the hydrotheca, to which it is altogether adnate except for a spout-like tip. Its cavity is interrupted by two processes: a button of chitin projects into it from the wall of the hydrotheca a short distance before the sarcotheca becomes free, and a septum, already described in connection with the internodal ridges, traverses its proximal end.

Three cauline sarcothecæ occur on each stem internode. Two of these are large, resembling the mesial sarcotheca in shape, and have a posterior internal ridge: the first lies on the anterior and near the proximal end of the internode, the other lies on that side of the hydroclade-bearing process which faces the centre of the stem, while the third sarcotheca is a mere perforation with slightly raised lips on the anterior of the process itself.

Gonosome.—Attached to the colony itself there occurred no reproductive body, but, entangled amongst the fibres at its base, a kind of corbula was found. This, in all probability, was really part of the colony, for no other Plumularian was contained in the same bottle, nor, in fact, were other Plumularians dredged at the same station. I shall describe it here on the supposition that gonosome and trophosome are one, a supposition which the similarity of their minute structures makes a virtual certainty.

The main body of this peculiar type of corbula consists of a hollow cigar-shaped portion within which lie six spherical reproductive masses in varying stages of development. Along the sides of this cylinder run two tiers of protective leaflets. Both the rows in the lower tier contain about 10 narrow, tubular leaflets armed with up to 16 or 18 nematophores, arranged biserially. In the two higher rows 8 or 9 leaflets are present, but they are more strongly developed and more irregular in shape than the others, frequently broadening out into leaf-like form. They, too, bear marginal nematophores but the biserial arrangement is less definite and the position of the sarcothecæ less regular. In structure the sarcothecæ correspond exactly to those which occur on the stem internodes.

All the leaflets stand away from the gonangia-bearing cylinder, and all are recurved, those of the upper tier more markedly than those of the lower. The lower surface of the cylinder, that is, the part corresponding to the keel of a typical corbula, bears longitudinal chitinous ridges—prolongations of the bases of the lower leaflets. On the upper side the gonangia are protected by delicate plates of chitin, some of which arise between the bases of the leaflets of the upper tier and bend inwards over the gonangia, while others

project from chitinous ridges stretching across the top of the cylinder from the bases of the leaflets.

Measurements.

Tube of fascicle, diameter	0·21—0·27 mm.
Stem internode, length	0·55—0·63 „
„ „ diameter	0·17—0·18 „
Hydroclade internode, length	0·63—0·64 „
Hydrotheca, depth	0·39—0·43 „
„ diameter at mouth	0·25—0·28 „
“ Corbula,” length	4 „
„ greatest diameter	0·59 „

LOCALITY: Andaman Islands; depth 490 fathoms. Reg. No. 64/7.

Type in the Indian Museum, Calcutta.

While the general aspect of this species approaches that of *Thecocarpus*, I have placed it in the genus *Aglaophenia* on account of the gonosome, the protecting portions of which form a structure resembling a complex, open corbula, from the bases of the leaflets of which hydrothecæ are absent.

By the gonosome and by the shape and positions of the inter-nodal septa in the hydroclades, together with the shape of the hydrotheca, this species may be distinguished from the other members of the genus.

Lytocarpus annandalei,¹ Ritchie.

(Pl. iv, figs. 8—10.)

Ritchie, J., 1909 (2), p. 527.

This species is formed for a single colony obtained at one of the deepest stations from which the “Investigator” obtained Hydroids. The colony, which is of a very dark brown colour, is unbranched, 63 mm. in height, with a rigid stem which is fascicled for its whole length, and is traversed by several pale constrictions slanting from behind downwards and forwards—such as occur in the species of *Thecocarpus*. Only the anterior tube, which does not possess nodes, bears hydroclades. These rest upon a short process from the stem, are close-set (separated by 0·5 mm.), alternate, and are divided into regular thecate internodes.

The hydrothecæ are closely approximated, deep, and rudely ovate in outline. Their aperture faces upwards and outwards, at an angle of about 45° with the stem; their profile is convex in the lower half, concave in the upper, while their margin bears a single prominent anterior tooth, and on each side four sinuations, of which

¹ I have pleasure in naming this species after Dr. Nelson Annandale, Superintendent of the Indian Museum, whose enthusiasm has done much for the advancement of our knowledge of the Invertebrate Zoology of India.

those second from the anterior tooth are somewhat larger than the others. The mesial sarcotheca is large, adnate for more than half the height of the hydrotheca, but with a scoop-shaped extremity free. The supracalycine sarcothecæ are very large, reach just above the margin of the hydrotheca, and possess a huge aperture. They are cylindrical in shape but for a constriction about midway, which is associated with an internal ridge traversing part of their cavity from the posterior wall.

The intrathecal ridge is little evident. Where present it is short, and projects into the lumen of the hydrotheca from a knob of chitin which terminates an angular in-bending of the posterior wall, situated a short distance above the floor of the cavity. The bases of the two sides of the angle are marked by well-defined ridges projecting from the posterior of the hydrotheca into the cavity of the internode, while a third posterior ridge arises just above the bases of the supracalycine sarcothecæ. Another shorter ridge projects backwards into the proximal portion of the internode from its anterior wall. Two important and characteristic chitinous thickenings are associated with the mesial nematophore: one is a simple knob, projecting forwards from the hydrotheca wall into the nematophore cavity near its mid point, the other is a sinuous septum traversing the base of the sarcotheca and isolating its cavity from that of the internode, except for a small opening through which the sarcostyle passes. Occasionally from the convex surface of this hook-like septum a small chitinous ridge projects backwards (see lower hydrotheca, pl. iv, fig. 9).

Two large scoop-shaped sarcothecæ lie on the hydroclade-bearing tube at the base of each hydroclade, one proximal to the process on which the hydroclade rests, the other supero-lateral, on the side of the process which faces inwards. The process itself bears a small, anterior, tubular sarcotheca.

Gonosome.—A few structures, apparently phylactocarps, are present, although unfortunately they are immature, or have lost their gonangia. They replace hydroclades on the lower portion of the stem, and are obviously morphological modifications of these, for they are divided into internodes each of which bears three regularly-arranged, scoop-shaped sarcothecæ—one median and proximal, the others lateral and distal, in a pair (pl. iv, fig. 10). Each internode corresponds to a thecate internode, without the hydrotheca. No hydrotheca occurs on the proximal internode of the phylactocarp. No gonangia are present, but, as in other species, they no doubt assume the positions of the missing hydrothecæ.

Measurements.

Hydroclade-bearing tube, diameter	0·21 mm.
Hydrocladial internode, length	0·48 „
Hydrotheca, depth	0·35 „
„ diameter at mouth	0·21 „
Phylactocarp, length of internodes	0·27 „

LOCALITY: R.I.M.S. "Investigator" Station 241, lat. 10° 12' N., long. 92° 20' 30" E., between the Andaman and Nicobar Islands; depth 606 fathoms.

This is a very well-defined species, easily distinguished by the peculiar arrangement of its internodal ridges, by its large sarcothecæ, and by the sinuous margin of its hydrothecæ.

Type in the Indian Museum, Calcutta.

Lytocarpus pennarius (Linnæus).

(Pl. iv, fig. 11.)

Linnæus, C., 1758, p. 813; as *Sertularia pennaria*.

Allman, J. G., 1883, p. 42, pl. xiv; as *L. secundus*, Kirchenpauer.¹

This species is represented by a solitary much-weathered colony 56 cm. long, with a large basal mass of matted rhizoids; and by a few unattached branches. While the specimens agree with Allman's description, the following additional observations have been made. The hydroclades spring alternately from the anterior tube of the fascicle, and sometimes reach a length of 18 mm., three times the recorded length of those in the "Challenger" collection. The hydroclade-bearing process is accompanied by three large, scoop-shaped sarcothecæ, two of which are anterior—one on the process, the other proximal to it—while the third lies on the inner side of the angle between process and stem.

The hydrothecæ agree closely with the description of Marktanner-Turneretscher (1890, p. 273). The margin bears a prominent anterior tooth, and about four indefinite sinuations on each side. The intrathecal ridge is short, slants upwards, and often terminates in a prominent knob, while the internodal ridges are much more insignificant than those in Allman's figures. The mesial sarcotheca is adnate for little more than half the height of the hydrotheca and a connection exists between the distal portion of its cavity and that of the hydrotheca. The supracalycine sarcothecæ are asymmetrical, that on the side of the hydrotheca facing inwards towards the centre of the stem being very large and bowl-shaped, while the other has a diameter scarcely half that of its fellow (pl. iv, fig. 11). This difference may in part account for the discrepancy between the sizes of the sarcothecæ as figured by Kirchenpauer (1872) and by Allman, the latter having figured the hydrotheca from the stem side, the former from the opposite. Notwithstanding, however, the hydrothecæ of our specimens, as did those of Marktanner-Turneretscher, agree more closely with Kirchenpauer's diagnosis of *Aglaophenia crispata* than with that of *A. secunda*, to which Allman referred his specimens.

¹ The identity of the "Challenger" specimens with the Linnean species has been established by Billard (1908, p. 3) after comparison of the former with the Linnean type specimen in the British Museum.

A few branches of a specimen also occur in the collection in an unlabelled bottle. The hydrothecæ of these differ from those described above in being slightly more closely approximated, in possessing more distinct internodal and intrathecal ridges, larger cauline sarcothecæ, a longer mesial sarcotheca jutting out more strongly from the hydrotheca, and a margin rising into a broad lobe on each side. They differ also somewhat in size,—see table below. The branches bear phylactocarps with sometimes as many as 14 nematoclasts. The gonangia spring from near the bases of the nematoclasts and are broadly ovate.

Measurements.

	Andamans specimen.	Unlabelled fragments.
Hydroclade internodes, length	0.28 mm.	0.22 mm.
Hydrotheca, depth	0.27 „	0.22 „
„ diameter at mouth	0.14 „	0.13 „
Gonangium, length		0.64 „
„ greatest diameter		0.49 „

LOCALITY: Andaman Islands (collected by J Wood-Mason, Marine Survey).

Distribution.—A distinctively Indo-Pacific species; recorded from the South Sea, China Sea, Pelew Islands, by Kirchenpauer (1872); from the Philippine Islands by Allman (*loc. cit.*), from Singapore by Marktanner-Turneretscher (*loc. cit.*), and now from Indian waters.

Lytocarpus philippinus (Kirchenpauer).

Kirchenpauer, G. H., 1872, pp. 29, 45, pls. i, ii, vii, fig. 26; as *Aglaophenia philippina*.

Nutting, C. C., 1900, p. 122, pl. xxxi, figs. 4—7.

A specimen in fragmentary condition represents this species. The minute structures are altogether similar to those of previous descriptions, but there is considerable variation in insignificant details. Thus while the lateral margin is, more generally perhaps, a single large lobe, as in Marktanner-Turneretscher's figure of a specimen from the Red Sea (1890, pl. vi, fig. 15), sometimes it is divided into two distinct waves as in a Madagascar specimen figured by Billard (1907, fig. 18, p. 377). There are also considerable differences in the size of the embayment which separates the anterior tooth of the hydrotheca from the median sarcotheca.

Measurements.

Hydrocladial internode, length	0·25 mm.
Hydrotheca, diameter at mouth ¹	0·11 ,,
Median nematophores, length	0·15—0·18 ,,

LOCALITY: Eight miles west of Interview Island, Andaman Islands; depth 270—45 fathoms.

Distribution.—An Indo-Pacific species, which has been recorded from (1) Northern Pacific Ocean (Japan; Mark.-Turn., 1890, Stechow, 1907 and 1909: Hawaiian Islands; Nutting, 1905); (2) China Sea (Amoy; Mark.-Turn., *l.c.*); (3) East Coast of Australia (Port Denison; Bale, 1884); (4) North Coast of Australia (Port Darwin; Bale, *l.c.*: Torres Strait; Busk, 1852, Kirkpatrick, 1890); (5) East Indies (? Singapore; Kirchenpauer, 1872, as *Aglaophenia rostrata*); (6) Indian Seas (Mark.-Turn., *l.c.*: Ceylon, 7—10 fms.; Thornely, 1904: Andaman Islands, present record).

Halicornaria balei (Marktanner-Turneretscher).

(Pl. iv, fig. 12, var.)

Marktanner-Turneretscher, G., 1890, p. 272, pl. vii, figs. 19, 20; as *Aglaophenia balei*.

A very few fragmentary colonies of this species were found projecting from a sponge. One agrees closely with the original description, but it is a fragment only 13 mm. in height, and from the delicacy of its structures appears to be a young specimen. Few differences, and these of no specific value in a genus where considerable variation is the rule, distinguish our specimens from the Red Sea examples. Thus the median lobe of the hydrotheca is less long and less pointed, and occasionally a second indistinct lobe appears on the margin; the median sarcotheca is somewhat longer, reaching clear of the edge of the hydrotheca; the hydrotheca is less markedly tilted forward; and in our specimens the opening at the base of the hydrotheca, through which the cœnosarc passed, is bordered by sharp chitinous spines, projecting into the hydrotheca cavity, which in profile give a pectinated appearance to the base of the cup. Probably the basal pecten was overlooked by Marktanner-Turneretscher, as it is difficult to be distinguished until the cœnosarc has been removed. The upper margin of the intrathecal ridge, viewed from in front, is seen to be rudely pectinated.

Although the gonosome is absent, the characters of the trophosome warrant the transference of this species from *Aglaophenia* to the genus *Halicornaria*. It is closely related to *H. hians*, Busk, 1852, from which it is to be distinguished by the strong convexity of its median sarcotheca (apparently a constant character), by its deeper hydrotheca, and by the position of the intrathecal ridge

¹ Measured in the direction of the hydrocladial axis.

which is situated at a greater distance from the base of the hydrotheca.

Measurements of parts are placed, for the sake of comparison, alongside those of the variety recorded below.

LOCALITY: Andamans, 1899; 60 fathoms.

H. balei, var. *flava*, Nutting (?).

(Pl. iv, fig. 12.)

Nutting, C. C., 1905, p. 955, pl. xiii, figs. 11, 12, as *Halicornaria flava*.

The remaining fragments of this species belong to colonies more robust in build, but with similar minute characters. Variations in the number and prominence of the lateral lobes occur here also, the large lateral lobe being sometimes accompanied by a smaller. The variety differs from the type however with regard to the compression of its hydrothecæ, for in the former they are so closely set that the lower part of the mesial sarcotheca of one depresses the upper margin of the hydrotheca immediately below it.

I am unable to find characters sufficient to separate Professor Nutting's *Halicornaria flava* from the compressed variety of *H. balei*, a species which, since he considered the chitinous projection within the mesial sarcotheca to be unique for the genus, Nutting had apparently overlooked. In our specimens, however, the stem nodes are irregular, bearing varying numbers of hydroclades, and in addition to the two sarcothecæ at the front of the base of each hydroclade, a third is situated behind.

Measurements.

	<i>F. typica.</i>	<i>V. flava.</i>
Stem, diameter	0.13 mm.	0.35 mm.
Hydroclade internodes, length	0.32 ,,	0.22--0.24 ,,
Hydrotheca, depth, base to topmost point	0.25 ,,	0.22 ,,
,, width, wing to wing	0.20 ,,	0.21 ,,

LOCALITY: Andamans, 1899; 60 fathoms.

Distribution.—The species has been recorded only from the Red Sea (Mark-Turn.); from the Bay of Bengal (present record) and from the Hawaiian Islands (Nutting, 1905).

Halicornaria gracilicaulis (Jäderholm).

Jäderholm, E., 1903, p. 299, pl. xiv, figs. 3, 4; as *Lytocarpus gracilicaulis*.

A graceful species represented by a few fragments protruding from a sponge. Although in an early stage of development the stem is already fascicled, and bears a single branch. The unjointed basal portion of the branch, to which Jäderholm refers, was indistinguishable, for although a length in our specimens is destitute of

hydrothecæ or hydroclades, it is divided by faint nodes into four internodes each of which bears a single median sarcotheca on its anterior surface.

The minute characters of the hydrothecæ agree exactly with those given by Jäderholm. It is worthy of note that in some of the hydrothecæ the internodal septa at the base of the supracalycine nematophores and opposite the intrathecal partition are much more strongly developed than Jäderholm's figure shows, while a third septum is occasionally visible stretching across the thecate internode close to its proximal end. One end of this septum rests on a knob of chitin projecting from the abcauline wall of the internode. In these details our specimens vary somewhat as did those described by Billard (1907 (2), p. 366).

The gonosome is not present but through its occurrence in specimens described by him Billard transferred the species from *Lytocarpus* to *Halicornaria*.

Measurements.

Hydroclade, length	1—3	mm.
" internode, length	0·29—0·33	"
Hydrotheca, diameter	0·91	"
" " of mouth, side		
to side	0·11—0·13	"
" " " back		
to front	0·08—0·10	"

LOCALITY: Andaman Islands, 1899; 60 fathoms.

Distribution.—This species has seldom been recorded, but its distribution appears to be Indo-Pacific, for it has been found off South Japan (Jäderholm, 1903); at Ternate, in Oceania (figured by Campenhausen, 1897, pl. xv, fig. 3); on the south-east coast of Africa, at Macalonga and Mozambique (Billard, 1907 (2)); and the present record adds it to the fauna of India.

Halicornaria hians, Busk, var. *profunda*, Ritchie.

(Pl. iv, figs. 13, 14.)

Bale, W. M., 1884, p. 179, pl. xiii, fig. 6; pl. xvi, fig. 7, *H. hians*, *typicus*.

Ritchie, J., 1909 (2), p. 528.

The longest of the few colonies in the collection was only 4 cm. in height, with monosiphonic, unbranched stem, divided into internodes bearing generally two, occasionally three, alternate hydroclades. Each hydroclade is divided into thecate internodes twice as long as broad near the stem, but gradually becoming longer and more slender as they recede from it, until at the distal end of a hydroclade their length may be to their breadth as four to one.

The hydrothecæ are deep, with a margin divided on each side into three lobes, of which the superior and the median are the

sharpest and the most pronounced, and an aperture lying at an angle of about 30° with the axis of the hydroclade. A stout intrathecal ridge, running backwards to the middle of the lumen, where it ends in an upturned thickening, marks the position of an anterior fold in the hydrothecal wall. Small chitinous points surround the opening through which the hydranth connects with the common cœnosarc. The mesial sarcotheca is very variable, its early stage, as seen in young colonies or on the distal ends of some hydroclades, closely resembling that of *H. variabilis*, Nutting (1900, p. 127, pl. xxxiii, fig. 7), for it stops considerably short of the intrathecal ridge; while in its mature state it is adnate almost to the lip of the hydrotheca, projecting beyond the margin as a short free spout. Its most marked character in all stages is the concavity of its profile, and there is always present, more or less strongly developed, an internal chitinous projection almost on the level of the base of the hydrotheca. The supracalcine sarcothecæ are small, not reaching to the margin of the hydrotheca, almost oval in outline, with a solitary wide superior aperture. The cauline sarcothecæ are three in number, two on the stem anterior to the hydroclade and one posterior, almost in the angle above the hydroclade. In shape they resemble the supracalcine sarcothecæ—none are bilobed, nor have any two apertures.

Gonosome.—The gonangia, a funnel- or flask-like form of which has been described by Stechow (1907, p. 200; 1909, p. 102, pl. vi, fig. 17), are present in numbers. They are unprotected and are borne on very short stalks, one at the base of each hydroclade. In shape they are saucer-like, convex beneath, concave above, and appearing as perfect disks when viewed from the anterior of the colony.

Measurements.

	Mature colony.	Young colony.
Hydroclade internode, length	0.35—0.42 mm.	0.39—0.43 mm.
" " diameter at base ..	0.11—0.17 "	0.07—0.10 "
Hydrotheca, depth from base to highest teeth	0.28—0.29 "	0.25—0.27 "
" diameter of lower portion	0.14—0.15 "	0.11—0.12 "
" vertical diameter of mouth	0.20—0.21 "	0.17—0.18 "
Gonangium, diameter of disk.	up to 0.38 "	

LOCALITY: Andaman Islands, 1899; 60 fathoms.

Distribution.—Previously recorded from Torres Strait (Busk. 1852; Kirkpatrick, 1890).

Type of variety in the Indian Museum, Calcutta.

Remarks.—This variety is distinguished from the typical form as figured by Bale, by the greater length of the thecate internodes compared with their diameter, the greater depth and more erect posture of the hydrothecæ (to the former of which characters the name of the variety alludes), and the greater distance which separates the intrathecal septum from the base of the hydrotheca. The less

prominent nature of the marginal teeth, and the smaller size of the colonies are variations of little significance. There is a similarity between this variety and some of the stages of *H. variabilis*, Nutting (1900, p. 127), but the latter species possesses very large bilobed cauline sarcothecæ.

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II NOTES ON FRESHWATER SPONGES

By N. ANNANDALE, D.Sc., Superintendent, Indian Museum.

XII.—DESCRIPTION OF A NEW SPECIES FROM CAPE COMORIN.

The sponge described below was discovered by Mr. R. S. N Pillay of the Trivandrum Museum in a tank near Cape Comorin, the southernmost point of the Indian Peninsula. I have examined several specimens.

Genus SPONGILLA.

Subgenus Stratospongilla, Annandale.

Spongilla ultima, sp. nov.

Sponge hard and strong, forming a thin layer on solid objects, of a pale green colour (dry); the oscula small but rendered conspicuous by the deep radiating furrows that surround them; external surface of the sponge rough but not spiny.

Skeleton forming a compact but somewhat irregular reticulation, in which the radiating fibres are not very much more distinct than the transverse ones; a considerable amount of almost colourless spongin present.

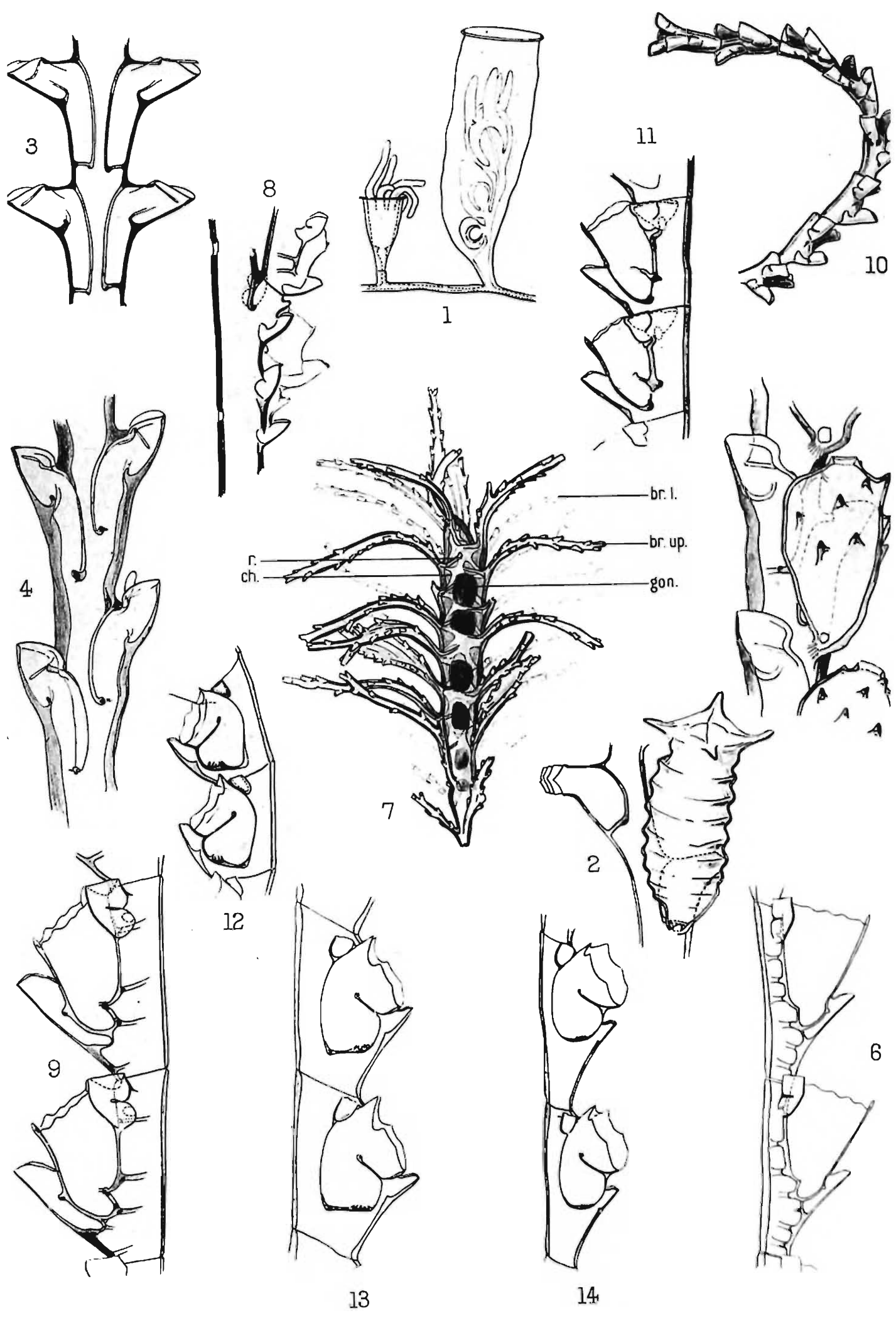
Spicules.—Skeleton spicules smooth, stout, amphioxous; as a rule straight or nearly straight, not infrequently inflated in the middle or otherwise irregular. No flesh spicules. Gemmule spicules variable in size, belonging to practically every type and exhibiting practically every abnormality possible in the genus, the majority being more or less sausage shaped and having a roughened surface, but others being cruciform, spherical, subspherical, rosette-like, needle-like, bifid or even trifid at one extremity.

Gemmules adherent, spherical, large, each covered by two distinct layers of horizontal spicules; the outer layer intermixed with skeleton spicules and often containing relatively large siliceous spheres, a large proportion of the spicules being irregular in shape; the spicules of the inner layer much more regular and as a rule sausage-shaped. The outer layer is contained in a chitinous membrane, which spreads out over the base of the sponge. The foraminal tubules short and straight.

This sponge is allied to *S. bombayensis*, from which it is distinguished not only by the abnormal characters of its gemmule spicules and the absence of flesh spicules, but also by the form of its skeleton spicules and the structure of its skeleton.

EXPLANATION OF PLATE IV

- FIG. 1.—*Hebella crateroides*, Ritchie. Portion of colony, showing both trophosome and gonosome, $\times 35$.
- „ 2.—*Sertularella polyzonias*, var. *cornuta*, Ritchie. Portion of branch with gonotheca, $\times 25$.
- „ 3.—*Diphasia mutulata* (Busk). Portion of stem with hydrothecæ, $\times 35$.
- „ 4.—*Diphasia thornelyi*, Ritchie. Portion of stem with hydrothecæ, front view, $\times 50$.
- „ 5.—*Diphasia thornelyi*. Portion of stem bearing gonangia, seen partly from the side, $\times 50$.
- „ 6.—*Aglaophenia septata*, Ritchie. Portion of hydroclade, $\times 45$.
- „ 7.—*Aglaophenia septata*. Gonosome, $\times 13$: *br.l.*, branchlet of lower tier; *br.up.*, branchlet of upper tier; *gon.*, gonangium; *r.*, ridge at base of upper leaflets projecting over gonangia; *ch.*, chitinous plate.
- „ 8.—*Lytocarpus annandalei*, Ritchie. Portion of stem showing bases of hydroclades, $\times 35$.
- „ 9.—*Lytocarpus annandalei*. Portion of hydroclade, $\times 60$.
- „ 10.—*Lytocarpus annandalei*. Phylactocarp, $\times 30$.
- „ 11.—*Lytocarpus pennarius* (Linn.). Portion of hydroclade, $\times 70$.
- „ 12.—*Halicornaria balei*, var. *flava*, Nutting(?). Portion of hydroclade, $\times 70$.
- „ 13.—*Halicornaria hians*, var. *profunda*, Ritchie. Portion of hydroclade with hydrothecæ at a late stage of development, $\times 70$.
- „ 14.—*Halicornaria hians*, var. *profunda*. Portion of hydroclade with hydrothecæ at an early stage of development, $\times 70$.



III. DESCRIPTIONS OF NEW SHELLS IN
THE COLLECTION OF THE INDIAN
MUSEUM FROM BURMA, SIAM AND THE
BAY OF BENGAL

By H. B. PRESTON, F.Z.S.

Plectotropis biggiei, sp. nov.

Shell broadly conic, carinate at the periphery, rather solid, reddish brown; whorls 7, regularly increasing, covered with a laminiferous periostracum and transversely sculptured with closely set, oblique, transverse wrinkles, the last whorl descending; base of shell presenting a curiously granular appearance; sutures impressed; umbilicus very wide, deep; columella descending somewhat vertically, inflated in the middle; peristome white, reflexed, the margins joined by a very thin callus and bearing a *very slight* thickening just below the columella; aperture subquadrate.

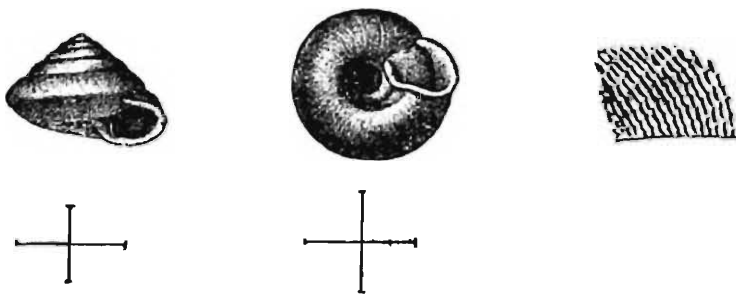


FIG. 1.—*Plectotropis biggiei*, sp. nov.

Altitude	7.5 mm.
Diam., major	10.75 ,,
Aperture, alt.	3 ,,
„ diam.	3 ,,

Hab.—Pitsamloke, Siam. (H. D. Biggie, Esq.)

Type in Indian Museum (Reg. No. M. 1412).

Differing chiefly from *P. ptychostyla*, von Marts., its nearest ally, in its more conical shape, deeper and much wider umbilicus, narrower aperture, in being less keeled at the periphery and by the granular sculpture which is absent in *P. ptychostyla*.

Opeas innocens, sp. nov.

Shell bluntly subulate, whitish, thin; whorls 8, flat, rather sharply shouldered above and below, transversely striate with

lines of growth; sutures deeply impressed; columella descending in a slight curve, extending above into a thick, parietal callus which joins the margin of the lip above; labrum acute, simple; aperture elongately ovate.

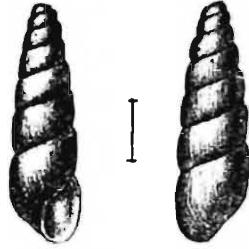


FIG. 2.—*Opeas innocens*, sp. nov.

Altitude	5.5 mm.
Diam., major	1.25 ,,
Aperture, alt.	.75 ,,
„ diam.	.25 ,,

Hab.—Khayon Cave, near Moulmein, Lower Burma. (Dr. N. Annandale.)

Type in Indian Museum (Reg. No. M. $\frac{4639}{1}$).

Dolium varicosum, sp. nov.

Shell ovate, perforate, white without any trace of painting, somewhat solid; remaining whorls 6, sculptured throughout with rather closely set, flat, spiral ribs, the last whorl bearing a vaxex about eleven millimeters from the labrum, such as is seen in

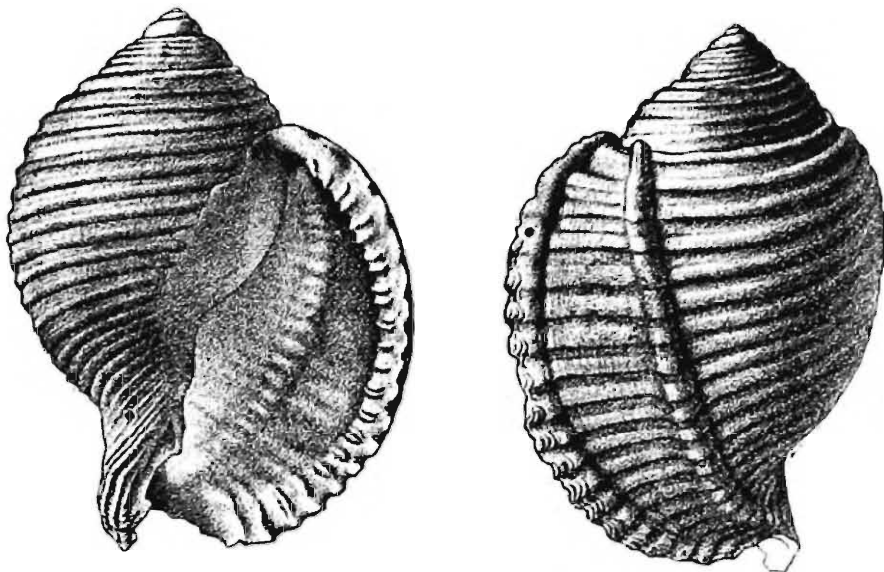


FIG. 3.—*Dolium varicosum*, sp. nov.

Cassis, but which appears to be quite normal; sutures impressed; perforation rather narrow; columella descending vertically at first, obliquely curved below, a thin, smooth callus joining it with the lip above; labrum posteriorly varicose, serrated and somewhat

coarsely denticulate just within; aperture elongately inversely auriform.

Altitude	54 mm.
Diam., major	39 „
Aperture, alt.	37 „
„ diam.	17 „

Hab.—Balasore Bay, Orissa Coast. (Bengal Fisheries.)

Type in Indian Museum (Reg. No. M. $\frac{4311}{1}$).

A remarkable species which is easily recognizable both by its closely set, flat ribbing and by the extraordinary vorex on the last whorl: it has all the appearance of a comparatively deep-sea form.

Avicula smithi, sp. nov.

Shell thin, subquadrate; right valve flattish, somewhat scabrous; left valve convex, smooth, polished, both valves greyish white, tessellated with golden brown, stained in places with bright yellow and blotched with deep blackish purple; winged

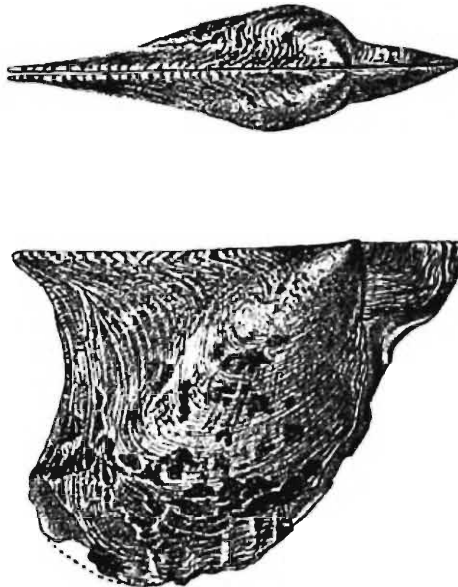


FIG. 4.—*Avicula smithi*, sp. nov.

both anteriorly and posteriorly, the anterior wing being broader and longer than that on the posterior side; dorsal margin straight; ventral margin rounded; anterior side obliquely curved; posterior side concavely sloping, rostrate below; interior of shell nacreous, iridescent.

Long.	34 mm.
Lat. (across wings)	45 „

Hab.—Off Gopalpur, Ganjam Coast, 24 fathoms. (Bengal Fisheries.)

Type in Indian Museum (Reg. No. M. $\frac{4311}{2}$).

Modiola jenkinsi, sp. nov.

Shell subtrapezoidal, scarcely curved, dark green shading to a paler colour towards the margins and posteriorly painted with thin, pale brown, radiate lines, marked with concentric lines of growth; umbones large, very anteriorly situate; dorsal margin somewhat straight; ventral margin slightly concave; anterior

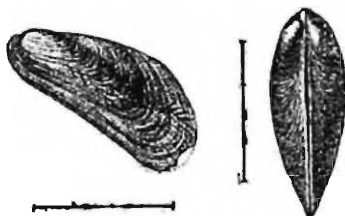


FIG. 5.—*Modiola jenkinsi*, sp. nov.

side rather angularly rounded; posterior side sloping above, gently rounded below; interior of shell nacreous, iridescent in places.

Long.	. 6 mm.
Lat.	. 13'5 ,,

Hab.—Manikpatna, Lake Chilka. Forming colonies on *Ostrea lentiginosa*, Sow. (Dr. J. T. Jenkins.)

Type in Indian Museum (Reg. No. M. $\frac{4881}{1}$).

Differing from *M. evansi*,¹ Smith, from S. Siam by its narrower form and less fan-like shape; it is also much paler in colour and, except for the lines of growth, quite smooth; moreover the interior of the shell is much lighter than is the case with *M. evansi*.

¹ *Journ. of Conch.*, x, p. 368.

IV MATERIALS FOR A REVISION OF
THE PHYLACTOLÆMATOUS POLYZOA
OF INDIA

By N. ANNANDALE, D.Sc., C.M.Z.S., F.A.S.B., Superintendent,
Indian Museum.

The Phylactolæmata of the Oriental Region have hitherto attracted little attention on the part of zoologists, except a few short papers of my own in the Journal of the Asiatic Society of Bengal and these "Records," the following are the only references (besides a few bare statements as to the existence of *Plumatella* in the East) I can find in literature :—

- 1859. Carter described and figured the statoblast of a "*Lophopus*" (*Lophopodella carteri*) and recorded *Plumatella repens* and *P. stricta* from Bombay (*Ann. Mag. Nat. Hist.* (3), vol. iii, p. 332).
- 1862. Mitchell recorded a species of "*Lophopus*" from Madras (*Quart. Journ. Micr. Sci.* (3), vol. ii, p. 61).
- 1865. Hyatt named the Indian "*Lophopus*" described by Carter as *Pectinatella carteri* (*Comm. Essex Inst.*, vol. iv, p. 203).
- 1887. Kraepelin described *Plumatella philippinensis* (*Deutschen Süßwasser-Bryozoen*, part i, p. 118, footnote).
- 1895. Meissner recorded the discovery of statoblasts of *Lophopodella carteri* in E. Africa ("Moosthiere," p. 6, in *Deutsch-Ost. Africa*, vol. iv).
- 1904. Rousselet placed this species in his new genus *Lophopodella* (*Journ. Quekett Micr. Club*, 1904, p. 51).
- 1906. Kraepelin described *Plumatella javanica* (*Mitth. Naturh. Mus. Hamburg*, vol. xxiii, p. 143).
- 1908. Loppens referred *Plumatella javanica* to *P. emarginata* as a variety (*Ann. Biol. Lacustre*, iii, p. 162).

The following papers by Oka on Japanese forms are also of importance to students of the Indian species of the Phylactolæmata :—

- 1891. "Observations on Freshwater Polyzoa," in *Journ. Coll. Sci. Imp. Univ. Tokyo*, vol. iv.
- 1907. "Zur Kenntnis der Süßwasser-Bryozoenfauna von Japan," in *Annot. Zool. Japon.*, vol. vi.
- 1908. "Ueber eine neue Gattung von Süßwasser-bryozoen," in *Annot. Zool. Japon.*, vol. vi.

As, however, a considerable proportion of the Phylactolæmata of India are identical with or very closely related to northern forms, many of which are practically cosmopolitan, the bulk of the literature regarding them is to be sought in memoirs that refer directly to the fauna of Europe or North America. Fortunately it is possible to regard two separate memoirs as having been unusually complete at the several dates on which they were published. I refer to Allman's *Monograph of the Fresh Water Polyzoa* (1856) and Kraepelin's *Süsswasser-Bryozoen* (1887-1892). It is possible to differ from the conclusions at which either or both of these authors arrived; but the wealth of detail and accuracy of delineation displayed in their works are beyond criticism. Another important memoir is Jullien's "Monographie des Bryozoaires d'eau douce" (*Bull. Soc. zool. France*, vol. x, 1885), which, in spite of the lack of critical instinct and the somewhat splenetic attitude to former writers displayed by its author, contains much valuable information. Braem's "Untersuchungen über die Bryozoen des süßen Wassers" (*Bibliotheca Zoologica*, vol. ii, 1890) deals mainly with anatomy and development but gives good descriptions of the European Phylactolæmata, while Loppens has recently published a concise summary of our present knowledge of the group (*Ann. Biol. Lacustre*, vol. iii, p. 141, 1908).

There are few groups in the animal kingdom on which the views of different authorities as to taxonomy are at greater variance than the Phylactolæmata, and this is the case even as regards the main divisions of the group. The following classification is adopted because it seems to be most convenient:—

Order PHYLACTOLÆMATA.

Family I.—PLUMATELLIDÆ.

Ectocyst well developed; base of zoarium never modified to form an organ of progression.

Subfamily A. Zoœcia tubular; lophophore circular or oval when expanded; statoblasts without air-cells

Fredericellinæ.

Subfamily B. Zoœcia tubular or concealed in a gelatinous syncœcium; lophophore horse-shoe-shaped when expanded; some or all of the statoblasts surrounded by a ring of air-cells

Plumatellinæ.

Family II.—CRISTATELLIDÆ.

Ectocyst absent, polypides embedded in a common syncœcium, the base of which is modified to form a creeping "sole"; lophophore horse-shoe-shaped, statoblasts surrounded by a ring of air-cells.

The *Cristatellidæ* consist of a single genus and probably of a single species (*Cristatella mucedo*), which, so far as is at present known, is confined to Europe and North America. Both the *Fredericellinæ* and the *Plumatellinæ* are, however, represented in India. The former subfamily consists of a single genus, in which four species can now be distinguished; while seven genera, five of which have been recorded from India, constitute the *Plumatellinæ*.

Family PLUMATELLIDÆ.

Subfamily **Fredericellinæ**.

Genus FREDERICELLA, Gervais.

Zoæcia cylindrical, each arising directly from another. *Zoarium* recumbent or, more usually, with upright branches. *Statoblasts* flat, oval or kidney-shaped, surrounded by a stout chitinous ring. *Polypide* slender and elongate; the tentacles of the lophophore filiform, not very numerous.

Until recently, although several distinct phases or varieties had been described as species, it was only possible to recognize a single form as worthy of specific rank, namely the Holarctic *F. sultana* (Blumenbach). Four species may, however, now be distinguished, although they are all closely allied to one another and might perhaps be regarded rather as local races or subspecies. They are *F. sultana* (Europe, N. America, N. and S. Africa), *F. australiensis*¹ (New South Wales), *F. indica* (Western India) and *F. cunningtoni*² (Lake Tanganyika, Central Africa). The following key will serve to distinguish them.—

Key to the species of Fredericella.

- A. Ectocyst never heavily encrusted.
- a. Statoblast smooth on both surfaces.
 - a. Lophophore circular *F. sultana.*
 - a' Lophophore oval *F. australiensis*
 - a' Statoblast with minute prominences on the upper surface.
 - Lophophore circular *F. indica.*
- B. Ectocyst heavily encrusted with sand grains.
- Lophophore circular; zoæcium short (statoblast unknown) *F. cunningtoni.*

Fredericella indica, Annandale.

Rec. Ind. Mus., iii, p. 373, fig. (1909).

To my recent description of this species I need only add that the lophophore is accurately circular when fully extended. The

¹ Goddard, *Proc. Linn. Soc. N. S. Wales*, xxxiv, p. 489, pl. xlvii (1909).

² Rousset, *Proc. Zool. Soc. London*, 1907, p. 254, pl. xv, figs. 9, 10.

statoblasts of specimens taken in Travancore were invariably oval, although varying considerably in proportions, but some of the statoblasts of those from the Bombay Presidency were distinctly kidney- or bean-shaped.

In both localities the specimens were taken in November, but in different years. Those from Travancore (1908) were found to be undergoing a process of regeneration owing to the development of statoblasts *in situ*, and only a few polypides were fully developed. Those, however, from Bombay (1909) were in a much more vigorous condition, although even in their case many of the polypides were not fully formed. It seems not improbable that *F. indica* is one of the species that dies down at the beginning of the hot weather, and is regenerated by the sprouting of the statoblasts, either in the old zoëcia or on a new site, at the beginning of the Indian "winter."

Subfamily Plumatellinæ.

Key to the genera of Plumatellinæ

1. Statoblasts without hooked processes.
 - A. Zoëcia cylindrical, not embedded in a gelatinous investment.
 - a. Zoëcia arising directly from one another; no stolon; free statoblast oval *Plumatella*.
 - a' Zoëcia upright, arising singly or in groups from a linear stolon; free statoblasts oval *Stolella*.
 - B. Zoëcia cylindrical, embedded in a structureless gelatinous investment.

Zoëcia arising from a ramifying stolon; statoblasts circular *[Stephanella]*
 - C. Polypides embedded in a hyaline synœcium that conceals the cylindrical form of the zoëcia.
 - c. Polypides upright, their base far removed from that of the zoarium when they are expanded *Lophopus*.
 - c' Polypides recumbent for the greater part of their length at the base of the zoarium *[Austrellella]*.¹

¹ *Austrellella*, gen. nov.—Zoëcia recumbent, aggregated into small linear groups, which are connected with each other by stolon-like lobes and embedded

2. Statoblasts armed (normally) with hooked processes.

A. Processes confined to the extremities of the statoblast; zoaria remaining separate throughout life

Lophopodella.

B. Processes entirely surrounding the statoblast; many zoaria embedded in a common gelatinous investment so as to form large compound colonies

Pectinatella.

Those genera of which the names are enclosed in square brackets have not been recorded from India, while the occurrence of *Lophopus* in this country is doubtful. *Plumatella* is represented by at least four European species as well as by two peculiar, so far as is known, to the Oriental region. Of the latter, one has only been recorded from a single locality in the Bombay Presidency, while the other was originally described from Java. *Lophopodella* and *Pectinatella* are each represented in the Indian fauna by a single species; that of the former genus occurring also in E. Africa and being specifically identical with a race found in Japan, while that of the latter is only known from India and Burma but has a very close Japanese ally.

Genus PLUMATELLA, Lamarck.

Zoarium recumbent or partially upright, branching freely, often in two planes. *Zoæcia* cylindrical, arising directly the one from the other, sometimes upright, greatly elongated and agglutinated together; at least the older zoæcia in each zoarium commonly recumbent. *Statoblasts* frequently of two kinds, free and fixed; the latter devoid of air-cells and fastened to the support of the zoarium; the former surrounded by a well-developed ring of air-cells, without processes at the periphery, never more than about 0.6 mm. in length, oval in outline. *Polypide* never with more than about 60 tentacles.

Hardly any two authorities are agreed as to the number of species and varieties that should be recognized in this genus, and it is generally believed that the zoaria exhibit very great individual variation. Observations, however, carried out on a considerable amount of European material as well as a large Indian collection, make me inclined to believe that this is not the case, but rather that a considerable number of forms exist which breed remarkably true even in very diverse conditions. The fact that it is possible to recognize the majority of the well-established European "species" among

in a structureless gelatinous mass. Statoblasts oval, without hooked processes, intermediate in size between those of *Lophopus* and those of *Plumatella*. Type *Lophopus lendenfeldi*, Ridley, *Journ. Linn. Soc. London, Zool.*, vol. xx, p. 62 (1890).

Indian specimens, as well as several of the varieties, would suggest that the type is preserved with considerable exactness, and this view is confirmed by the fact that several distinct forms are frequently found growing together in conditions so absolutely identical that their zoaria are intertwined.¹

Two better tests as to the distinctness of "forms" could not, in my opinion, be found; but whether these "forms" should all be recognized as "species" is another question. Personally I think that it would be inconvenient to adopt a course so extreme. I have been forced, therefore, to devise a test for distinguishing "species" from "varieties." The test adopted is as artificial as all such tests must be in the present unsettled state of biological knowledge. I have called those forms (*i.e.*, groups of specimens) "species," the differences between which are so constant and so clear that it is possible to express the more important of them in the form of a key to the genus; while my "varieties" are groups of specimens separated from those comprised in the nearest species by differences that do not appear to be altogether constant or are of a kind that cannot be represented easily in words or numbers. The question of "subspecies" (*i.e.*, local races) hardly arises as regards *Plumatella*, for there is little evidence that such races exist in the genus.

Up to the present time I have been unable, owing to unfavourable climatic conditions, to carry out direct biological experiments as to the effect of environment on the individual zoarium in the Polyzoa, but evidence obtained in the unnatural environment of an aquarium is usually unsatisfactory as regards such points, and I think that the facts stated above will at any rate make my position clear as regards the "species" and "varieties" described below.

Key to the Indian species of Plumatella.

Group I. (*Repens* group.)

Ectocyst more or less rigid, pigmented or colourless; tip of the zoœcia rounded when the polypide is retracted.

1. All the zoœcia entirely recumbent, having the aperture on the dorsal surface and a strong furrowed keel; ectocyst colourless and transparent; free statoblast elongate

P. javanica.

2. The younger zoœcia as a rule forming long free branches, each with the aperture at the tip; a furrowed keel never

¹ In a pond in the Calcutta Zoological Gardens I have found the following forms growing together in this way:—*P. fruticosa* (with the phase *coralloides*), *P. emarginata* (with the phase *benedeni*), the varieties *diffusa* and *dumortieri* of *P. allmani*, *P. javanica* and *P. punctata*.

- present; ectocyst lightly pigmented; statoblasts elongate *P. fruticosa.*
3. Zoëcia and ectocyst as in 2; free statoblasts broadly oval *P. repens.*
4. At any rate the older zoëcia entirely recumbent, sometimes with the aperture on the dorsal surface, with a triangular colourless patch at the tip of the same surface; the ectocyst of the basal part of the zoëcium densely pigmented; free statoblast elongate *P. emarginata.*
5. All or nearly all the zoëcia with their bases recumbent but with their distal part free and turned upwards; the ectocyst of the basal part translucent, roughened on the surface, that of the distal part colourless and smooth, the colourless part frequently passing into the coloured part in the form of a V; free statoblasts very variable in shape *P. allmani.*

Group II. (*Philippinensis* group.)

Ectocyst rigid, deeply pigmented, tip of the zoëcia abruptly truncated when the polypide is retracted.

Zoëcia irregularly but strongly annulated; with a strong furrowed keel on the basal part; free statoblast elongate

*P. bombayensis.*Group III. (*Punctata* group.)

Ectocyst soft and flexible, much swollen; tip of the zoëcia rounded.

Ectocyst colourless; zoëcia without a furrow; statoblasts broadly oval, often asymmetrical in outline

*P. punctata.*a. *Repens* group.*Plumatella repens*, Allman (? Linné).? *Tubipora repens*, Linné, *Syst. Nat.* (Ed. x), 1758.*Plumatella repens*, Allman, *Mon. Fresh Water Polyzoa*, p. 93, pl., v, figs. 1—8 (1856).

- Plumatella polymorpha*, Kraepelin, *Deutsch. Süßwass.-Bryozoen*, pl. iv, fig. 119, pl. v, fig. 122, pl. vii, fig. 139 (1887).
Plumatella repens, Braem, *Bibl. Zool.*, vol. vii, p. 2 (1890).
 „ „ Loppens, *Ann. Biol. Lacustre*, vol. iii, p. 158
 (*partim*) (1908).

This species is distinguished rather by negative than by positive characters, and it is perhaps for this reason that I find it difficult at present to regard the form *fungosa* as more than a variety, although the latter appears to exhibit certain peculiarities even at a stage at which it has not assumed its most characteristic features.

P. repens may be recognized by the following characters :—

- (1) The great majority of the free statoblasts in any one zoarium are broadly oval in shape, the greatest width being at least $\frac{5}{7}$ of the length.
- (2) Fixed statoblasts without air-cells are produced.
- (3) The zoëcia, when the polypides are contracted, are always round at the tip. They are never emarginate.
- (4) A *furrowed* keel is never present on the dorsal surface.
- (5) The pigmentation is never dense.
- (6) The zoëcia are slender, and the ectocyst is never very stiff, although it is never soft and contractile as in *P. punctata*, the only species, except *P. fruticosa*, with which *P. repens* is likely to be confused.

The first two of these characters will at once serve to distinguish *P. repens* from *P. fruticosa*, but it must be remembered that elongated statoblasts are occasionally found in the former species, although never in large numbers. The swim-ring of the free statoblasts of *P. repens* is rarely much, if at all, broader at the sides than at the ends.

Var. *fungosa*, Pallas.

Tubularia fungosa, Pallas, *Comment. Acad. Sci. Imp. Petropol.*, vol. xii, p. 565, pl. xiv (1768).

Alcyonella fungosa, Allman, *op. cit.*, p. 86, pl. iii (1856).

Plumatella polymorpha var. fungosa, Kraepelin, *op. cit.*, p. 124, pl. iv, fig. 112, pl. viii, figs. 140—142.

Plumatella fungosa (partim), Braem, *op. cit.*, p. 2, pl. i, fig. 2.

Plumatella repens var. fungosa, Loppens, *op. cit.*, p. 161.

The essential characters of this form seem to be (1) that the zoarium branches very profusely when still young and recumbent, and (2) that the ectocyst is surrounded by a gummy secretion. These characters cause crowding together of the zoëcia, which are forced to assume an upright growth and finally, under pressure, a polygonal form in cross-section. Dense masses, often an inch or more in diameter, are thus produced, consisting of upright parallel tubes closely packed together. Specimens from Norfolk, which Dr. F. Harmer has been kind enough to send me, show the earlier stages

of this process, while others from Russia, received from the Geneva Museum, exhibit the actual transition. Dr. Kraepelin has kindly given me some fine German examples named by him *P. polymorpha* var. *fungosa* and including both young and old zoaria, and I have examined others from England and Italy.

Although *P. repens* is here included in the Indian fauna, I am doubtful as to its having been actually found anywhere in the Oriental Region. The form recorded by Carter from the island of Bombay as *P. repens* was, as he himself recognized, the one described by van Beneden under that name and subsequently called *P. stricta* by Allman, who did not regard it as identical with Linné's *Tubipora repens*. The variety *fungosa* has not been recorded from India except by myself, and further experience both of Indian and European specimens proves that what I found was actually an extreme form of the *coralloides* phase of *P. fruticosa*.

Plumatella fruticosa, Allman.

Plumatella stricta, Allman, *op. cit.*, p. 99, fig. 14.

Plumatella fruticosa, *id.*, *ibid.*, p. 102, pl. vi, figs. 3—5.

Plumatella repens and *P. stricta*, Carter, *Ann. Mag. Nat. Hist.* (3), vol. iii, p. 332 (1859).

Plumatella princeps var. *fruticosa*, Kraepelin, *op. cit.*, p. 120, pl. vii, fig. 148.

Plumatella fruticosa, Braem, *op. cit.*, p. 9, pl. i, fig. 15.

Plumatella repens, Annandale, *Journ. Asiat. Soc. Bengal*, 1907, p. 83.

This species agrees with *P. repens* in never having the zoœcia emarginate or with a furrowed keel and in having the ectocyst neither deeply pigmented (naturally¹) nor very stiff. The great majority, if not all of the statoblasts in every zoarium are, however invariably elongate, the length being twice or nearly twice the greatest breadth. The swim-ring, however, is as a rule not much broader at the ends than at the sides. Just as in *P. repens* an occasional statoblast may be found that is elongate, so in *P. fruticosa* an occasional statoblast may be found that is short and broad; but in both species such cases are rare and must be regarded as abnormal; they therefore do not affect the question of the specific distinctness of the two forms. The zoœcia of *P. fruticosa*, although frequently stout, are invariably long, so that the branches are far apart from one another; there is often a simple keel, but with no trace of a furrow, on the dorsal surface of the proximal part of the zoœcium. Young colonies are recumbent but with the tip of each zoœcium upturned, so that the aperture is terminal. In favourable conditions, however, horizontal or dependent branches, often of considerable length, are freely produced. The ectocyst is not sufficiently stiff to give much support to long upright branches, and the branches invariably collapse or droop if the zoarium is removed from the water. The alimentary canal is rather less stout

¹ If attached to dead wood they are apt to become stained.

than in *P. repens*. Among Indian specimens of *P. fruticosa* two varieties can be distinguished:—

Var. A has the branches long and composed of many zoëcia, while the zoëcia themselves have a diameter at the broadest part of nearly half a millimetre. The ectocyst is tinted of a delicate brownish colour.

Var. B (Allman's *Plumatella stricta*), on the other hand, has much more slender zoëcia (greatest diameter about 0.35 mm.), and its branches are sparingly produced and short, consisting of not more than three or four zoëcia each. The ectocyst, except when stained by contact with rotting wood, is practically colourless.

A third form, the *P. coralloides* of Allman, occurs frequently in India but must be regarded merely as a phase directly due to environment. When the zoarium of *P. fruticosa* becomes overgrown by a freshwater sponge, as is frequently the case, the zoëcia are forced by the pressure of its growth to assume an upright direction and often reach a considerable length without branching, in order that their apertures may be on the surface of the sponge. As a rule, however, they are not exactly parallel to one another, and they never assume a polygonal form in cross-section or become agglutinated together. Frequently, moreover, they give rise to branches on the surface of the sponge, even after reaching a considerable length. Zoaria may be found in which the proximal (*i.e.*, the oldest) part is free and has the typical form of *P. fruticosa*, while the younger parts, being embedded in a sponge, have assumed the form of *P. coralloides*.

P. fruticosa is a common form in India, especially in Lower Bengal. I have examined specimens of var. A from the island of Bombay, from Igatpuri in the W Ghats, from Lahore in the Punjab (Major J. Stephenson, I.M.S.), and from Calcutta and other places in the Ganges delta. Form B I found growing in abundance in Shasthancottah lake in the plains of Travancore (some of my specimens from that locality being embedded in gelatinous masses formed by a colonial rotifer and having assumed to some extent the *coralloides* characters), and in a jungle stream at the base of the W Ghats in the same State; I also obtained specimens at Igatpuri, and at Kawkareik in Lower Burma. Specimens collected in a pond at Darjiling (alt. 6,900 feet) by Mr. R. Kirkpatrick and now in the British Museum, probably also belong to form B of this species but are in too bad a condition of preservation to make a definite statement possible.

Indian specimens of var. A agree well with a specimen from Germany sent me by Dr. Kraepelin labelled *Plumatella princeps* var. *fruticosa*, while examples of the *coralloides* phase from Calcutta and elsewhere in Bengal closely resemble a specimen of this phase from the neighbourhood of Edinburgh.

In some of the Calcutta tanks *P. fruticosa* grows with great luxuriance. It is only found, so far as my experience goes, during

the cold weather, beginning to flourish in November and dying down again about March. I have not seen resting statoblasts in this species.

Plumatella emarginata, Allman.

Plumatella emarginata, Allman, *op. cit.*, p. 104, pl. vii, figs. 5—10.

Alcyonella benedeni, *id.*, *ibid.*, p. 89, figs. 5—11.

Plumatella princeps var. *emarginata* (*partim*), Kraepelin, *op. cit.*, p. 120, pl. iv, fig. 108, pl. v, fig. 123.

Plumatella emarginata, Braem, *op. cit.*, p. 9, pl. i, figs. 12, 14.

Plumatella emarginata (*partim*), Annandale, *op. cit.*, p. 89.

The main characters of this species, which is remarkably constant, are the following:—

- (1) The zoecia are slender and nearly cylindrical, often quite straight, never dilated at the tip, often (in young or poorly developed colonies) adherent to the support of the zoarium by their whole length. The distal part of each zoecium is never strongly bent upwards when the base is recumbent.
- (2) The aperture is frequently situated on the dorsal surface of the zoecium rather than at the tip.
- (3) The ectocyst is stiff. It is deeply pigmented at the base of each zoecium but colourless at the tip.
- (4) The ectocyst is defected on a triangular area situated at the tip of each zoecium on its dorsal surface,¹ the apex of the triangle, which points away from the aperture, being frequently produced as a furrow running along the middorsal line of the zoecium. The defective area is hyaline, but the furrow is never very deep.
- (5) The statoblast is invariably elongate (not less than 1½ times as long as broad), and (the capsule being small and relatively short) the swim-ring is usually much narrower at the sides than at the extremities.
- (6) In well-developed zoaria part of each zoarium is usually flat and recumbent and part upright, the upright part consisting of branches ramifying in one plane.
- (7) The main axis of the branches forms an angle less than a right angle with that of the zoarium, and is approximately straight.

In this species the distinction between the dorsal and the ventral surface of the zoecium is often retained, even in the case of entirely free zoecia, more clearly than it is in allied forms, the ventral surface keeping its flattened appearance. The coloration is characteristic. The basal part of the zoecium varies from a fairly pale brown to nearly black in tint, but is always opaque and contrasts with the white tip, which is by no means coterminous with the emargination.

¹ This is what is meant by calling the zoecium emarginate.

Both free and fixed statoblasts are produced in considerable numbers.

In Lower Bengal at any rate, most well-developed zoaria assume, sooner or later, the form described by Allman under the name *Alcyonella benedeni*. This is apparently due to the fact that the growth of the zoarium is vigorous, that proper space for its expansion, in the general absence of large areas of attachment of a suitable kind, cannot be found in a horizontal plane, and that the organism is therefore crowded. Profuse branching takes place and the branches are closely pressed together and forced to assume a vertical direction. The individual zoœcia affected become elongated, although not to the same extent as in *P. repens* var. *fungosa*; they do not lose their power of branching, that is to say, of producing daughter zoœcia; no gummy substance is secreted.¹ The masses formed are, therefore, analogous to those of the *coralloides* phase of *P. fruticosa* rather than to those of *P. repens* var. *fungosa*.

P. emarginata is a common species in the East. I have myself found it abundant in Calcutta and the neighbourhood, and also both in Upper and in Lower Burma (Rangoon and Mandalay), in the Malay Peninsula (Jalor in the Patani States) and in Lower Siam (Tale Noi, Lakon Sitamarat). Indian specimens agree with a German one sent me by Dr. Kraepelin as typical of his *Plumatella princeps* var. *emarginata*. The species is usually found in ponds, adhering to solid objects either at the bottom or on the surface, such as stones, logs of wood or large woody seeds; it flourishes in the cold weather, but small feeble colonies, with the majority of the polypides dead, may sometimes be found during the "rains" (July to September).

Plumatella allmani, Hancock.

Plumatella allmani, Hancock, *Ann. Mag. Nat. Hist.* (2), vol. v, p. 200, pl. v, figs. 3—5 (1850).

Plumatella diffusa, Leidy, *Proc. Acad. Nat. Sci. Philadelphia*, vol. v, p. 261 (1851).

Plumatella diffusa, *P. allmani*, and *P. dumortieri*, Allman, *op. cit.*, pp. 105, 106, 108, pl. viii, figs. 1—5.

Under the name *Plumatella allmani* I here group several forms that have been practically ignored by recent writers on the Phylactolæmata, except perhaps Jullien, whose synonymy cannot be elucidated without an examination of the specimens on which he worked. These forms, however, seem to me to deserve, together, specific rank, being related to *P. emarginata* but invariably distinguishable from that species. It is possible that they include more than one species, but the different forms here described must be regarded for the present as varieties.

The essential characters in which *P. allmani* differs from *P. emarginata*, the only form with which confusion is likely, are the following :—

¹ Kraepelin's *P. princeps* var. *muscosa* is not identical with "*Alcyonella benedeni*."

- (1) The zoëcia are stout and relatively short ; they are never straight or flat, but invariably have the proximal or basal half horizontal and the distal half bent vertically upwards.
- (2) The basal half in the great majority of the zoëcia is adherent, and the aperture is always terminal.
- (3) Vertical branches are rarely formed and never consist of more than three or four zoëcia.
- (4) The base of each zoëcium is usually tinted, but not very deeply ; it is invariably rough on the external surface, while the distal part is smooth, colourless and hyaline.
- (5) The free statoblast is very variable in shape and is often much broader (relatively) than that of *P. emarginata*.

Although well-developed specimens of this species often look to the naked eye extremely like the *benedeni* phase of *P. emarginata*, examination with a lens invariably reveals the characteristic differences in the coloration of the ectocyst and the growth of the zoarium.

The following varieties may be distinguished .—

Var. A. (*P. allmani*, Hancock.)

The zoëcia in this variety are always more or less distorted and are usually broader at the tip than at the base ; some or all of them are strongly emarginate and have a well-developed furrow. They are never densely pigmented as a whole, but in the older specimens obtained at Bhim Tal in the W. Himalayas there is a band of dark pigment round the middle of each zoëcium. The zoarium is never of great extent. I have found every gradation between this form as figured by Hancock and Allman's *P. elegans*.

Var. B. (*P. dumortieri*, Allman.)

This variety differs little from var. A, but the zoëcia are much more regular in shape. Allman states that the statoblast is like that of *P. repens* but figures it as distinctly elongate.

Var. C. (*P. diffusa*, Leidy.)

The growth of this variety is much more vigorous than that of the other two, and the zoaria frequently cover large areas on logs of wood and stones. The zoëcia are stouter and more strongly curved in outline ; they are often closely pressed together, so that a resemblance to the phase *benedeni* is produced. The base of each zoëcium is usually of a yellowish brown colour, but I refer to the variety with some doubt a fragmentary specimen from Bulandshahr in the United Provinces (*Major H. J. Walton, I.M.S.*) in which it is practically colourless. Even in this specimen the separation of each zoëcium into two distinct regions is quite clear. The variety closely resembles Kraepelin's figures of his *Plumatella polymorpha* var. *cæspitosa*, except that the statoblasts differ in shape (*Deutsch Süßwass.-Bryozoen*, part i, pl. v, figs. 126—128). Resting statoblasts are produced.

Although these three varieties cannot be regarded as local races, seeing that they occur in Europe or North America as well as in India, they are not usually found together. I have only seen var. A in Bhim Tal, a W Himalayan lake several miles in length, and var. B in a tank in Calcutta, in a small lake at Kawkareik in Lower Burma and in a pond at Kurseong (alt. c. 5,000 ft.); but var. C is common all over N. India. Major J Stephenson, I.M.S., has sent me specimens from Lahore, while I owe to Mr. R. Kirkpatrick and Capt. F. H. Stewart, I.M.S., specimens taken on different occasions, in a small pond at Gangtok in native Sikhim (E. Himalayas). I have myself found the variety growing in great abundance in the environs of Calcutta and at Rajshahi on the R. Ganges about 150 miles north of Calcutta. On one occasion I discovered a small colony in the Zoological Gardens at Alipore, growing on a brick side by side with *P. emarginata*.

Plumatella javanica, Kraepelin.

Plumatella javanica, Kraepelin, *Mitth. Nat. Mus. Hamburg*, vol. xxiii, p. 143, figs. 1—3 (1906).

Plumatella emarginata var. *javanica*, Loppens, *op. cit.*, p. 163.

This is a much more constant species than the last, related to *P. emarginata* but distinguished by characters that vary little. These characters are the following :—

- (1) The zoëcia are entirely and invariably recumbent, so that the aperture is always on the dorsal surface. They are very long and narrow and produce daughter zoëcia sparingly, so that linear series without lateral branches are sometimes formed. The emargination and furrow are strongly developed.
- (2) There is never any trace of pigment in the ectocyst, which is markedly transparent and delicate; the external surface is smooth.
- (3) The capsule of the statoblast, which is elongate, is large as compared with the swim-ring.

Dr. Kraepelin has very kindly sent me one of the types of this species, and I have found other specimens among Prof. Max Weber's collection of sponges from Java. *P. javanica* is common in Calcutta, and I obtained specimens in a canal near Srayikad in Travancore. In a freshwater sponge collected by Prof. Max Weber in Natal there are the remains of a zoarium that may belong to this species.

b. *Philippinensis* group.

The type of this group is Kraepelin's *Plumatella philippinensis* from the Philippines, and the only other species definitely known to belong to it except *P. bombayensis* is Rousset's *P. tanganyikæ* from Central Africa. The group would therefore appear to be essentially a tropical one.

Plumatella bombayensis, Annandale.

P. bombayensis, Annandale, *Rec. Ind. Mus.*, vol. ii, p. 169, figs. 1, 2.

Zoarium. The whole colony is recumbent but branches freely and at short intervals in a vertical plane, so that the zoœcia become crowded together and the branches sometimes overlap one another. The zoarium often covers a considerable area, but growth seems to be mainly in two directions.

Zoœcia. The walls of the zoœcia are thick, stiff and densely pigmented; the external surface, although not very smooth, is always clean; a flat membrane, which is apparently an extension of the ectocyst, frequently extends between different zoœcia and branches. The two most noteworthy characters of the zoœcia are (1) their truncated appearance when the polypide is retracted, and (2) the conspicuous, although often irregular external annulation of their walls. The tip of each zoœcium, owing to the fact that the tentacular sheath is soft and sharply separated from the stiffened wall of the tube, terminates abruptly and is not rounded off gradually as is the case in most species of the genus; sometimes it expands into a trumpet-like mouth. The annulation of the external surface is due to numerous thickened areas of the ectocyst that take the form of slender rings surrounding the zoœcium; they are most conspicuous on its distal half. On the dorsal surface of the base of each zoœcium there is a conspicuous furrowed keel, which, however, does not extend to the distal end; the latter is oval in cross-section. The zoœcia are short and broad; their base is always recumbent, and, when the zoarium is attached to a stone, often seems to be actually embedded in the stone; the distal part turns upwards and is free, so that the aperture is terminal; the zoœcia of the older parts of the zoarium exhibit the specific characters much more clearly than those at the growing points.

Polypide. The lophophore bears 20 to 30 tentacles, which are long and slender; the velum at their base extends up each tentacle in the form of a sharply pointed projection, but these projections do not extend for more than one-fifth of the length of the tentacles. Both the velum and the tentacular sheath bear numerous minute tubercles on the external surface. The base of the stomach is rounded, and the whole of the alimentary canal has a stout appearance.

Statoblasts. Both fixed and free statoblasts are produced, but not in very large numbers. The latter are broadly oval and are surrounded by a stout chitinous ring, which often possesses irregular membranous projections; the surface is smooth. The free statoblasts are small and moderately elongate, the maximum breadth as a rule measuring about $\frac{2}{3}$ of the length; the ring of air-cells is not very much broader at the ends than at the sides; the dorsal surface of the central capsule is profusely tuberculate. The outline of the whole structure is somewhat irregular.

This species is perhaps no more than a variety or a local race of the African *P. tanganyikæ* and is closely related to *P. philippinensis*; from the former it differs mainly in its darker and more strongly

annulated ectocyst, while it may be at once separated from *P. philippinensis* by the fact that the latter's zoëcia are smooth and polished and show no trace of annulation.

Habitat. As yet only known from Igatpuri Lake, which is situated in the Western Ghats about 60 miles N. E. of the island of Bombay at an altitude of about 2,000 feet.

Habits. I found this species common in the lake in November, 1907 and 1909. The largest zoaria were growing on the lower surface of stones, but a few were found attached to the stems and leaves of water-plants. The latter, however, did not appear to be in a very flourishing condition and were all small; their pigmentation was not so dense as that of the colonies on the stones. Probably *P. bombayensis* is a species that flourishes during the "rains," for even the most vigorous colonies appeared, in November, to be dying; there were patches among them in which the polypides had disappeared from the zoaria, and sometimes the zoaria had decayed, leaving the fixed statoblasts to mark their former position.

c. *Punctata* group.

This group comprises Jullien's genus *Hyalinella* (1893) and probably consists of a single species.

Plumatella punctata, Hancock.

Plumatella punctata, Hancock, *Ann. Mag. Nat. Hist.* (2), vol. v, p. 200, pl. v, figs. 6, 7, and pl. iii, fig. 1.

Plumatella punctata, Allman, *op. cit.*, p. 100.

„ „, Kraepelin, *Deutsch. Süßwass.-Bryozoen.*, p. 126, pl. iv, figs. 115, 116, pl. v, figs. 124, 125, pl. vii, figs. 153, 154.

The most striking character of this species is the nature of the synœcium. Although the zoëcia retain their tubular nature to a very considerable extent, the ectocyst is so soft and as a rule so much inflated that this character of the zoëcia is masked, and frequently the zoarium appears to represent an almost uniform flat area rather than a branching structure. The movements of the polypides, moreover, affect the ectocyst directly, and it is drawn together by the contraction of the muscles in a way that does not occur in other species of the genus. There is therefore no difficulty in recognizing living specimens; but preserved ones are often apt to be confused with *P. repens*. The statoblasts are, however, often even broader than is the case in that species, and even in badly shrunken specimens the ectocyst is always thicker. The zoëcia are colourless or nearly so, either hyaline or translucent.

In Europe Kraepelin has recognized two seasonal forms as varieties under the names *prostrata* and *densa*, the former being found in summer, the latter in autumn. In var. *prostrata* the zoëcia are elongated and entirely hyaline, with the external surface nearly smooth, whereas in var. *densa* they are much stouter

and more closely crowded together, and have the ectocyst distinctly clouded and the external surface tuberculate. Var. *densa* has also bigger and broader statoblasts than var. *prostrata*. In the Indian race the degree of transparency of the ectocyst is somewhat variable, but the surface is, in all the specimens I have seen, slightly tuberculate and the method of growth resembles that of var. *densa*. There appears to be a difference as regards the number of tentacles, for while European specimens are said to have from 40 to 60, specimens from Calcutta have from 30 to 40. The statoblasts of Indian specimens resemble those of var. *densa* in being broad, but are rather smaller; they are frequently somewhat asymmetrical in outline. Fixed statoblasts have not been found.

I have, as yet, only found *P. punctata* in the neighbourhood of Calcutta, where it is common in ponds in which a slight infiltration of brackish water may be suspected. It flourishes during the "rains" and the cold weather, but I can detect no difference between specimens taken in July and others taken in January.

Genus *STOLELLA*, Annandale (1909).

This genus is closely allied to *Plumatella* and especially to the *punctata* group, from which it is probably derived. The young zoarium closely resembles that of *P. punctata*, and it is only after several zoëcia have been produced that the characteristic mode of growth becomes apparent, long processes being given out from the base of certain zoëcia so as to take the form of a stolon, and all the zoëcia assuming an upright position.

Stolella indica, Annandale.

Stolella indica, Annandale, *Rec. Ind. Mus.*, vol. iii, p. 279 (1909).

This species is often found growing in close proximity to *Plumatella punctata*, from which even young zoaria may be readily distinguished by their strong emargination and furrow. The upright position of the older zoëcia and the false stolon that separates the little groups of zoëcia in well-developed colonies are, of course, clear diagnostic characters. I have never seen a zoarium with lateral or vertical branches. The free statoblasts are variable in length; they are usually elongate as a whole, but the capsule is nearly as broad as long and the swim-ring is exceedingly narrow on both faces at the sides. The fixed statoblasts, which are produced in considerable numbers, are very variable in proportions. The chitinous ring surrounding them is stout and is surrounded in its turn by a narrow membranous ring indistinctly ornamented with a reticulate pattern. The surface of the capsule is smooth. The tentacles possess a short and feebly festooned velum at the base.

S. indica is common in the neighbourhood of Calcutta during the "rains" and has been taken by Major Walton at Bulandshahr in the United Provinces.

Genus *LOPHOPUS*, Dumortier.

The *punctata* group of *Plumatella* is to some extent intermediate between *Lophopus* and the typical species of its own genus, but in *Lophopus* the tubular character of the zoëcia is still further masked by the development of the synœcium, which takes the form of a gelatinous vertical sack. The polypides are invested in this sack in an upright position, as is most clearly seen when they are fully expanded. Their lowest point is separated by some little distance from the base of the zoëcium, except when the whole organism is very strongly contracted. The free statoblasts resemble those of *Plumatella* but are much larger; fixed statoblasts are not formed.

Only two species of *Lophopus* can be recognized, namely *L. crystallinus* (Pallas) and *L. jheringi*, Meissner. The former occurs in Europe and North America and has the statoblasts of an oval shape with the extremities much produced; the latter has only been found in Brazil and has the statoblasts irregularly polygonal or almost circular.

It is doubtful whether any species that really belongs to *Lophopus* occurs in India, for the species found by Carter in Bombay must be placed in the genus *Lophopodella*, while there is no information available regarding a form said to occur in Madras.

Genus *LOPHOPODELLA*, Rousselet (1904).

There has been much confusion between this genus and *Lophopus*, but a recent examination of living specimens, which I was able to keep under observation for some weeks, shows me that I was wrong in regarding the two as identical. Rousselet's genus may be distinguished by the following characters:—

- (1) The polypides are arranged in the synœcium in such a way that they radiate from a common centre. When fully expanded they do not stand upright but recline with their main axis at a tangent to the base of the synœcium, from which they are not far separated.
- (2) The statoblasts normally bear at either end a series of delicate chitinous processes each provided with several pairs of minute hooks.

From *Pectinatella* the genus is distinguished, (1) by the fact that different zoaria do not become embedded in a common jelly, and (2) by the structure and position of the chitinous processes of the statoblasts.

Three species of *Lophopodella* may be distinguished.

- | | |
|----------------------------------------------------------|-----------------------------------|
| I. Extremities of the statoblast produced | <i>L. capensis</i> . ¹ |
| II. Extremities of the statoblast convex or sub-truncate | <i>L. carteri</i> . |
| III. Extremities of the statoblast concave | <i>L. thomasi</i> . |

¹ Miss I. B. J. Sollas, "A new freshwater Polyzoon from S. Africa," *Ann. Mag. Nat. Hist.* (8), vol. ii, p. 264 (1908).

All three species occur in Africa, but *L. carteri* was discovered in Bombay and is represented in Japan by what appears to be a local race.

Lophopodella carteri (Hyatt).

Lophopus sp., Carter, *Ann. Mag. Nat. Hist.* (3), vol. iii, p. 335, pl. viii, figs. 8—15 (1859).

? *Lophopus* sp., Mitchell, *Quart. Journ. Micros. Sci.* (3), vol. ii, p. 61 (1862).

Pectinatella carteri, Hyatt, *Comm. Essex Inst.*, vol. iv, p. 203 (1865).

Lophopodella carteri, Rousselet, *Journ. Quek. Micr. Club*, 1904, p. 47, pl. iii, figs. 6, 7.

Lophopus lendenfeldi, Annandale (nec Ridley), *Journ. Asiat. Soc. Bengal*, 1907, p. 92, pl. ii, figs. 1—4.

Lophopus lendenfeldi var. *himalayanus*, *id.*, *Rec. Ind. Mus.*, vol. i, p. 143, figs. 1, 2.

Lophopus carteri, *id.*, *ibid.*, vol. ii, p. 171, fig. 3.

The characteristic features of the zoarium of this species are obscure unless it be examined either in a healthy living condition or preserved with the polypides fully expanded. The general form of each zoarium as viewed from above is circular or oval, with more or less distinct lobate projections, which become more conspicuous when the animals are strongly contracted. The centre of the structure, owing to the arrangement of the polypides, appears to be practically empty when the polypides are expanded, so that the whole has a ring-like appearance. Viewed from the side it resembles a low mound. The gelatinous parts are colourless, but the stomach has a greenish tinge. The tentacles are long and slender but much shorter than those of *Austrellella lendenfeldi*; they usually number about ninety. The shape and proportions of the statoblast vary considerably, but the extremities are never concave. The number of chitinous processes is not constant, and their degree of development varies even in specimens from the same locality.

The form described by me as *Lophopus himalayanus* is distinguished by the small number of its tentacles and the absence or abortive condition of the processes on the statoblast. This form, however, must be regarded merely as an abnormality in which the polypides are stunted and the statoblasts retain immature characters. I have recently received typical specimens of *L. carteri* from Bhim Tal, in which the abnormal form was originally discovered.

Pectinatella davenporti, Oka, of which Dr. Oka has been kind enough to send me specimens, is certainly, as Loppens indicated,¹ a form of *L. carteri*, the range of which, therefore, extends from E. Africa to Japan. In India, however, the occurrence of the species is sporadic. It was originally found in Bombay and is common in Igatpuri Lake; possibly it occurs at Madras. It is usually found either on the lower surface of stones or among gelatinous green algæ on the stems of plants.

¹ "Les Bryozoaires d'eau douce," *Ann. Biol. Lacustre*, vol. iii, p. 166 (Decr. 1908).

Genus PECTINATELLA, Leidy.

The structure of the individual zoarium of this genus agrees closely with that found in *Lophopodella*, but in fully mature colonies a large number of zoaria secrete a common investment or basal membrane of a gelatinous nature, so that compound colonies, often of gigantic size, are produced. The statoblast is entirely surrounded by chitinous processes, each of which bears at its extremity a pair or a small bunch of hooks.

Three species of *Pectinatella* can be distinguished, *P. magnifica* from N. America and the continent of Europe, *P. gelatinosa* from Japan, and *P. burmanica* from Bengal and Lower Burma. They may be distinguished as follows :—

- | | | |
|------|----------------------------------------------------------------------------------------------------------------|-----------------------|
| I. | Statoblast circular, surrounded by processes which are much longer than the hooks at their tips | <i>P. magnifica.</i> |
| II. | Statoblast somewhat irregular in shape but nearly circular ; the processes not or barely longer than the hooks | <i>P. burmanica.</i> |
| III. | Statoblast subquadrate ; processes as in II | <i>P. gelatinosa.</i> |

Pectinatella burmanica, Annandale.

Pectinatella burmanica, Annandale, *Rec. Ind. Mus.*, vol. ii, p. 174 (1908).

Zoaria circular or oval, sometimes constricted in the middle owing to approaching division, of large size, embedded in large numbers in a greenish jelly of considerable thickness, the compound colonies often measuring a yard or more in length and several inches in diameter.

Polypides large, the free part measuring when fully protruded about 5 mm. Tentacles numbering about 90, slender, moderately long, tuberculate ; the velum at their base narrow, never strongly festooned.

Statoblast almost circular but invariably a little irregular in outline, measuring about 1.75 mm. in diameter, provided with a complete ring of very short chitinous projections each of which bears a pair of hooks at the tip. The hooks normally bend backwards in a wide arc and nearly touch the edge of the statoblast ; sometimes they are distorted or abortive.

Young zoaria resemble those of *Lophopodella carteri* both in general structure and in histology but may be distinguished, even before the secretion of the common jelly, by the large size of the polypides and the green colour of the synœcium.

I described *P. burmanica* from a statoblast found in March in a lake at Kawkareik in Lower Burma, but later in the year (October) discovered mature colonies growing in great abundance in the Sur Lake near Puri in Orissa. They grew on the stems of rushes, which they completely encased. Both larvæ and statoblasts were being given out in large numbers.

In concluding these notes I have to thank the many colleagues who have assisted me with specimens and information. For Indian examples of the Phylactolæmata I am indebted to Major H. J. Walton, Major J. Stephenson and Capt. F. H. Stewart of the Indian Medical Service, and to Mr. R. Kirkpatrick, to whom I must also express my thanks for assistance as regards exchanges with the British Museum. The named European specimens sent me by Dr. Kraepelin and Dr. W. Michaelsen from Hamburg have proved exceedingly useful, while I cannot express my admiration too strongly as regards the exquisite preparations given me by Mr. C. Rousselet. I owe to Dr. F. Harmer's generosity some valuable specimens and am indebted to Prof. Max Weber, Dr. Oka, Mr. T. Evans and the authorities of the Geneva Museum for others. Last but not least the Trustees of the Indian Museum are entitled to my gratitude for the liberality with which they have allowed me to travel in India and Burma.

This paper is merely a preliminary attempt to classify the Indian representatives of a very difficult group. It will, I hope, be followed by the publication of a more ambitious work. I need, therefore, hardly say that criticism will be most valuable, especially on the part of those who have a practical acquaintance with the Phylactolæmata of Europe and N. America.



V STUDIES ON THE AQUATIC OLIGO- CHÆTA OF THE PUNJAB.¹

By J STEPHENSON, M.B., D.Sc. (Lond.).

I.—ON *Lahoria*, A NEW GENUS OF THE NAIDIDÆ ALLIED TO *Branchiodrilus*, MCHLSN. (*Chætobanchus*, BOURNE).

The worm of which the following is a description shares with *Branchiodrilus* the remarkable peculiarity of the possession of gill-processes on the anterior part of the body; the hair-setæ of the dorsal bundles are contained within the more anteriorly situated gills; but further back, though still in the region of the gills, a certain number of these setæ project freely.

Branchiodrilus semperi, the only species of the genus originally named *Chætobanchus* by Bourne, was found by him in a tank in Madras town [2]. It has not since then (1890) been recorded from any place in India, nor has it since been encountered at all under what may be described as natural conditions; though Beddard [1] has found specimens in the *Victoria regia* tank at the Botanical Society's Gardens in Regent's Park. The chief difference between this form and the one now to be described, and the feature which makes it necessary to constitute a new genus for the reception of the latter, is the absence of gills and dorsal setæ from the most anterior segments (ii-v) in the present form, and their presence on these segments in the form described by Bourne.

Lahoria hortensis, sp. nov.

The worm was found in a small pond in the Lawrence Gardens, Lahore. This pond is artificial, having been first made about two years ago; it is kept supplied with canal-water by a small irrigation channel, and has been for some time overgrown and almost choked up with aquatic plants. The specimens were first obtained early in July, 1908. The animals lived then in fair numbers on and amongst the water-weeds near the edge of the pond, and it was not difficult to obtain specimens by passing a small net through this vegetation. One or two samples of mud from the bottom of the pond did not seem to contain any of these worms. Specimens were also found later in the year in the same place.

External characters (plate vii, fig. 1).—The worms are usually from about two-thirds of an inch to an inch, or 16—25 mm. in length, and less than a millimetre in diameter, on an average .5 to .75 mm. The number of segments varies considerably; specimens which were not preparing to divide showed from 90 to 120

segments; many were, however, preparing for fission, and one of these showed seventy-nine in its anterior and ninety-one segments in its posterior half, or 170 altogether. In addition to the segments recognizable as such, there is always a posterior tapering region of the body where growth is apparently taking place actively, and where distinct segments have not yet been differentiated.

The *prostomium* is bluntly conical in shape, and is well marked, though by no means so large relatively as is figured for *Branchiodrilus* (Bourne, *loc. cit.*, fig. 1). There are no eyes. The first few segments, as far as the first gills, form a region of the body which is in preserved specimens somewhat narrower than that which succeeds it, though this is not obvious in the living and moving animal; indeed this region may then appear somewhat swollen. A peculiarity noticed on a number of different occasions was that when after a somewhat prolonged examination a specimen died and began to disintegrate under the microscope, this latter process began by a shrivelling up of the region of the first ten gills, this region of the body becoming wrinkled and much narrower in diameter than before.

The anterior portion of the body is pigmented (plate vii, fig. 2), the *pigment* being black and occurring in granules more or less closely aggregated. On the dorsal surface there is a blotch of pigment about the level of the mouth, just in front of the level of the cerebral ganglion, and there are a few scattered granules towards the tip of the prostomium. A segmental distribution of the pigment is hardly to be recognized in segments ii-iv; but after this it is distributed as well-marked transverse bands one in each segment. These bands become less dense as one proceeds posteriorly, and after about the twentieth segment are inconspicuous; scattered pigment spots occur for some distance further, but these, too, ultimately disappear. On the ventral surface the appearances are more variable; there may be well-defined segmental bands here also, or there may be only scattered spots; but in any case the pigment is less than on the dorsal surface.

The segments are delimited externally by a fairly well-marked *annulation*.

The *branchial processes* are dorso-laterally situated hollow projections of the body-wall, cylindrical in shape, longest in the anterior part of the body, and gradually diminishing posteriorly. The first of these processes are situated on the sixth segment as a rule, but occasionally on the fifth. It is not always easy in the living and moving worm to be certain of the exact numbering of the segments; and I therefore examined a number of individuals fixed and mounted in balsam; in nine such specimens the gills began in segment v in one, in vi in the rest.

The first gill on each side is a little shorter than the second; when turned forwards these reach well in front of the tip of the prostomium. The branchial processes of the anterior part of the body are easily visible to the naked eye, and are over a millimetre in length; the longest I have measured was 1.6 mm. After the

anterior segments they decrease somewhat in size, and become progressively smaller and smaller; about the fortieth segment they may be only .4 mm. long, about the fiftieth .3 mm., and after the seventieth they are mere tubercles. These figures are approximate only, and are given for the sake of illustration, as there is a certain amount of individual variation. The processes are however recognizable, though as minute tubercles only, till within quite a short distance of the growth zone at the posterior end of the body; in this respect the present form seems to differ from *Branchiodrilus*, where, according to Bourne's figure, there may be as many as sixty-seven posterior segments without any recognizable processes.

In an animal which was preparing to divide asexually, the anterior portion of seventy-nine segments had recognizable gills throughout its length, the most posterior, just in front of the budding zone, being .13 mm. long. The first gill of the posterior animal was .35 mm. long, the second .48 mm.; as above, small tubercle-like processes were visible to within a short distance of the hinder end, practically as far as distinctly differentiated segments were to be recognized.

These processes in the anterior part of the body contain the

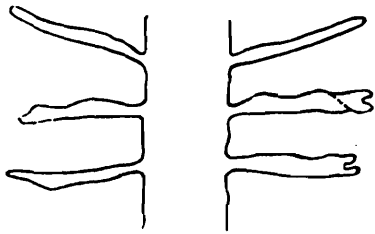


FIG. 1.—Irregularities of shape of branchial processes in *Lahoria hortensis*.

dorsal hair-setæ; they are, like the general surface of the body, ciliated; they present here and there short stiff hairs, presumably sensory; they are hollow, and body-cavity corpuscles may be seen moving into or out of them; they contain two well-marked blood-vessels, one afferent and one efferent. They are usually regularly cylindrical in shape, but occasionally show irregularities of outline, and there may be a tendency to forking

at the free end (text-fig. 1); they are somewhat constricted at their attachment to the body-wall. They are in the natural condition stiffened by the contained setæ, but appear to possess a certain amount of contractility, since in fixed and preserved specimens the long anterior processes are usually found much curved, often into the shape of a semicircle.



FIG. 2.—Ventral seta of *Lahoria hortensis*.

The setæ, except in the most anterior region, are in four bundles per segment, two dorsal and two ventral. The ventral setæ (text-fig. 2) begin in the second segment; they are of the usual \int -shape, forked distally, the two prongs being equal in length, the proximal prong, however, being twice as thick at its base as the distal. The nodulus is slightly distal to the middle of the length of the seta, the proportions of the proximal and distal parts of the seta being 7 : 6 or 8 : 7. The total length of these

setæ varies from .15 mm. in the anterior to .13 mm. in the posterior part of the body. I have not been able to recognize any difference in type between the setæ of the anterior and posterior segments. There are usually four or five setæ in each ventral bundle.

The *dorsal setæ* are of two kinds, long slender hair-setæ, and short straight singly-pointed needle-setæ. The hair-setæ are quite smooth; they begin in the same segment as the gills, within which they are at first contained; two such setæ usually extend into each gill, of which one, somewhat longer than the other, may reach very nearly to the tip of the gill; like the gills themselves, their length will thus be, in extreme cases, considerably more than a millimetre.

At a varying distance from the anterior end, about the fortieth to the fiftieth segment, the hair-setæ begin to project freely from the surface of the body; as a rule, however, only one of each bundle does so, rarely two; the gills still contain a seta, a comparatively short one however, in correspondence with the shorter gills. The first free dorsal setæ are longer than the gills they accompany; e.g., the setæ may be .51 mm. long, the gill .4 mm.; but the disproportion may be much greater—setæ .88, gill .28; or setæ .5, gill .144 mm. These hair-setæ, like the gills they accompany, gradually decrease in length posteriorly, though not so markedly as the gills. The needle-setæ, usually two per bundle occur along with the hair-setæ as short pointed rods scarcely projecting beyond the level of the body-wall. I have not seen any sickle-shaped setæ, as described for *Branchiodrilus*.

It has been mentioned that the gills are ciliated; these *cilia* are extremely fine and delicate, and though sometimes visible without much difficulty, are frequently only to be recognized by the movements of small particles in the water in their vicinity. Similarly over the general surface of the animal; the whole body seems to be ciliated, though the cilia themselves are only occasionally to be discerned; their presence is however evidenced by the commotion of minute particles in the water near the surface of the body.

The body-cavity is traversed by well-marked *septa*; these are perforated in places, allowing the lymph-corpuscles to pass from segment to segment. These *corpuscles* are round, and very granular; they are not pigmented.

Alimentary canal.—The mouth cavity is ciliated; the pharynx, an oval dilatation, occupies the first few segments, narrowing about segment vii to become the œsophagus. This is a straight tube continued posteriorly into the intestine; there is no sharp demarcation between these, and it is difficult to say where one ends and the other begins. Antiperistaltic movements are frequent, and may be violent, in the intestine; they may extend as far forwards as the tenth segment. A postero-anterior ciliary action may occur in the intestine of these worms, similar to that observed in *Nais*, *Pristina*, *Slavina*, etc.

Vascular system.—The blood is yellowish red, and contains no corpuscles. The dorsal vessel contracts from behind forwards; it is incorporated with the wall of the intestine, and like the intestine is covered by a layer of chloragogen cells. The ventral vessel is non-tractile, and is separate from the alimentary canal, with which it is connected in each segment by at least two vessels which pass into the wall of the latter. Besides branching vessels to the body-wall there are present in each segment a pair of lateral loops, which in the anterior part of the body extend into the gills (plate vii, fig. 3), the limbs of the loop forming the afferent and efferent vessels of these organs. The afferent vessel, springing from the dorsal vessel, is in this part of the body contractile; further back, where the branchial processes are small, the lateral loops do not extend into them, and no part of the loops is contractile; the lateral loops exist, however, though much reduced in

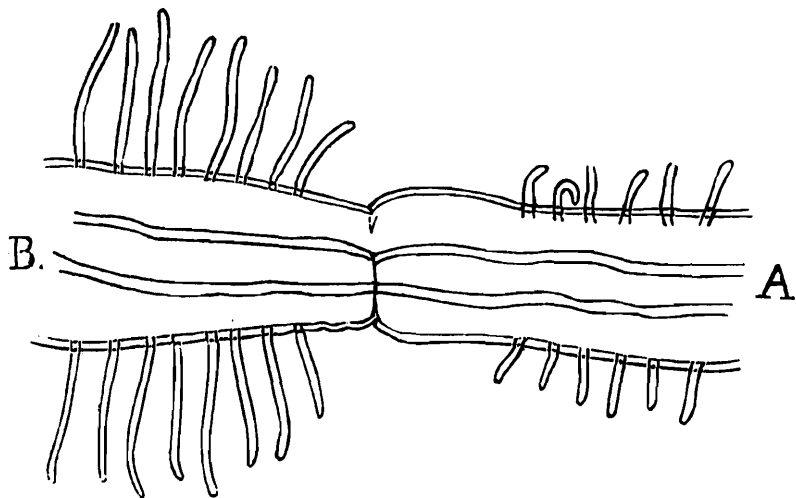


FIG. 3.—Region of approaching division in a specimen of *Latoria hortensis*; showing portions of both anterior and posterior animals without gill-processes, and hence consisting of newly budded segments: A = anterior animal; B = posterior animal.

size, back to the hinder end of the animal. In the first five segments the lateral vessels do not present the appearance of regular loops, but form an extremely irregular and complicated plexus.

The *nephridia* begin by an open ciliated mouth; parts, at least, of the nephridial tube are also ciliated. I am not certain as to the segment in which they begin, my observations (which were a matter of some little difficulty, since these organs are not in this region very conspicuous) being discordant; in one case the first nephridium seemed to be in segment ix, in another in xi, and again in xiv, xv, xvi and xvii; it is possible that the position varies. They end some little distance in front of the posterior extremity of the animal; thus the last thirteen seta-bearing segments may have none. They become smaller and smaller posteriorly, appearing as small loops in contact with the ventral vessel and attached to the alimentary canal, somewhat as if they were budded out from the latter.

The *nervous system* has the usual relations. The two halves of the cerebral ganglion appear to be more distinct than is often the case in the Naididæ, and in the living condition were seen as two separate ganglia united by a transverse commissure; this is not apparent in preserved specimens.

Asexual reproduction.—In the description of *Branchiodrilus*, Bourne mentions the absence of a budding zone between the two components of a chain, and remarks that the process of division resembles rather a simple fission of the animal into two. The present form, however, shows a distinct, though not extensive, budding zone. A reference to text-fig. 3 will illustrate this. The specimen had almost reached the stage of complete division; and the two components separated, in fact, when the specimen was being transferred to balsam. It will be seen that the last branchial processes of the anterior animal (A) are still of some considerable length, and that the most posterior portion of this animal has no branchial processes at all; this last portion, therefore, is evidently a new production, or the series of branchial processes would have been continued over it. Similarly the anterior portion of the hinder animal (B); the ventral setæ (not shown in figure) are small—hence new productions, not a continuation of the original series; and, as usual, these anterior segments are without gill-processes, which would have been present, and even of moderate size, had these segments been a continuation of those of the anterior animal.

It appears, therefore, that the posterior segments of the anterior of two still conjoined animals are produced in a budding zone, and that the same is the case with the anterior five segments of the posterior component. It is interesting to compare this phenomenon with what occurs in *Chætogaster* [10] and *Nais* [11]; in both these forms the anterior region, comprising five segments which are differentiated from the rest by the distribution of the setæ, is formed as a new production in the budding zone; in the present form also these segments are differentiated from the rest (by the absence of dorsal setæ), and are formed in the budding zone; while in *Branchiodrilus*, where there is no differentiation, the budding zone is inconspicuous, being limited presumably, as far as the posterior animal is concerned, to the production of the prostomium and first segment. *Genital organs* have not been observed.

Systematic position.—The presence of branchial processes alone would not be sufficient to ally this form in any close connection with *Branchiodrilus*, since the genus *Dero* among the Naididæ also possesses similar organs, and there is no reason to suppose that such physiologically similar organs may not have arisen independently.

But when, in addition to the mere occurrence of branchial processes, we consider their distribution in the anterior part of the body, their gradual diminution in size posteriorly, their length and shape, and the fact that anteriorly they enclose the dorsal hair-setæ, while posteriorly these setæ project freely, we must

conclude that we have here a collection of morphological resemblances which are comparatively unimportant from a physiological standpoint, and which it is in the highest degree improbable should have arisen independently.

Admitting then the close connection of the two forms, is it possible to unite them in the same genus? Most of the differences between the two are obviously of only specific value; such are the greater extension posteriorly of the branchial processes in the present form; the absence of sickle-shaped setæ in the dorsal bundles, and of any difference between the anterior and posterior setæ in the ventral bundles; the colourless character of the coelomic corpuscles; and, possibly, the pulsation of the anterior lateral vascular loops and the ciliation of the general body-surface, which two last characters do not appear to have been observed in *Branchiodrilus*.

The difference in the anterior limit of the dorsal setal bundles (and branchial processes) belongs, however, to a different category. Such a feature has generally been held to be of generic and not merely specific value. Thus the presence of dorsal setæ on all segments from the second onwards is mentioned as a feature in the generic diagnosis of *Branchiodrilus* in Bourne's original paper [2], in Beddard's Monograph of the Oligochæta [1], and by Michaelsen [5]; a similar feature is the chief, if not the only, generic distinction between *Naidium* and *Nais*; Beddard ([1], p. 281), merging together a number of genera of other authors under the one name *Nais*, does so largely because they "agree in the important fact that the first five segments are cephalized,—that the dorsal setæ do not commence until the sixth segment," and by implication would exclude from the genus any form which did not show this cephalization. Similarly *Pristina* and *Naidium* are united by him on the ground of the absence of this feature. Bourne [3] also believed that the number of cephalized segments is constant for the genus, and thought it probable that *Dero furcata*, possessing four achætous dorsal segments, should on this account be removed from the genus, since the other members of it have five such segments.¹

It seems necessary, therefore, to erect for the present form a new genus, for which I suggest the name *Lahoria*, with *hortensis* as a specific distinction. I believe notwithstanding, on the ground of the similarity of distribution of the branchial processes and of their relations to the setæ in the two forms, that the connection between the present form and *Branchiodrilus* is a close one; and if this be admitted, it is perhaps worth while asking whether a cephalization which affects only the setal distribution (for the absence of gills on segments ii-v of the present form is evidently correlated with the absence of the setæ which are necessary to

¹ On the other hand Michaelsen [5] unites into one genus *Paranais* the *Naidium naidina* of Bretscher, *Paranais littoralis* of Czerniavsky, and *Uncinails* (*Ophidonais*) *uncinata* of Levinsen, though their dorsal setæ begin respectively on the second, fifth and sixth segments.

stiffen them) has the systematic value hitherto generally attributed to it.

The same question is suggested by the fact that the cephalization is itself a variable feature, sometimes more, sometimes fewer segments being so differentiated. Thus, while in most of the genera of the Naididæ which show this feature the dorsal setæ begin in segment vi, they begin in iii in *Amphichæta*, in v in *Bohemilla*. Again, the feature varies within the same genus; in *Dero* some species bear the first dorsal setæ on segment v, others on vi. Lastly, the feature varies in individual specimens of the same species; this has already been stated for the present form; it is asserted for *Nais communis* by Piguet [9]; and it possibly occurs in a *Slavina*, according to my observations [11], though these may possibly have been made on specimens which had separated before the complete production of their anterior segments in the budding zone, and in which possibly the full number would subsequently have been formed.

II.—ON THE REPRODUCTIVE ORGANS OF *Nais variabilis*, FIGUET, VAR. *punjabensis*, AND OF *Chætogaster orientalis*, MIHL.

The usual mode of reproduction in the Naididæ is the asexual, by fission. The sexual organs have not hitherto been much used in the discrimination of species; and are not referred to in specific diagnoses; they cannot be said to be well-known in more than a limited number of species, and in many have not even been seen. It is probable, nevertheless, that a fuller knowledge of the sexual organs of the Naididæ would be of considerable systematic value; with regard to the genus *Nais* for example, Michaelsen [6] says, "Die bedauerliche Unsicherheit, die noch immer in der Diagnostizierung der Arten des Genus *Nais* herrscht, mag meiner Ansicht nach am leichtesten durch eine exacte Klarstellung des bisher zur systematischen Gliederung dieser Gattung nicht in Rücksicht gezogenen Geschlechtsapparates gehoben werden." The following account of the sexual organs of two species, one of them belonging to the genus *Nais* referred to above by Michaelsen, may therefore be useful.

Nais variabilis, Piguet, var. *punjabensis* (plate viii, fig. 1).

In a former paper [11] I gave an account of certain features of the reproductive apparatus of this form, as far as they could be made out by microscopic examination of the living animal. Any such account must, however, be very incomplete, since after the formation of the clitellum none of the details are any longer visible; and, as a matter of fact, I had not then seen the male efferent apparatus, which is perhaps the most important part of the system for comparative purposes.

The present description is founded on sections prepared from specimens taken in the Shalimar Gardens, near Lahore, in March,

1909. The animals were present in one of the tanks in considerable numbers, along with *Chætogaster orientalis*; and a fair proportion of both species were in a condition of sexual maturity. For the sake of completeness I have incorporated in the present account a certain number of the facts recorded in my earlier paper.

Both sexual and asexual reproduction may go on together. The testes are the first organs to be formed, and appear on examination of the living worm as homogeneous hyaline masses attached to the posterior face of septum 4/5. The sperm-morulæ ripen in the vesicula seminalis, but may sometimes be seen in the body-cavity of the anterior part of the animal, as far forwards as the third or even the second segment; and I have previously noted that slight violence may cause spermatozoa to be discharged through a rupture of the body-wall at the tip of the prostomium.

The vesicula seminalis, or sperm-sac, forms early, and is properly (plate viii, fig. 1) an extension of septum 5/6; later it becomes much dilated, extending backwards through the sixth, seventh and eighth segments, and finally may even reach the tenth.

The relations of the funnel of the vas deferens will be understood after reference to fig. 1. The mouth is turned backwards into the sperm-sac; it is of fair size, and the lip of the funnel appears in some specimens to be much prolonged on one side (apparently not always the same side), so that the plane of the opening is very oblique. The tube is fairly broad, and is lined by cells of approximately cubical shape; it at first passes vertically down along the septum, then takes one or two bends, but is not coiled. It opens by a rather wider portion into the atrium, on the anterior face of the latter, a little below the middle of its height. Its more or less horizontal portion is surrounded by prostatic cells, in two or more layers. The atrium is approximately spherical, is lined by cells which are a little higher than broad, and has only a thin external muscular coat. The passage to the exterior is short, and opens into a shallow funnel-shaped depression of the surface; the passage and funnel-shaped depression are lined by columnar cells. On a surface view of the animal these depressions are distinguishable as clearer spaces in the opaque clitellum.

The ovaries form soon after the testes, and are attached to the posterior face of septum 5/6. The ovisac is a diverticulum of septum 6/7; its relations may be seen in fig. 1. The sperm-sac is included within it, and the ova lie as a rule behind the sperm-sac, sometimes as far back as segment x; they may however lie on one side of it, so that some sperm-morulæ or spermatozoa may occupy a position posterior to that of the ova. Eggs are seen in various stages of development; in their later stages they accumulate within themselves an enormous amount of yolk-matter; I did not in my former paper recognize how enormous (for so small an animal) this aggregation of yolk might be (y, fig. 1; a much larger mass is shown in fig. 21 of my previous paper); and I was led to describe it and the spherical glancing particles of which it is composed as

something apart from the ova. I have not seen any trace of female apertures in my specimens.

The spermathecæ are in the fifth segment, opening externally not far behind the level of septum 4/5. At first they are small, somewhat pear-shaped or sausage-shaped, extending vertically upwards. Later they become much elongated, and extend backwards into the seventh segment, being contained within the cavity of the sperm-sac. In this stage they are full of spermatozoa; the wall of the receptacle is thin, and its cavity sharply marked off from that of the passage to the exterior, where the lumen is very narrow, and the wall thick (fig. 1).

The clitellum forms after the sperm-sac has developed, but before the spermathecæ and male ducts. When fully formed, it includes segments v, vi and vii, ending by a fairly definite margin both in front and behind. It consists of a single layer of cells, much larger and taller than those over the general surface of the body; these cells in sections prepared in the usual way are seen to have their nuclei near their base, while the greater part of the remainder of the cell shows a large vacuole (fig. 1). On examining the surface of the clitellum in the living animal, it is seen to be tuberculated, and each tubercle appears to be compounded of a number of smaller ones: the large tubercles seem to correspond to individual cells, while each smaller tubercle corresponds to a circular refractile particle, of the same appearance as the glancing particles of yolk in the ripe ovum; when the animal breaks up under examination, the disintegration of the clitellum gives rise to a number of circular masses, each compacted of a number of these particles; these masses appear to be each a portion of an epithelial cell of the clitellum,—the superficial portion apparently, which in the prepared sections is represented by the vacuole and surrounding cell-substance. The appearance of the surface of the clitellum under an oil-immersion lens is represented in plate viii, fig. 2.

The genital setæ are described in the paper already referred to.

Chætogaster orientalis, mihi (plate viii, fig. 3).

When I first [10] gave a description of the present species of the genus *Chætogaster* under the specific name *pellucidus* (which I have since learnt was preoccupied), I had only had the opportunity of observing the sexual organs in a single specimen. I have now to give a more complete description, as well as to correct certain errors of interpretation in my former paper.

The specimens on the examination of which the present account is founded were obtained near Lahore in February and March, 1908. Other sexually ripe specimens have been obtained from Shalimar during the present month, March, 1909. The animals therefore, like the *Nais* previously described, have their period of sexual maturity in the early part of the year in this climate.

Both sexual and asexual reproduction may go on together. This is noted by Piguet [9] for *C. diastrophus*, which, according to

that author, buds at all times except when in an advanced condition of sexual development. In the present species however the limitation just expressed does not hold; all the specimens I have seen, whether sexually ripe or not, show one or more zones of budding; the single individual is never met with, but always a chain.

The testes seem to disappear early, and I could not distinguish them in a specimen which showed sperm-morulæ in all stages of development, but no other genital organs, male or female, except the ovaries in an early stage. A small granular mass situated near the ventral body-wall and a short distance in front of the funnel of the vas deferens, seen in a specimen (plate viii, fig. 4) which had developed the male efferent apparatus but not the clitellum, perhaps represented a testis, whose disappearance may have been somewhat delayed.

The funnel of the vas deferens is in segment v, on the anterior face of septum 5/6; it is ciliated. From it the vas deferens runs backwards in segment vi, with a somewhat curved course in living specimens, to the atrium; this is an oval or stoutly spindle-shaped dilatation of the tube, from which a short ejaculatory duct leads to the exterior. The male aperture is at the level of the setæ of segment vi, which are modified as described below (genital setæ). There is no prostate.

There is also no sperm-sac. Sperm-morulæ in all stages of development are scattered throughout the body-cavity of the animal; and not only through the body of the anterior animal which contains the reproductive organs, but through all the members of the chain. Spermatozoa may be seen passing from one segment to another through the incomplete septa, and may reach as far forwards as the pharyngeal region.

The ovaries are two cellular masses (described as testes in my former paper) in segment vi, at the level of or slightly anterior to the atrium on each side. They seem to appear early; one specimen showed two hyaline protoplasmic aggregates in which cell outlines were not (in the living condition) visible; these were suspended in the ventral part of the body-cavity on fine strands passing between the alimentary canal and body-wall, one on each side at a level a little in front of the setæ of segment vi; with the exception of sperm-morulæ, these, which were apparently an early stage of the ovaries, were the only signs of sexual organs.

There is no ovisac, and the ova ripen in the general body-cavity. Though ova are sometimes met with in the posterior animals of a chain, they are more usually found collected in the posterior part of segment vi, and here may cause a fairly definite backward bulging of the septum. The larger size of the egg-masses as compared with the sperm-morulæ probably occasions the restriction of their wanderings. What I figured in my earlier paper as an ovary is such a collection of ova.

The ripe eggs are of considerable size, and consist mainly like those of the species of *Nais* previously described, of aggregations of glancing particles of yolk, opaque in mass by transmitted light.

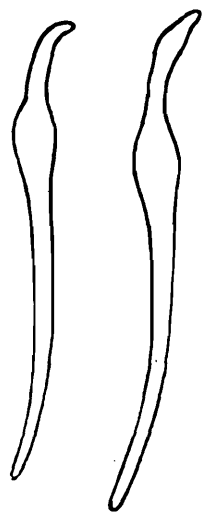
The aggregate, when it has attained some size, is visible to the naked eye as a brilliant white spot.

A curious condition was found in a number of animals examined about the same time of the year as those containing well-marked sexual organs. Those to which I now refer had no clitellum, and no male organs or male products, but showed throughout their extent masses of what was apparently yolk-substance. In some cases these masses were large, filling up nearly the whole diameter of the body-cavity; in others they were numerous and small, somewhat resembling sometimes the white cœlomic corpuscles of the Punjab variety of *Nais variabilis* [II], but showing no nucleus on staining. In a few cases small isolated masses of ova were found along with these aggregations of yolk. These animals may have been individuals which had passed through their sexual stage and had failed to get rid of all their female products; or possibly they were the posterior animals of a chain, into which, contrary to the usual rule, female products had spread; the chain then breaking up, these products had been retained by the posterior animals without any means of getting rid of them. The eggs would, on this supposition, have entered the posterior components of the chain while still small, and would have formed their yolk there; eventually breaking up they might thus give rise to the appearances observed.

The spermathecæ are two short oval structures attached to the posterior face of the septum which delimits the short œsophagus from the distended crop. This is probably septum $\frac{4}{5}$ (not $\frac{3}{4}$, as I assumed in my earlier paper), and the organs are, as commonly in the Naididæ, in segment v. They open externally by a short passage; the pore has somewhat tumid lips. They develop rather late, and may be absent after the full development of the ovary and male efferent apparatus.

The clitellum is situated primarily on segment vi, and spreads later half-way over both v and vii, thus coming ultimately to occupy a space of about two segments. It is a tuberculated area, the tubercles being at first minute and discrete. Each tubercle appears singly as a small round clear particle; but the region as a whole is opaque, though not so densely opaque as in other Naididæ, e.g., *Nais* and *Pristina*. The clitellum forms late, and may still be absent after the establishment of all the other organs. The order of development of the various organs is thus: testes, ovaries, male efferent apparatus, spermathecæ, clitellum.

FIG. 4.—Two genital setæ of *Chaetogaster orientalis*.



The genital setæ are the modified setæ of the sixth segment. They make their appearance during the time of development of the male efferent apparatus; thus in a specimen in which the funnel was not yet ciliated, and

where the ejaculatory duct was not yet formed (the atrium appearing as a rounded mass sessile upon the inner side of the body-wall), there were, in addition to the normal setæ of the segment, small setæ with the characteristic distal ends of the genital setæ developing beside the normal setæ in the body-wall. The genital setæ (text-fig. 4) are shorter and stouter, as well as fewer in number (*e.g.*, three on each side) than the normal setæ of the segment. The nodulus is very large and prominent, and near the distal end; the distal end is blunt and not forked. These setæ vary somewhat in shape, as for example in the degree of bluntness of the end, and they may or may not present a slight swelling just proximal to the tip.

III.—ON A SPECIES OF *Dero* FOUND IN LAHORE; A CONTRIBUTION TO THE *Dero*-QUESTION.

A number of specimens of this form were discovered in the mud from a pond near the boarding house of the Government College, and were brought to my notice by Lala Bishambar Das, my demonstrator, in November, 1908. The pond has since been drained, and the form has not been met with again.

External characters.—The animals were thin and filiform when extended, in length from 10 to 12 mm. Most of the animals were preparing to divide, and showed a zone of newly budded segments about the middle of their length. The number of distinguishable segments in each half of such an animal was about twenty. There were no eyes. The prostomium was bluntly conical, and the posterior end of the body was slightly swollen in a club-shaped manner. The animals moved backwards quite easily.

Gill-processes.—The anus opened posteriorly at the bottom of a funnel-shaped depression, the base of the funnel facing dorsalwards. Ventral and posterior to the funnel, the posterior end of the body was prolonged into a pair of finger-shaped lobes, which could be curved dorsalwards and thus bent over the gill-processes about to be described, but were not completely retractile, though they could be appreciably shortened. These processes were not ciliated, and did not contain blood-vessels: they bore a number of sensory "hairs."

On each side of the funnel, extending in a line forwards and dorsalwards from the posterior tactile processes just described, were four vascular gill-processes. These diminished in size from behind forwards, the most anterior being thus the smallest. All were rounded, tuberculated, ciliated, and vascular; they were very contractile, and hence their appearance varied much from time to time. The smallest, most anterior gill on each side was a projection of the margin of the funnel; the other three appeared to be inserted just within the margin in such a way that when fully expanded the margin of the funnel disappeared as a continuous line, but when contracted the margin of the funnel appeared as a

separate and distinct line enclosing the bases of the gill-processes. A number of variations, in different animals and at different

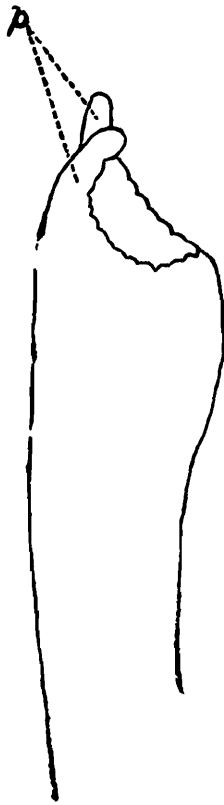


FIG. 5.

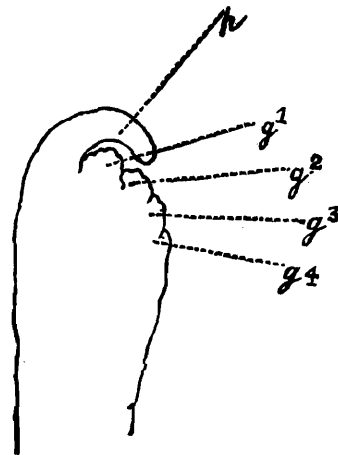


FIG. 6.

FIGS. 5, 6.—Posterior end of body of *Dero* sp.: *p.* = palp; *g*¹.—*g*⁴. = gill-processes. Fig. 5 shows a much contracted condition, the gills not projecting from the funnel at all.

times, are shown in the figures (plate vii, figs. 4—6, and text-figs. 5 and 6).



FIG. 7.—Dorsal needle-seta of *Dero* sp., showing relative sizes of prongs of fork, and a second slight irregularity of outline distal to nodulus.

Setæ.—The dorsal setal bundles began on the fifth segment; each bundle consisted of one hair- and one needle-seta. The hairs were fine, smooth, pointed, and about .16 mm. long, or nearly as long as the body of the animal was broad. The needles had a slight double curve (text-fig. 7), and were forked distally, the prong on the outer side of the curve being slightly shorter and much thinner than that on the inner side; the nodulus was situated at the junction of the distal and middle thirds, and there was a second slight nodulus, or rather perhaps an irregularity of contour merely, a little way distal to the first. In length these needles were about .05 mm.

The ventral setæ (text-fig. 8) were of the usual double-curved and forked type, usually four, occasionally two or three in a bundle; the bundles began in the second segment. Two types were distinguishable; those of the second, third, and fourth segments had the prongs of the fork of the same thickness at their base, and the distal prong half as long again as the proximal; in the remaining segments the prongs were almost equal in length (the proximal being possibly very slightly the longer), and the proximal was twice as thick as the distal at its base. The length of the setæ varied from .06 to .05 mm., those of the anterior segments being slightly longer than those of the posterior; the thickness was about the same, 2.2μ throughout.



FIG. 8.—Ventral seta from a posterior segment of *Dero* sp.

The position of the nodulus was found to vary regularly in each bundle. This may be illustrated by the following tables:—

(a) Setal bundle of iv segment—

Total length.	Prox. to nodulus.	Distal to nodulus.
.058	.026	.032
.058	.029	.029
.062	.032	.030
.054	.032	.021

(b) Setal bundle of a posterior segment—

Total length.	Prox. to nodulus.	Distal to nodulus.
.056	.026	.029
.056	.029	.026
.057	.035	.022
.053	.035	.018

The series in each case begins from the innermost seta of the bundle. It will be seen that in each bundle the inner seta has the nodulus proximal to the middle of its length, while in the outer seta the nodulus is markedly distal; and that the intermediate setæ show intermediate conditions.

Lymph corpuscles may be present or absent, and when present they were of two kinds. Both were spherical; but one variety contained a number of shining white granules, while the other contained a small number of fairly large yellow refractile spheres, looking like small oil droplets. These two kinds of corpuscles were similar to those described for the Punjab variety of *Nais variabilis* [11] (plate viii, fig. 6).

Alimentary canal.—The pharynx occupied segments ii, iii and iv, and the œsophagus v and vi. Around the œsophagus, in segments v and vi, were lobular hyaline masses somewhat resembling the “septal glands” of *Pristina*. There was no distinct stomach;

chloragogen cells covered the alimentary canal as far forwards as septum 6/7 (plate viii, fig. 5).

Circulatory system.—The dorsal vessel was attached to the alimentary wall as far as septum 6/7, where it became free. The ventral vessel was non-contractile, was quite separate from the intestine except posteriorly, and gave off segmental branches to the intestine, which entered a ventral intestinal sinus, or median vascular channel in the intestinal wall. Posteriorly, at a little distance in front of the hinder end of the body, the ventral vessel became joined to the wall of the intestine; finally it bifurcated, the two branches curving round dorsalwards and then gently bending inwards to unite and form the posterior end of the dorsal vessel. Before meeting, they branched once or twice; the branches, however, soon re-united (plate viii, fig. 7).

There were, as a rule, five lateral commissural vessels connecting the dorsal and ventral vessels in the anterior part of the body; of these, the first was in segment vi, the last in x; the largest was that in vii, the next largest that in vi, then those in viii, ix, and x in the order given. Several variations, however, were observed; in one case the first lateral vessel was in segment vii; in another case, in addition to the five usual vessels, there was also a small vessel in v; in another case there were four only, in segments vi-ix. All these vessels were contractile.

The blood is red.

Nephridia.—The first nephridium occurred in the seventh segment; but here again there were variations. Thus in one case the first nephridium was in segment viii; in another, the first was in vii as usual, but the eighth segment had no nephridia.

It will be apparent, on looking over a list of species of the genus *Dero*, that the presence of palps at the hinder end of the body excludes the present form from all species, except *vaga*, *stuhlmanni*, *furcata*, *tonkinensis*, *schmardai* [7] and *palustris* ([8], *Aulophorus palustris*). The form of the dorsal setæ excludes it from *D. stuhlmanni*, *vaga* and *tonkinensis*; in *D. schmardai* the dorsal setæ begin in segment vi, the ventral setæ are far more numerous in segments ii-v, and the gill-processes are fewer; *D. palustris* has many more segments (50), and a larger number of gills (4 or ? 5 pairs), but this last form still awaits complete description.

The form to which the animal now described approaches most closely is *D. furcata*, Ok. The differences appear to be the following: the palps are much longer in *D. furcata*, appearing in Bousfield's figures ([4], figs. 17 and 18) to be relatively to the diameter of the animal about three times as long as in the species here described; the gills also are longer, slenderer and almost cylindrical, in three pairs, of which one pair are "secondary branchiæ," *i.e.*, projections of the margin of the funnel only. Further, the present form differs in a number of characters from all the other species of the genus, according to the diagnostic summary given by Michaelsen [5]. Thus, according to his definition of the genus—

- (a) the ventral setæ are throughout the genus longer in segments ii-v than in the rest of the body ;
- (b) the alimentary tube is dilated to form a stomach ;
- (c) the nephridia begin in the sixth segment ;

to which may be added—

- (d) the genus does not possess cœlomic corpuscles (Bousfield [4]); but it seems nevertheless (Beddard [1]) that these are present in *D. vaga*, from which, however, the present form is far removed.

With regard to the length of the ventral setæ, I have previously stated that in the present forms, those of the anterior segments are slightly longer than those of the posterior ; but even this difference is gradual, not abrupt after the fifth segment ; nor in any case is its magnitude such that it could be used as a diagnostic character (*cf.* figures for length of various setæ, p. 73, *ant.*).

As regards a stomachal dilatation of the alimentary tube, this is stated [7] to be not well marked in *D. schmardai*.

I have not seen any account of a species of *Dero* in which, as in the present form, the nephridia begin in the seventh segment.

Lastly, the character mentioned under (d) above is not an absolute distinction between the other species of the genus and the present one ; since, as mentioned, cœlomic corpuscles are present in *D. vaga*, and may be absent in the present form.

A list of six or seven characters which distinguish this form from its nearest neighbour, especially when four of these are peculiar, or almost peculiar, to the present form alone, might perhaps be held as a sufficient warrant for the erection of a new species.

The species of the genus *Dero* are, however, variable in a high degree : this is illustrated in the present form by the variations recorded in the branchiæ, vascular commissures, cœlomic corpuscles and nephridia. Michaelsen, discussing this variability [6], alludes to the possible advisability of uniting all (European) species under two heads, *digitata*, without palps, and *furcata*, with palps. In such a case the present form would be included in *D. furcata*, which is, as we have seen, at any rate its nearest ally.

On reading Bousfield's paper already referred to, which I was only able to do after my examination of the worms had been completed, I was a little disconcerted as to the value of my observations by finding that, according to that author, "It is almost impossible to determine the species of any given example when ordinary methods, such as the compressorium or the live-trough, are alone employed;" the reason given being that, in the case of the compressorium, the full expansion of the branchial area, which is absolutely necessary for exact observation, is prevented. I do not however now think that a thin cover-glass would so greatly reduce the length of palps and gills as to explain the great difference between his figures and mine, and I observe that Michaelsen [6], [7], [8] has lately described new species from preserved material.

Since, however, my acquaintance with the genus is limited to

the present form, I will not definitely pronounce an opinion as to whether the range of variability in the genus is such, and the characters of the form now described are so distinctive, as to render the erection of another species desirable. The above account may however be of use as a contribution to the "*Dero-frage*," concerning which Michaelsen writes [6]: "Trotz Bousfield halte ich eine Revision der Gattung *Dero*, zumal eine ausführlichere, auch die Borstenverhältnisse berücksichtigende Beschreibung der verschiedenen Formen oder Arten, noch für ein Desideratum."

As recommended by Michaelsen, I have paid particular attention to the setæ; whether the peculiar relations shown by the position of the nodulus in the several component setæ of a ventral bundle will also be found, when looked for, in other members of the genus, cannot be predicted; it has not been noticed by the last-mentioned author in his recent detailed description of *D. schmardai* [7] and *D. incisa* [6], and it may not improbably be found to be of systematic value.

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11. Stephenson, J. .. "The anatomy of some Aquatic Oligochæta from the Punjab," *Memoirs of the Indian Museum*, vol. i, No. 3, Calcutta, 1909.



EXPLANATION OF PLATE VII.

- FIG. 1.—*Lahoria hortensis*: a somewhat diagrammatic representation of the general form of the animal. Free dorsal setæ not represented.
- „ 2.—Anterior part of body, from above (living specimen), to show pigmentation, etc.: *bch* = branchial process; *c.g.* = cerebral ganglion of left side; *comm.* = commissure between cerebral ganglia of the two sides; *m.* = level of mouth, which is indicated by an irregular black line, showing through the cerebral ganglia; *oes.* = œsophagus; *ph.* = outline of pharynx; *pr.* = thickened epithelium of pro-stomium; *s.* = setæ contained in branchial process.
- „ 3.—A segment in the middle of the body, showing arrangement of blood-vessels: *a.v.* = afferent vessel to gill; *bch.* = epithelium of branchial process; *d.v.* = dorsal vessel; *e.v.* = efferent vessel; *int.* = intestine; *s.* = setæ in branchial process; *sp.* = septum, to which on the other side the efferent vessel appears to be attached.
- „ 4—6.—Posterior end of body of *Dero* sp.; from various specimens, in various conditions of contraction or expansion. In fig. 4 the margin of the funnel is seen, and the insertions of the gill-processes are visible within it by transparency. In fig. 5 the gills and palp of one side only are shown; the third gill appears as a projection of the margin of the funnel; the fourth small (dorsal or anterior) gill was noted in this case as being apparently single and median; the outline of the funnel is shown within by transparency. Fig. 6 is seen from the dorsal surface looking into the funnel; the fourth (anterior) gills are not distinguishable as separate projections.
p. = palp; *s.h.* = sensory hairs; *g*¹.—*g*⁴. = gill-processes.

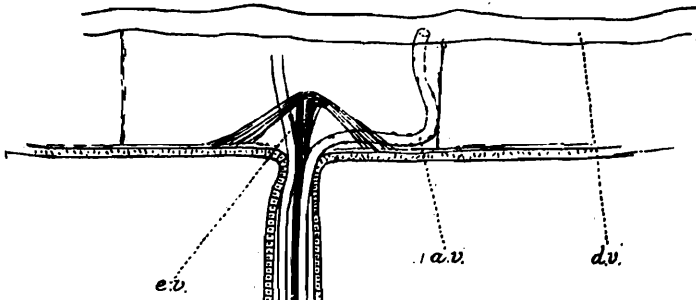
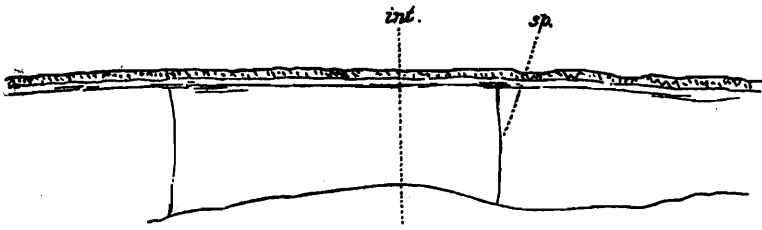


Fig. 3.

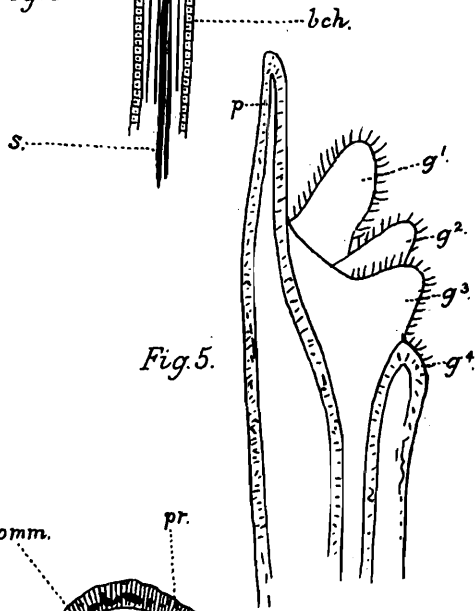


Fig. 5.

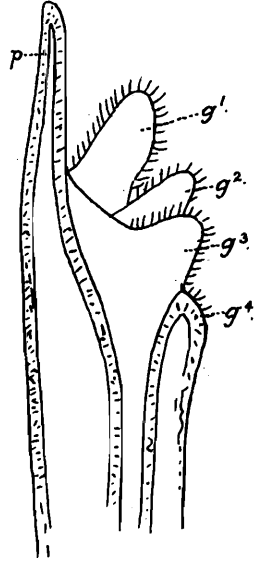


Fig. 6.

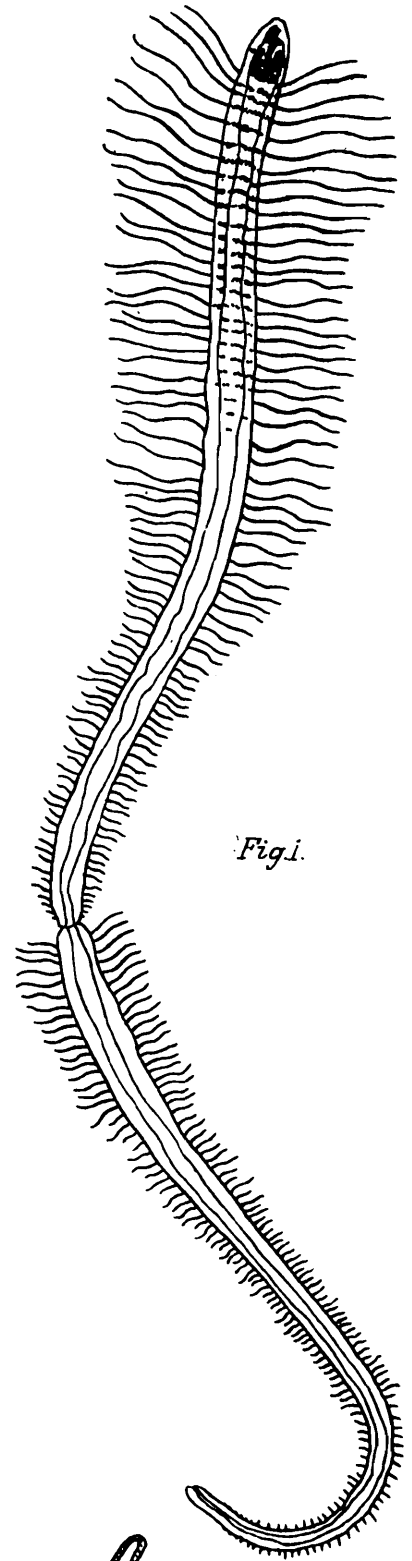


Fig. 1.

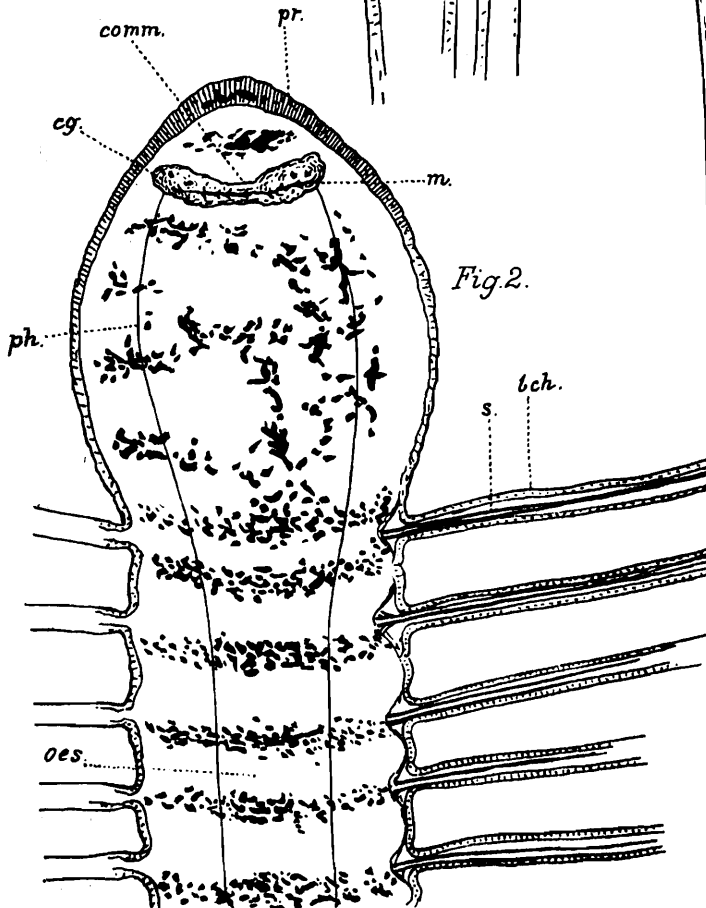


Fig. 2.

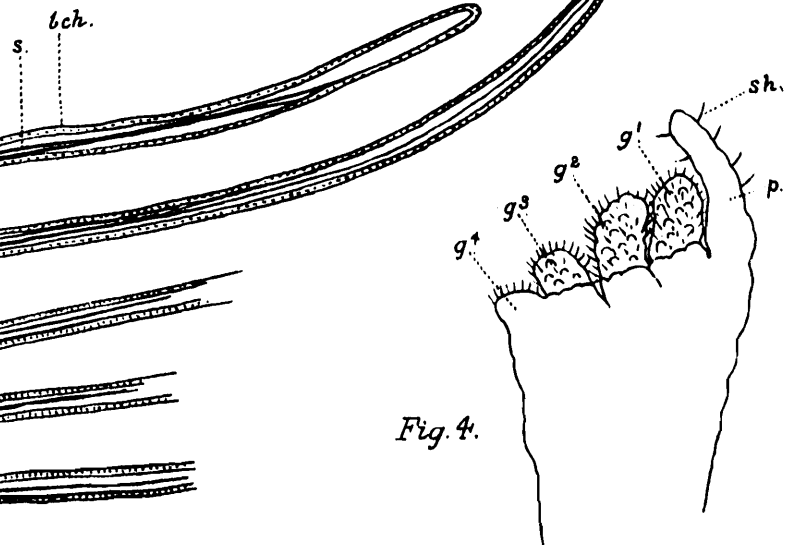


Fig. 3.

EXPLANATION OF PLATE VIII.

- FIG. 1.—Reproductive organs of *Nais variabilis*, var. *punjabensis*, as seen in longitudinal section. The figure is diagrammatic, and in order to show all organs, is compiled from several successive sections.
- „ 2.—Portion of clitellum of the same, as seen in surface view under oil-immersion lens.
- „ 3.—Anterior part of body of *Chætogaster orientalis*, to show reproductive organs; clitellar area lightly shaded. The living animal represented as seen by transparency, obliquely from the ventral surface.
- „ 4.—Middle region of the body of the same, showing an early stage in the development of the genital organs. Ovary and testis present, but not the spermathecæ; clitellum not developed. The organs of the other side were not seen.
- At.* = atrium; *cl.ep.* = clitellar epithelium; *c.m.* = circular muscular layer; *cr.* = crop; *f.* = funnel of vas deferens; *g.s.* = genital setæ; *l.m.* = longitudinal muscular layer; *o.*, *o*¹. = ovaries; *oes.* = œsophagus; *os.* = ovisac; *ova* = ova; *ph.* = pharynx; *pr.* = prostate; *s.* = setæ, *sp.*, *sp*¹. = septa; *sp.* 4/5, *sp.* 5/6, *sp.* 6/7 = the septa between the segments thus indicated; *spth.* = spermatheca; *spth*¹. = posterior extension of spermatheca into sperm-sac; *spz.* = spermatozoa entering funnel of vas deferens; *spz*¹. = spermatozoa in body-cavity; *s.s.* = sperm-sac; *st.* = stomach; *t.* = testis; *v.d.* = vas deferens; *y.* = yolk of ripening ova; σ = male aperture.
- „ 5.—Anterior part of body of *Dero* sp.: *d.s.*⁵—*d.s.*⁸ = dorsal setæ of fifth to eighth segments; *gl.* = glands surrounding œsophagus; *int.* = intestine; *m.* = mouth; *oc.* = œsophagus; *ph.* = pharynx; *pr.* = prostomium; *v.s.*²—*v.s.*⁸ = ventral setæ of second to eighth segments.
- „ 6.—Lymph corpuscles in body-cavity: *a* and *b*, with large yellowish droplets; *c*, with white refractile particles.
- „ 7.—Blood-vessels of hinder end of body of *Dero* sp.: *al.* = outline of ventral wall of alimentary canal; *br.* = branches of ventral vessel to intestine; *d.v.* = dorsal vessel; *v.s.* = ventral setal bundles; *v.v.* = ventral vessel.

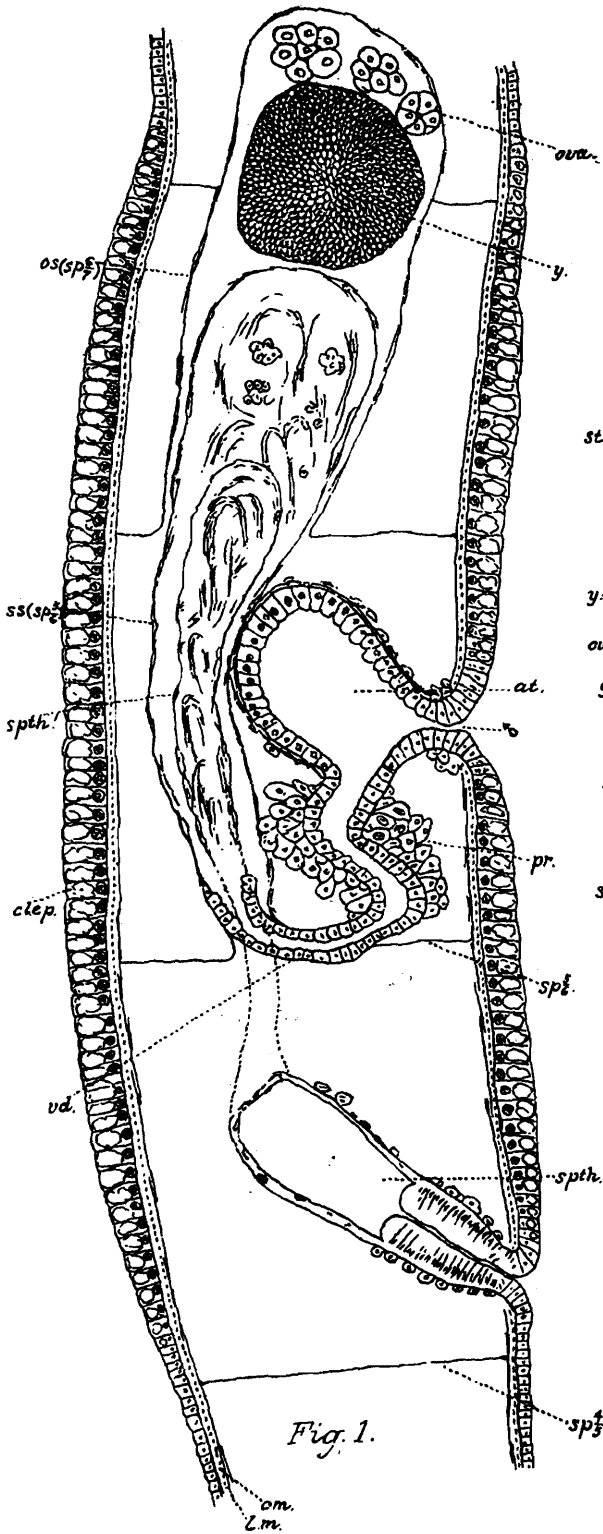


Fig. 1.

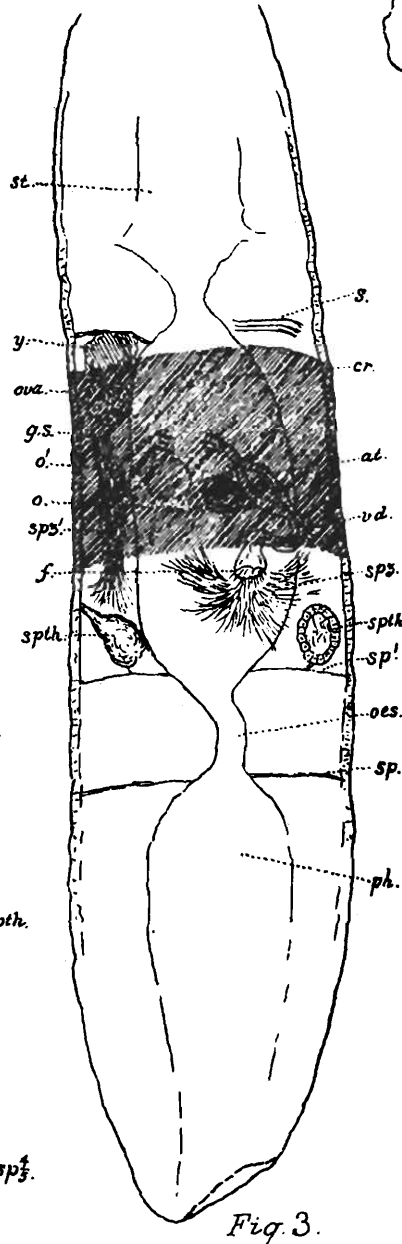


Fig. 3.

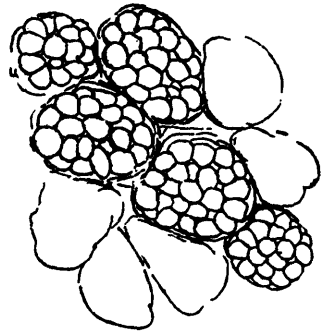


Fig. 2.

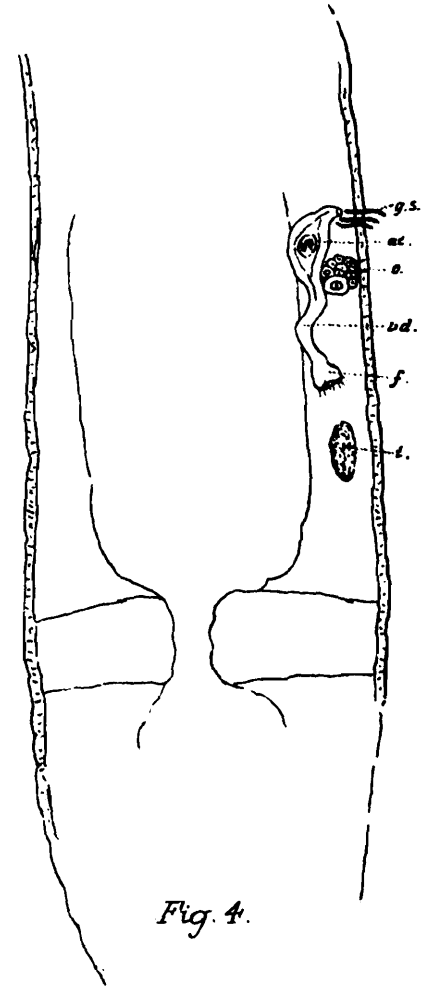


Fig. 4.

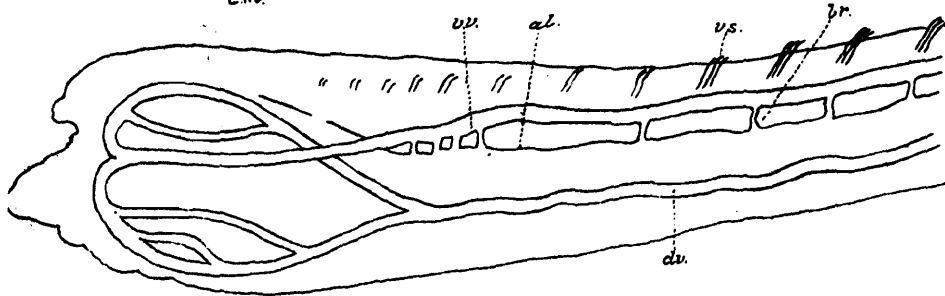


Fig. 7.

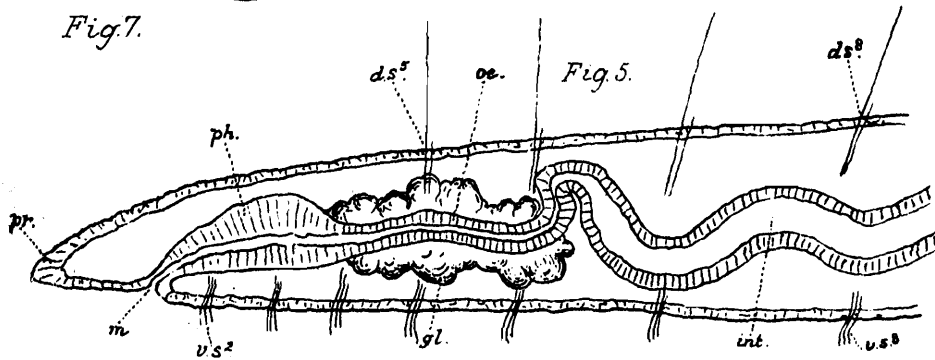


Fig. 5.

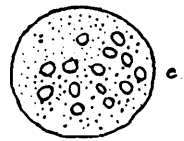
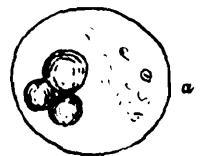
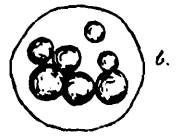


Fig. 6.



VI. AN UNDESCRIBED BURMESE FROG
ALLIED TO *RANA TIGRINA*

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

Mr. I. H. Burkill has recently called my attention to certain frogs eaten in Burma and represented by specimens in the collection of the Reporter on Economic Products to the Government of India. Among these specimens are several that appear to represent a species hitherto confused with *Rana tigrina* and here described as:—

Rana burkilli, sp. nov.

Closely allied to *Rana tigrina*, Boie, from which it may be distinguished by the following characters:—

- (1) The snout is much less strongly pointed and does not project so far beyond the mouth, so that the upper jaw when viewed from below appears to be of nearly the same width throughout instead of being distinctly broader in front than at the sides.
- (2) The tibio-tarsal joint falls short of the ear, as a rule by a considerable distance.
- (3) The internal metatarsal tubercle is somewhat feebly developed.
- (4) The skin of the back and the dorsal surface of the thighs is more warty than is usually the case in *R. tigrina*.
- (5) The dorsal surface is of a dull brownish or greyish colour spotted with black, the surface of the longitudinal ridges and the tips of the smaller warts being whitish. The ventral surface is marked with black, the markings sometimes taking on a reticulate character all over the belly. There is no pale dorsal stripe.

Localities.—Mandalay, Upper Burma (*J. Anderson*, Indian Museum); Tavoy (types); Bassein, Pegu.

Length of type specimen (No. 16569, Indian Museum) 91 mm. without legs.

None of the specimens have vocal sacs, but as most of them have been eviscerated their sex cannot be ascertained.

Mr. Burkill tells me, on the authority of the Burmese, that the new species buries itself in the embankments of rice-fields during the dry weather, while *R. tigrina* remains active throughout the year. The two species occur in the same localities.

MISCELLANEA.

BIRDS.

NOTES ON THE OCCURRENCE OF *Vultur monachus* IN CALCUTTA.—On the 21st of November 1909 an attendant at the Calcutta slaughter-house captured and brought to the Museum alive, an adult male specimen of the Cinereous Vulture (*Vultur monachus*) the prepared skin of which I had the pleasure of inspecting the following month.

This capture very greatly extends the hitherto-recorded range of this fine vulture which is essentially a bird of the extreme north-west of India, straggling along the Himalayas to Bhutan and possibly further east in Tibet. As far as I can ascertain, the only record of *Vultur monachus* ever having occurred south or south-east of the Brahmaputra is my own record of a pair which I found breeding in North Cachar in 1888-89, and from the nest of which I twice took eggs (*Journ. Bomb. Nat. Hist. Soc.*, xi, page 391).

A pair were also seen by me at Dimagiri in Bhutan in November, 1885, and an egg was procured for me by the Bhuteas from a cliff further in the mountains and at a considerably higher elevation.

Throughout the Dooars I have no record of its having been shot, though it must occasionally occur there in the cold weather, and it is not until one gets well into the north-west that it is often met with.

Dr. Annandale has noted the colours of the soft parts of the Calcutta bird as follows: "The bill is blackish brown; the cere pale mauve; the iris brown; the naked skin of the neck livid flesh-colour; the legs and feet creamy or pearly white. The wing from carpal joint to tip of longest primary is 29.10 inches."

E. C. STUART-BAKER,
F.Z.S., F.L.S.

AN ALBINO OWL.—Among the birds recently received at the Indian Museum is an albino specimen of the Spotted Owlet (*Athene brama*) presented by Mr. D. Ezra, who obtained it alive from Benares. The eyes were of a uniform deep violet, and the soft parts showed no signs of pigmentation; the feathers are quite white. The bird was an adult male. The following are its measurements: length 8.5 inches; wing 6.1; tail 3.2; tarsus 1.1; bill .8.

N. ANNANDALE.

POLYCHÆTE WORMS.

“*Matla bengalensis*”: A CORRECTION.—In a previous number of this Journal (*Rec. Ind. Mus.*, vol. ii, p. 39) I gave a description of a form which I supposed to belong to a new genus of the Naididæ. The animals, discovered in the brackish ponds at Port Canning, showed no sexual organs; but on the other hand asexual reproduction was equally not to be observed.

Last summer, while working at the Millport Marine Biological Station on the west coast of Scotland, I came across countless numbers of *Capitella capitata*; and on examining a number of very young forms, I was surprised to find that they resembled in an extraordinary degree my previous specimens of *Matla*.

By a curious coincidence I received within the following week a letter from Prof. Michaelsen of Hamburg, in which he wrote that, after reading the description of *Matla*, he was of opinion that it was no Oligochæte but a Polychæte belonging to the Capitellidæ.

It is easy to see that the fact that my Port Canning specimens showed no signs of asexual division ought to have put me on my guard. I think there can be no doubt that the worms were very young specimens of a Capitellid, and hence that the name given to them ought now to disappear.

J STEPHENSON.



Miscellaneous Zoological Publications.

	Rs. As.		Rs. As.
Account of the Deep-sea Brachyura collected by the R.I.M.S. "Investigator." By A. Alcock, M.B., C.M.Z.S.	6 0	Echinoderma of the Indian Museum: Littoral Holothurioidea collected by the R.I.M.S. "Investigator." By R. Koehler and C. Vaney	2 0
Account of the Deep-sea Madreporaria collected by the R.I.M.S. "Investigator." By A. Alcock, M.B., C.M.Z.S.	4 0	Echinoderma of the Indian Museum: Deep-sea Ophiuroidea collected by the R.I.M.S. "Investigator." By R. Koehler	10 0
Account of the Triaxon (Hexactinellid) sponges collected by the R.I.M.S. "Investigator." By F. E. Schulze, Ph.D., M.D.	16 0	Echinoderma of the Indian Museum: Shallow-water Ophiuroidea collected by the R.I.M.S. "Investigator." By R. Koehler	4 0
Account of the Alcyonarians collected by the R.I.M.S. "Investigator." Part I. By J. Arthur Thomson, M.A., and W. D. Henderson, M.A., B.Sc.	16 0	Echinoderma of the Indian Museum, Part V: An account of the Deep-sea Asteroidea collected by the R.I.M.S. "Investigator." By R. Koehler	12 0
Account of the Alcyonarians collected by the R.I.M.S. "Investigator." Part II. By J. Arthur Thomson, M.A., and J. J. Simpson, M.A., B.Sc.	20 0	Figures and Descriptions of nine Species of Squillidæ from the Collection of the Indian Museum. By J. Wood-Mason, F.Z.S., etc., edited by A. Alcock, M.B., C.M.Z.S.	2 0
Aids to the identification of Rats connected with Plague in India. By W. C. Hossack, M.D.	0 8	Guide to the Zoological Collections exhibited in the Bird Gallery of the Indian Museum. By F. Finn, B.A., F.Z.S.	0 12
Catalogue of Indian Crustacea. Part I.—Introduction and Brachyura Primigenia. By A. Alcock, M.B., LL.D., F.R.S.	7 0	Guide to the Zoological Collections exhibited in the Fish Gallery of the Indian Museum. By A. Alcock, M.B., C.M.Z.S.	0 8
Catalogue of the Indian Decapod Crustacea. Part II.—Anomura. Fasciculus I.—Pagurides. By A. Alcock, M.B., LL.D., F.R.S., C.I.E.	14 0	Guide to the Zoological Collections exhibited in the Invertebrate Gallery of the Indian Museum. By A. Alcock, M.B., C.M.Z.S. (<i>Out of print.</i>)	
Catalogue of the Indian Decapod Crustacea. Part III.—Macrura. Fasciculus I.—The Prawns of the Peneus Group. By A. Alcock, M.B., LL.D., F.R.S., C.I.E.	7 0	Guide to the Zoological Collections exhibited in the Reptile and Amphibia Gallery of the Indian Museum. By A. Alcock, M.B., C.M.Z.S. (<i>Out of print.</i>)	
Catalogue of Indian Deep-sea Crustacea: Decapoda Macrura and Anomala in the Indian Museum. By A. Alcock, M.B., LL.D., C.M.Z.S.	10 0	Hand List of Mollusca in the Indian Museum, Parts I and II, and Fasciculus E. By G. Nevill, C.M.Z.S., etc. Index, Parts I and II. By W. Theobald	7 4
Catalogue of Indian Deep-sea Fishes in the Indian Museum. By A. Alcock, M.B., C.M.Z.S.	5 0	List of Batrachia in the Indian Museum. By W. L. Sclater, M.A., F.Z.S.	1 0
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Echinoderma of the Indian Museum: Account of the Deep-sea Holothurioidea collected by the R.I.M.S. "Investigator." By R. Koehler and C. Vaney	16 0	Monograph of the Oriental Cicadidæ, Parts I to VII. By W. L. Distant, F.E.S.	31 14

The above can be obtained from the Superintendent of the Indian Museum, Calcutta, and from Messrs. Friedlander & Sohn, 11, Carlstrasse, Berlin.

Other Publications edited and sold by the Superintendent of the Indian Museum (also obtainable from Messrs. Friedlander & Sohn) issued by the Director of the Royal Indian Marine.

Illustrations of the Zoology of the R.I.M.S. "Investigator" 1892. Fishes, Plates I to VII. Crustacea, Plates I to V, 1894. Fishes, Plates VII to XIII. Crustacea, Plates VI to VIII. Echinoderma, Plates I to III, 1895. Echinoderma, Plates IV and V. Fishes, Plates XIV to XVI. Crustacea, Plates IX to XV, 1896. Crustacea, Plates XVI to XXVII, 1897. Fishes, Plate XVII. Crustacea, Plates XXVIII to XXXII. Mollusca, Plates I to VI, 1898. Fishes, Plates XVIII to XXIV. Crustacea, Plates XXXIII to XXXV. Mollusca, Plates VII and VIII, 1899. Fishes, Plates XXV and XXVI. Crustacea, Plates XXXVI to XLV, 1900. Fishes, Plates XXVII to XXXV. Crustacea, Plates XLVI to XLVIII. Index, Part I, 1901. Crustacea, Plates XLIX to LV. Mollusca, Plates IX to XIII, 1902. Crustacea, Plates LVI to LXVII. Crustacea, Plates LXVIII to LXXVI. Fishes, Plates XXXVI to XXXVIII, 1905. Crustacea (Malacostraca), Plates LXXVII to LXXIX. Crustacea (Entomostraca), Plates I and II. Mollusca, Plates XIV to XVIII, 1907. Fishes, Plates XXXIX to XLIII. Crustacea (Entomostraca), Plates III to V. Mollusca, Plates XIX and XX, 1908.—Re. 1 per plate. Mollusca, Plates XXI to XXIII, 1909.—As. 8 per plate.