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[It has been decided that the lists of scientific literature hitherto published in the Reports of the Board of Scientific Advice shall in future be issued separately by the Departments represented on the Board.

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I. MATERIALS FOR A GENERIC REVISION OF THE FRESHWATER GASTROPOD MOLLUSCS OF THE INDIAN EMPIRE.

No. 3. THE FRESHWATER GENERA OF HYDROBIIDAE.

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The small size and insignificant appearance of the members of this family have caused them to be generally neglected, and the classification of the Indian forms in the official *Fauna of British India* seems to be based on no principle at all. Indeed, one of the genera is even placed in the Littorinidae, apparently through inadvertence. The recent attempt¹ of one of us to revise the species assigned to *Bithynia*, Leach, was not, as Mr. A. S. Kennard has pointed out in a letter, sufficiently drastic, for some species distinct from it had been retained in the genus. For these species the name *Digonistoma* has been already² proposed. We include here a detailed description of this new genus.

It will be convenient to begin our discussion of the genera with a key, in which we will ignore their distribution into subfamilies, the diagnostic features of which are concealed in some species by secondary modifications in such a way that it is sometimes easier on first examination to recognize the genus than the subfamily. The subfamilies, nevertheless, seem to be founded on good anatomical as well as conchological characters. We do not propose at present to discuss the estuarine and maritime genus *Stenothyra*, Benson, which calls for a special revision, or the brackish-water species called *Bythinella* or *Belgrandia miliacea* by Nevill³ and *Bithinella canningensis* by Preston.⁴ The true generic position of this species will be considered best in reference to *Stenothyra*.

KEY TO THE INDIAN FRESHWATER GENERA OF HYDROBIIDAE.

- I. Shell very small, thin, elongate, narrowly perforate or imperforate, with the columellar callus poorly developed and the lip thin. Operculum thin, horny, paucispiral. Central tooth of radula without basal denticulations. Male organ without lateral process *Tricula*.
- II. Shell thick, globose, with the spire directed backwards and outwards, with the mouth broad and the columellar

¹ *Rec. Ind. Mus.* XIX, pp. 41—46 (1920).

² *Ind. Journ. Med. Res.* (paper in the press).

³ *Hand-List Moll. Ind. Mus.* II, p. 52 (1885).

⁴ *Ann. Mag. Nat. Hist.* (7), XIX, p. 216, fig. in text (1907), and *Fauna Brit. Ind. Freshw.-Moll.*, p. 66 (1915).

- callus flattened and plate-like, occluding the umbilicus. Central tooth of radula with basal denticulations.
- A. Lip of shell thickened. Operculum thick, calcareous, concentric. Male organ with a lateral process *Paranerita*.
- B. Lip of shell not or slightly thickened. Operculum horny, spiral ... *Lithoglyphus*.
- III. Shell more or less elongate, thick or moderately so, with the main axis of the spire and the body-whorl in the same straight line, and the mouth comparatively narrow. Operculum thick, calcareous. Male organ with a lateral process.
- A. Shell turbate, conspicuously perforate, ornamented with prominent spiral ridges. Operculum concentric externally. Central tooth of radula with a vertical lateral process on each side, but without basal denticulations ... *Mysorella*.
- B. Shell not turbate, without (in Indian species) prominent sculpture. Central tooth of radula with basal denticulations.
1. Shell almost trochiform, shallowly but openly umbilicate, ornamented with spiral incised lines. Operculum concentric externally ... *Sataria*.
2. Shell ovate, narrowly umbilicate or imperforate, with sculpture microscopic, except for a varix in some species.
- a. Lip of shell distinctly thickened. Operculum concentric externally.
- a. Columellar callus more or less flattened and plate-like; no channel proceeding downwards from the umbilicus; inner lower extremity of lip rounded ... *Hydrobioides*.
- β. Columellar callus ridge-like; a distinct channel proceeding downwards from the umbilicus; inner lower extremity of lip angulate and produced ... *Digoniostoma*.
- b. Lip of shell not distinctly thickened.
- α. Operculum concentric ... *Bithynia*.
- β. Operculum spiral ... *Amnicola*.
- i. Operculum horny ... subgenus *Amnicola* (s.s.)
- ii. Operculum calcareous ... subgenus *Alocinma*.

We divide these genera into four subfamilies, viz. Hydrobiinae (or Paludestrinae), Bithyniinae, Mysorellinae and Lithoglyphinae.

Subfamily HYDROBIINAE.

The representatives of this subfamily are small or minute. They may be recognized by their horny, paucispiral operculum, undivided foot, unbranched male organ¹ and by the absence of denticulations at the base of the central tooth of the radula. Their shells are never thick or inflated.

¹ In the European *Hydrobia* or *Paludestrina jenkinsi* males are seldom or never produced and the females are parthenogenetic. See Robson, *Ann. Mag. Nat. Hist.* (9), V, pp. 425—431, pl. xv (1920).

Genus *Tricula*, Benson (1843).

1843. *Tricula*, Benson, *Calcutta Journ. Nat. Hist.*, p. 467.
 1851. *Bithinella* (in part), Moquin-Tandon, *Journ. Conchyliol.* II, p. 239 (footnote).
 1892. *Bithinella* (in part), Kobelt in Rossmässler's *Icon. Land- u. Süßwass. Moll.* (2), V p. 36.

We can find no generic difference between the shell of the Himalayan species on which Benson founded his genus *Tricula*, and those assigned by most recent authors to *Bithinella*. Some of the figures published by Kobelt are very like the shells of *T. montana*, the type-species, and we have been able to examine a considerable number of European specimens. There is nothing, moreover, in Benson's brief description of the animal to contradict this view.

T. montana is the only described Indian species that can be assigned to this genus, but we have a second from the Central Provinces as yet undescribed. Nevill's *Bithinella miliacea* is not a *Tricula*. It is, however, an inhabitant of brackish water and need not be discussed here.

Subfamily BITHYNIINAE.

The great majority of the Indian genera and species belong to this subfamily, in which (except in *Amnicola*) the operculum is thick and calcareous, the male organ has a lateral appendage, the foot is simple (as it is in all Indian genera of the family) and the central tooth of the radula is provided with several basal denticulations.

Genus *Bithynia*, Leach (1818).

1920. *Bithynia* (in part), Annandale, *Rec. Ind. Mus.* XIX, p. 41.

In the recent notes on the Indian species of the genus *Bithynia* by one of us, certain characters in the mouth of the shell were overlooked. These, as Mr. A. S. Kennard suggests in a letter, for reconsideration of the generic position of *cerameopoma* and other true Indian species. For these the new name *Digoniostoma* has recently been proposed. There can be no doubt, however, that the Kashmir forms assigned provisionally to *B. tentaculata* (Linné) and *B. troscheli* (Paasch) have been placed in the correct genus. In *Bithynia* the lip of the shell is sharp and not at all thickened and the columellar margin is narrow and ridge-like.

The type-species is *Helix tentaculatus*, Linné.

Genus *Hydrobioides*, Nevill (1884).

1885. *Hydrobioides* (subgenus of *Bithynia*), Nevill, *Hand-List Moll. Ind. Mus.* II, p. 42.
 1918. *Hydrobioides*, Annandale, *Rec. Ind. Mus.* XIV p. 117.
 1920. *Hydrobioides*, *id.*, *ibid.*, XIX, p. 41.

Fully formed shells of this genus are easily distinguished from those of *Bithynia* by their thickened lip and much broader and flatter columellar margin. The channel leading from the umbilicus is also practically absent.

The type-species is *Fairbankia*? (an *Bithynia*?) *turrita*, Blandford, a form with a very narrow elongate shell. The genus is Burmese. Mr. Kennard tells us that he has seen a fossil (tertiary) species from the Loess of Lei Chung, west of Shun Le-fu, N. China.

Genus **Paranerita**, Annandale (1920).

1920. *Paranerita* (subgenus of *Hydrobioides*), Annandale, *op. cit.*, p. 45.

The structure of the animal and operculum in *P. physcus*, the only known species, is too close to that of *Hydrobioides* to permit of its expulsion from the Bithyniinae, but that of the shell is perhaps too different to allow its retention in the genus.

P. physcus is only known from the Shan Plateau in Upper Burma.

Genus **Digonistoma**, Annandale (1920).

1920. *Bithynia* (in part), Annandale, *op. cit.*, p. 41.

1920. *Digonistoma*, Annandale, *Ind. Journ. Med. Res.* (in the press).

The shell of this genus differs from that of the true *Bithynia* in the structure of the mouth. The lip is somewhat thickened, though usually less so than in *Hydrobioides*, and more or less laminate. It is produced and angulate at the inner lower extremity. The columellar callus is broad and stout and as a rule distinctly laminate, but not so flat as in *Hydrobioides*. Otherwise the two genera are closely related.

The type-species is *Paludina cerameopoma*, Benson, a common and widely distributed Indian mollusc.

Genus **Amnicola**, Gould and Haldeman (1841).

This genus is American and is distinguished from the other Bithyniine genera by its horny, spiral operculum and by the presence of only a single denticulation on each side of the base of the central tooth of the radula. Hutton's *Paludina parvula*¹ must be assigned to it provisionally as he says, "Operculum horny," and Hanley and Theobald² say that the shell is that of an *Amnicola*; but the species needs further investigation. It was found near Chaman, which is now on the Northern Afghan frontier of Baluchistan, and is not represented in the collection of the Indian Museum. Mr. G. C. Robson has kindly informed us that the opercula are no longer present in the two specimens figured by Hanley and Theobald, originally from Hanley's collection, and now preserved in the British Museum.

¹ *Journ. As. Soc. Bengal*, XVIII, p. 655, pl. ii (1849).

² *Conch. Ind.*, p. 61, pl. cli, figs. 8, 9 (1876).

The type-species of the genus is *A. porata*, Say, from Massachusetts, United States of America.

Subgenus **Alocinma**, Annandale and Prashad (1919).

1919. *Alocinma* (subgenus of *Amnicola*), Annandale and Prashad, *Rec. Ind. Mus.* XVIII, pp. 23, 24.

1920. *Alocinma*, Annandale, *ibid.*, XIX, p. 43.

This subgenus was recently established for *A. sistanica* and its Indian and Mesopotamian allies. Its distinguishing characters are noted in the two papers cited above.

The type-species of *Alocinma* is *A. sistanica*, Annandale and Prashad.

Genus **Sataria**, Annandale (1920).

1920. *Sataria*, Annandale, *Rec. Ind. Mus.* XIX, pp. 45, 46.

The genus *Sataria* was recently established for the species described by Blanford as *Bithynia everzardi* from Mahableswar in the Satara district and from Khandalla in the Poona district of the Bombay Presidency. The shell is almost trochiform, ornamented with spiral incised lines, and is shallowly but openly umbilicate. The operculum is calcareous and externally marked with strong concentric ridges. The radula resembles that of *Bithynia*, but has blunter denticulations and there is a quadrate process on the disc of the central tooth.

S. everzardi is the only known species of the genus.

Subfamily **LITHOGLYPHINAE**.

The shells of this subfamily are among the very few fresh-water forms that have the main axis of the spire not quite in the same straight line as that of the body-whorl. This, with their globose outline and plate-like columellar callus, gives them an almost neritiform appearance. The true diagnostic features of the subfamily are, however, to be found in the structure of the operculum (see key) and possibly in that of the male organ, about which there is some conflict of evidence; their shell-characters are closely analogous to those of the genus *Paranerita*, which we see no reason to separate from the Bithyniinae.

Genus **Lithoglyphus**, Mühlfeldt (1821).

1821. *Lithoglyphus*, Mühlfeldt in Sturm's *Fauna* (*fide* Kobelt).

1892. *Lithoglyphus*, Kobelt, *op. cit.*, p. 28.

Lithoglyphus martabanensis, the only species known from the Indian Empire, seems to be, so far as can be judged from the shell only, a normal species of the genus, to which the Chinese *L. lili-putanus*, Gredler, certainly belongs.

The type-species of the genus is *L. eburneus*, Mag. v. Mühlfeldt.

Subfamily *MYSORELLINAE*.Genus *Mysorella*, Godwin-Austen (1919).

1919. *Mysorella*, Godwin-Austen, *Rec. Ind. Mus.* XVI, p. 431.

1920. *Mysorella*, Annandale, *Rec. Ind. Mus.* XIX, p. 46.

In the second paper cited above, one of us has recently discussed the relationships of the genus and the subfamily and we have nothing to add to this account.

The genotype is *Paludina costigera* var. *curta*, Nevill. There are two local races of the only known species, the typical form from the plains of the southern part of the Madras Presidency and Ceylon, and the variety or subspecies *curta* from the Mysore Plateau. It is possible that the latter will ultimately be regarded as a distinct species.



II. MATERIALS FOR A GENERIC REVISION OF THE FRESHWATER GASTROPOD MOLLUSCS OF THE INDIAN EMPIRE.

NO. 4. THE INDIAN AMPULLARIIDAE.

By N. ANNANDALE, *D.Sc., F.A.S.B., Director*, and B. PRASHAD,
D.Sc., Assistant Superintendent, Zoological Survey of India.

The Indian species of this family present great difficulties to the systematist. A large number of species have been described, but between many of them annectant forms occur and some of them exhibit considerable individual variability. Hitherto all have been placed in a single genus, which has been variously called *Ampullaria*, *Pila* and *Pachylabra*, but recently one of us has expressed the belief¹ that Reeve's *Ampullaria nux* was probably worthy of generic distinction. Unfortunately very little is yet known of the anatomy of this species, but both the shell-characters and those of the radula certainly offer conspicuous differences from those of Swainson's *Ampullaria globosa* (the type-species of both *Pila*, Bolten and *Pachylabra*, Swainson) and its allies. Indeed the only difficulty in the way of granting generic rank to *A. nux* lay in the existence of the form referred to by Nevill² as "*Ampullaria nux*, var. (? n. sp.)" As we have been able to examine the radula of this form and find that it belongs to the normal *Pachylabra*-type, while that of *A. nux* shows distinct differences, we now feel justified in regarding the latter as the genotype of a new genus, for which we propose the name *Turbini-cola* in reference to its habits. We describe this genus here and also the apparently intermediate form, which we regard as an undescribed species, calling it after Nevill, *Pachylabra nevilleiana*.

Genus *Pachylabra*, Swainson.

The shell is dextral,³ large or very large, moderately thick, with a short globose spire and itself subspherical or broadly but irregularly ovoid. Its mouth is large but not greatly expanded; with a complete or almost complete but not very prominent peristome, and with the outer lip as a rule slightly thickened. The columellar callus is never expanded or incrassate. The sculpture

¹ Annandale, *Journ. Nat. Hist. Soc. Siam* IV, p. 2 (1920).

² Nevill, *Hand List Moll. Ind. Mus.* II, p. 4 (1885).

³ Abnormal sinistral shells occur very rarely.

is never prominent and the surface of the shell always has a smooth appearance. The periostracum is of some olivaceous tint, often with dark spiral bands. The interior of the shell is pale but still more frequently with dark spiral bands.

The *operculum* is thick and testaceous with an outer horny layer, more or less flame-shaped in outline. It exhibits no trace of spiral sculpture, but bears on the internal surface a large elongate sculptured scar. Its nacre is polished but not iridescent.

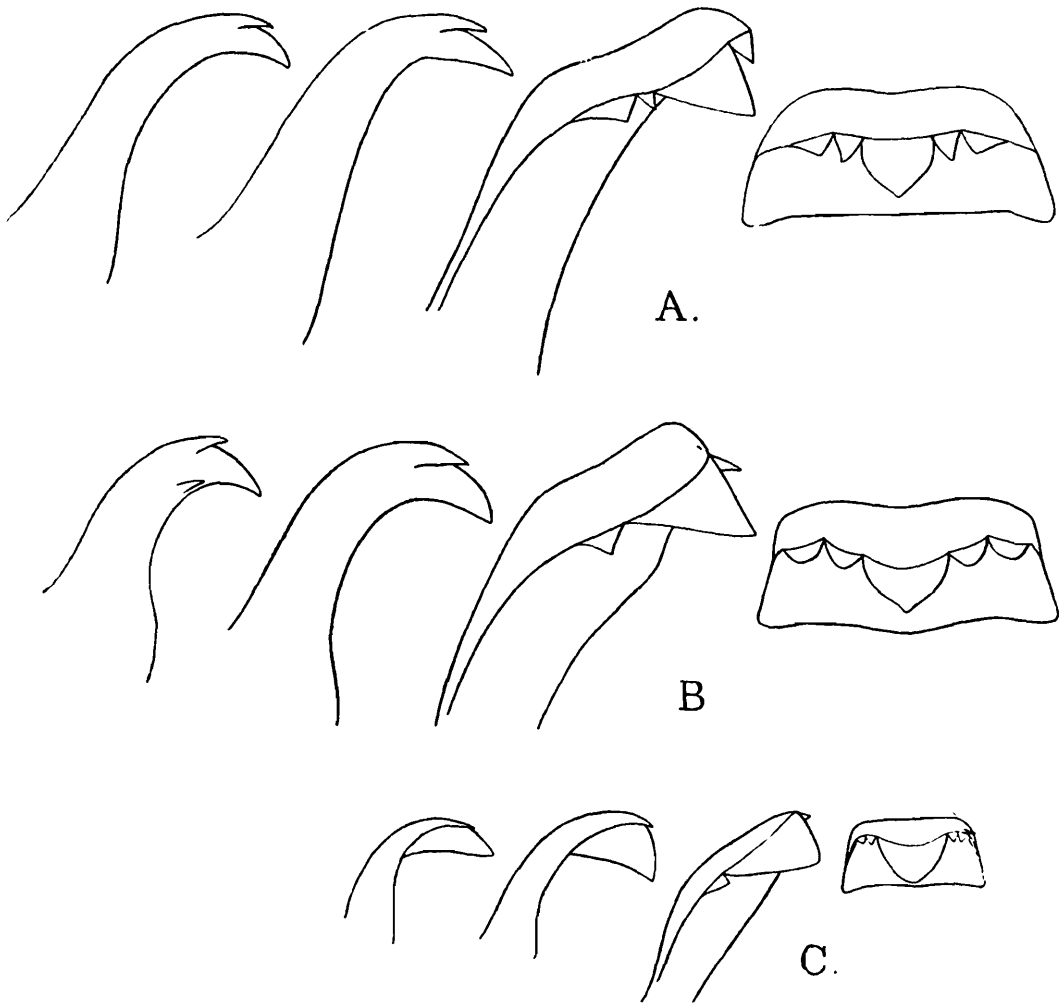


FIG. 1.—Radular teeth of Ampullaridae, $\times 50$.

A. *Pachylabra globosa*.

B. *Pachylabra nevilliana*.

C. *Turbinicola nux*.

The *radula*.—Owing to the poor figures published by Troschel¹ and Fischer² great confusion has been caused as to the exact structure of the radular teeth of *Pachylabra*. One of us has recently (*loc. cit.*) figured the radular teeth of some of the Siamese species. We now figure those of *P. globosa*, the type-species of the genus. Without giving a detailed description we may note that the marginal teeth have three denticulations, of these the middle one is the largest and best developed and is always sharply pointed,

¹ Troschel, *Gebiss der Schnecken*, I, p. 88, pl. vi, fig. 5 (1856—1863).

² Fischer, *Man. Conchyliol.* p. 736, fig. 505 (1887).

while the outer one is usually much reduced and may even be absent. The lateral teeth have five cusps, of these the third or central one is the largest and the innermost cusp is very much reduced.

Soft parts.—The right epipodial lobe is prominent and well developed. The inhalent siphon, which is formed by the left epipodial lobe, has, when contracted, the form of a prominent fold, forming part of a circle, but with its extremities widely separated. When expanded it is funnel-shaped and much broader than long.

Type-species.—*Ampullaria globosa*, Swainson.

Geographical Range and Habitat.—The genus is found all over the Oriental Region except in mountainous country. No recent species are known from the Punjab, but sub-fossil remains have been found in the Salt Range. At present no characters are known by which African species can be distinguished from Asiatic forms.

The species are found in ponds, rice-fields and backwater swamps in which there is abundant submerged vegetation of a succulent kind.

Turbinicola, gen. nov.

The *shell* is dextral, comparatively small, regularly ovate and less globose than in *Pachylabra*. Its mouth is relatively high and narrow. The outer lip is thin, the peristome is complete and the callus of the columellar region is, though narrow, flat and porcelainous. The umbilicus is closed.

The *operculum* is precisely like that of *Pachylabra*.

The *radula* has the following peculiarities: the lateral cusps of all the teeth are reduced, while the main cusp is extremely large and broad forming a scoop-like organ, more particularly on the laterals and the marginals. Only two cusps remain on the laterals and marginals and the inner cusp is vestigial, while the outer is expanded and obliquely truncate. We figure the radular teeth of the type-species, with that of *P. nevilliana* for comparison.

The *soft parts* have not been studied in detail, but it has been noted that the foot is short, broad and rounded behind and with the antero-lateral angles but slightly produced.

Type-species.—*Ampullaria nux*, Reeve.

Geographical Range and Habitat.—Only known from the northern part of the Western Ghats in the Nasik and Poona districts of the Bombay Presidency.

The type-species lives on rocks in small pools in mountain streamlets. The peculiar structure of its radular teeth doubtless permits it to scrape the algae from stones or to scoop up mud containing nutritious substances.

Turbinicola nux (Reeve).

1856. *Ampullaria nux*, Reeve, *Conchologia Iconica* X, *Ampullaria*, pl. xxviii, fig. 132.

1876. *Ampullaria nux*, Hanley and Theobald, *Conch. Ind.*, pl. cxv, fig. 1.

1877. *Ampullaria nux* (typical), Nevill, *Cat. Moll. Ind. Mus.* Fasc. E., p. 5.
 1885. *Ampullaria nux*, *id.*, *Hand List Moll. Ind. Mus.* II, p. 3.
 1918. *Ampullaria nux*, Annandale and Prashad, *Rec. Ind. Mus.* XVI, pp. 149, 150, pl. v, fig. 8.

The shell is very small compared with other species of the family (not more than 30 mm. high), and has $4\frac{1}{2}$ whorls. The apex is bluntly pointed and the first $2\frac{1}{2}$ whorls, which are always slightly eroded, are minute. The third whorl is much larger but shallow, band-shaped and much narrower than the body-whorl. Its outlines are feebly convex. The suture is linear and slightly impressed; the whorls are not or very slightly flattened outside it. The body-whorl is narrowly heart-shaped with the upper extremity nearly straight and the lower pointed and turned inwards, its outer outline as seen from above forms a regular curve and is relatively short, while the inner outline is long and sinuate. The whorl as a whole is by no means greatly swollen. The aperture is oblique, rather narrow and pyriform. It extends upwards for at least $\frac{3}{4}$ of the height of the shell. The incrassate columellar margin is narrow and is joined to the upper lip above by a thin porcellaneous deposit; it is considerably produced below the umbilicus, which is closed or rimate. The aperture as a whole projects outwards from the body-whorl and also forwards below the umbilicus. In the latter region the surface of the whorl slopes inwards and forwards. The surface has a matt appearance owing to the minute sculpture which consists of minute longitudinal and spiral lines crossing one another very regularly and closely, and of coarse longitudinal sinuate striae. The periostracum is of a pale yellowish olivaceous tint with ill-defined longitudinal streaks of a darker shade, and in some shells obscure narrow spiral bands of a pale brownish colour can be detected on the external surface. The mouth is pure white, but the interior of the shell is sometimes tinted with brown.

The outline of the operculum resembles that of the mouth. The external surface is slightly concave and is covered with a delicate brown periostracum. The scar on the internal surface is relatively large; it is divided longitudinally by a narrow ridge and surrounded completely by a groove, its sculpture is lobose. The nacre has a pinkish tinge.¹

The characters of the radular teeth² are well shown in the figure. Unfortunately we have no detailed description of the animal. The following notes on its colouration were made from a living specimen at Khandalla. The foot and mantle are yellowish,

¹ Reeve's original figure and description are somewhat misleading. The former gives the impression, owing to the position of the operculum, that the outer lip is thickened, while the description, in stating that the columellar lip is unusually callously reflected, does not indicate that it is in close apposition to the surface of the shell.

² The figure of the radular teeth, in our paper cited already, is rather poor. It was unfortunately drawn from worn out teeth and does not show their real characters.

tinged and clouded with black above; the free edge of the mantle is bright yellow. The tentacles are leaden grey on the dorsal surface, paler at the base and below. The eye-stalks are bright yellow.

Geographical distribution.—The species is only known from small streams near Khandalla and Igatpuri (Poona and Nasik districts) in the Western Ghats and from altitudes between 2500 and 3000 feet.

We may now give a description of the new species *Pachylabra nevilleiana*. The shell characters are so similar to those of *T. nux* that we can best do so by means of a short comparison.

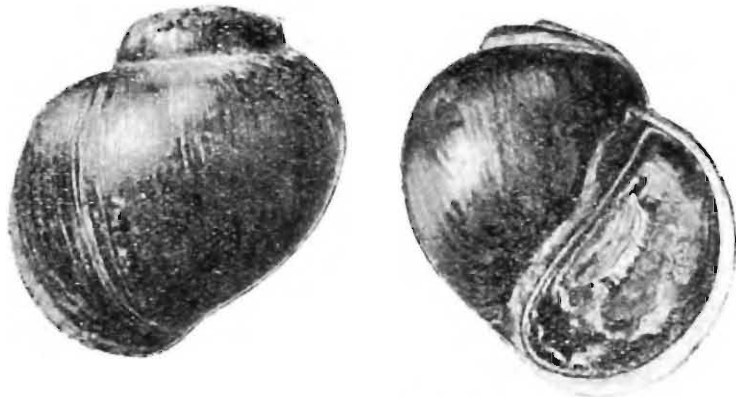


FIG. 2.—Photographs of the type-shell of *Pachylabra nevilleiana*, natural size.

***Pachylabra nevilleiana*, sp. nov.**

1877. *Ampullaria nux*, var. (? n. sp.), Nevill, *op. cit.*, p. 5.

1885. *Ampullaria nux*, var. (? n. sp.), *id.*, *op. cit.*, p. 4.

The species is considerably larger, stouter and more globose than *T. nux*, the spire is more swollen, the body-whorl more transverse, the aperture broader above, the suture more oblique and the sculpture of the shell coarser and less regular. The external colour is deep chestnut, with which the interior is also tinged. The peristome is white. The scar of the operculum is relatively smaller and its central ridge broader and flatter.

We have extracted the radula from one of the shells examined by Nevill, which have been in Calcutta for at least 60 years, but still in several instances contain the dried animal in a fairly good state of preservation.

Type-specimens.—No. M 11864/2 Z. S. I. (*Ind. Mus.*)

Measurements of shells (in millimetres).

	<i>T nux.</i>			<i>P nevilleiana.</i>		
Total height	26	23	17	35	37	34
Maximum diameter	20.5	19	14.5	28.5	33	29.5
Oblique height of mouth	18	16.5	13.5	25.5	27	25.5
Maximum diameter of mouth.	10	8.5	7	16	16	14.5

Locality.—The specimens are labelled, in writing on each shell, as being from Tranquebar, which is on the east coast of Southern India, and it is stated in the old catalogue of the A.S.B. collection that they were collected by Captain Lewis. Nevill, however, was of opinion that the “locality can only be accepted with considerable reserve.” We have seen no other specimens, but Nevill’s doubt as to the provenance of the type-series was probably due to his belief in its apparent specific identity with *T nux*.

III. NOTES ON FISHES IN THE INDIAN MUSEUM.

I. ON A NEW GENUS OF FISH CLOSELY RESEMBLING *PSILORHYNCHUS*, McCLELLAND.

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

While sorting out the fish of the genus *Garra* in the unnamed collection of the Indian Museum, I happened to mistake the specimen described below for one of *Garra*. On closer examination it has turned out to be an interesting species of a new genus, which I propose to describe in this paper.

***Parapsilorhynchus*, gen. nov.**

The new genus consists of small hill-stream Cyprininae closely resembling *Psilorhynchus*, McClell., from which it differs in the following characters:—

(i) There are two blunt, cylindrical barbels on the snout in the new genus, while in *Psilorhynchus* barbels are absent.

(ii) In *Psilorhynchus* the air-bladder¹ is always more or less reduced, while in this genus it is large and is of the normal Cyprinid type.

(iii) In *Psilorhynchus* the upper lip is exposed, and the lower lip, though it may be glandular, is never prominent, while in *Parapsilorhynchus* the upper lip is concealed by a fringed, plicate, labial fold which is densely covered with minute tubercles; the lower lip is very prominent, and usually there is either an indication of or a rudimentary disc behind it.

(iv) In *Parapsilorhynchus* the origin of the dorsal is almost opposite to that of the ventrals, while in *Psilorhynchus* it is in advance of the ventrals.

Of this genus I regard *Psilorhynchus tentaculatus*, Annand.,² as the type-species. I assign to it also the new species described below. While dealing with the genus *Psilorhynchus* in a recent paper, I provisionally included Dr. Annandale's species in it, but the discovery of the second species in the same range of mountains makes it desirable to lay stress on the differences between the forms found in the north-east of India, and those inhabiting the hills in the western part of Peninsular India. Dr. Annandale tells

¹ Hora, *Rec. Ind. Mus.* XIX, p. 209 (1920).

² Annandale, *Rec. Ind. Mus.* XVI, pp. 128-129 (1919).

me that he considers these forms to be probably convergent; but in describing *Psilorhynchus tentaculatus* preferred not to set up a new genus on a monotypic basis.

My new genus has some points in common with *Garra*; the main characters that distinguish it from this genus are the following:—

(i) The presence of two characteristic blunt barbels in a position quite different from that in any species of *Garra* with two barbels.

(ii) The gill-openings extend to the ventral surface, whereas in *Garra* they are usually restricted to the sides.

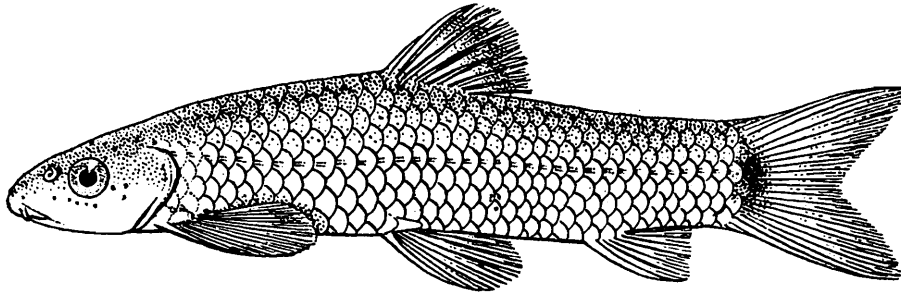
(iii) In *Parapsilorhynchus* the mouth is very small, while in *Garra* it is usually much wider.

***Parapsilorhynchus discophorus*, sp. nov.**

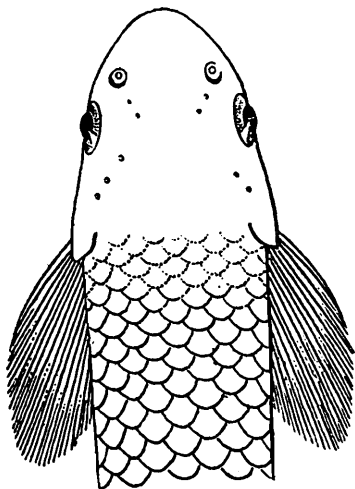
D. 2/6. V 7. A. 7. P. 16.

This is a small-sized fish, with the back moderately elevated. The dorsal profile rises gracefully from the tip of the snout to the origin of the dorsal, beyond which it slopes imperceptibly down to the base of the caudal fin. The ventral surface is somewhat flattened and its profile is almost straight and horizontal. The length of the head is contained $4\frac{1}{8}$ times, the depth of the body near the origin of the dorsal fin $4\frac{1}{8}$ times, and the length of the caudal fin $3\frac{1}{2}$ times in the total length without the caudal fin. The eyes are of a moderate size and are situated slightly nearer to the posterior margin of the operculum than to the end of the snout; their diameter is contained $3\frac{3}{5}$ times in the length of the head, twice in the interorbital width and $1\frac{1}{2}$ times in the length of the snout. The gape of the mouth is $1\frac{1}{3}$ times the diameter of the eye. The head is short and narrow; its greatest width is contained $1\frac{1}{4}$ times in its length. There are definite rows of open pores on the sides and upper surface of the head and also along the opercular borders on the under surface. The greatest height of the caudal peduncle is equal to its length. The vent is situated in the beginning of the last fourth of the distance between the end of the snout and the base of the caudal fin. There is a pair of short barbels on the snout. The barbels are thick and stumpy and are not pointed distally; they are situated ventrally, a short distance behind the anterior end of the snout and are partly visible from above. There is a deep groove on either side running from the base of the barbel to the angle of the mouth. The mouth is small and crescentic, and is situated on the ventral surface considerably behind the anterior end of the snout. The upper labial fold is long and fringed and is covered with minute tubercles. The lower lip forms the anterior free border of the mental disc and is studded with fairly big tubercles. The labial fold tapers towards the angle of the mouth and partially covers the lateral borders of the lower lip. The most significant point about this species is the presence of a small, rudimentary disc behind the lower lip. The

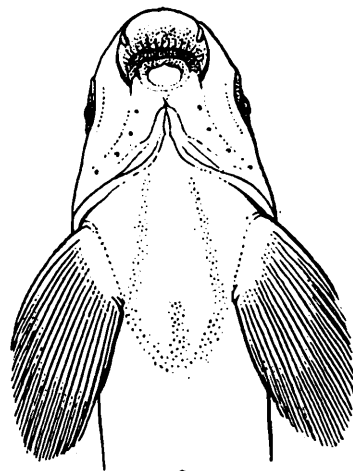
disc consists of an oval callous portion in the middle, with its longest diameter at right angles to the length of the fish and a well-



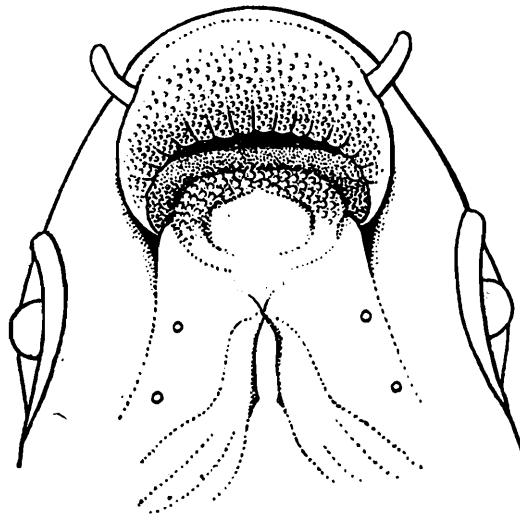
A.



B..



C



D.

Parapsilorhynchus discophorus, sp. nov.

- A. Lateral view of the type-specimen, $\times 2$.
- B. Dorsal surface of head of the same, $\times 3$.
- C. Ventral surface of head of the same, $\times 3$.
- D. Anterior part of the ventral surface of head of the same, $\times 9$.

defined tubercular border anteriorly, but becoming obscure behind. The opercular borders meet a short distance behind the mental

disc. The scales are small and are totally absent from the ventral surface, there are 34 scales along the lateral line and 9 rows between the bases of the dorsal and the ventral fins. The dorsal fin is $\frac{3}{4}$ as high as the depth of the body below it; it is situated nearer to the base of the caudal than to the end of the snout and its origin is equidistant from the nostrils and the base of the caudal. The origin of the ventrals is almost opposite or slightly behind that of the dorsal fin. The pectorals are shorter than the head and are separated from the ventrals by a considerable distance. The caudal is forked and both the lobes are pointed. The ventrals are provided with a short fleshy appendage. The air-bladder is of the normal Cyprinid type.

The sides and the upper surface of the head are dusky; while the ventral surface is white. There is a dark bar across the dorsal fin near its free border and a short black bar at the base of the caudal.

Type-specimen.—F. 9952/1. *Zool. Survey of India* (Ind. Mus.).

Locality.—Only one specimen was obtained by Dr. F. H. Gravely at Pophli in the Vashishti valley, in the Western Ghats, Ratnagiri district, Bombay Presidency, at an altitude of 400 ft.

Measurements in millimetres.

Total length excluding caudal	33.0
Depth of body in front of dorsal	8.0
Length of head	. 8.0
Width of head	6.5
Diameter of eye	.. 2.2
Length of snout	. 3.3
Interorbital width	4.5
Gape of mouth	3.0
Length of caudal peduncle	5.5
Least height of caudal peduncle	5.0
Height of dorsal fin	6.5
Length of pectoral	7.5
Length of ventral	6.5
Length of anal	5.0
Length of caudal	8.5
Distance of vent from end of snout	24.0

The new species is closely related to *Parapsilorhynchus tentaculatus* (Annand.), recently described from the adjacent Poona and Satara districts of the Bombay Presidency. The fundamental points of resemblance are the presence of two short, stumpy and blunt barbels on the snout and also the presence of a well-defined air-bladder. The species are also alike in having a narrow and pointed operculum which is sharply marked off and bluntly truncate above. In both the species there is a black bar across the dorsal and a black spot at the base of the caudal fin. The

general facies in the two is similar as is also the position of the mouth and the structure of the labial fold. The points of differences are, however, numerous and important. In a well-preserved specimen of *P. tentaculatus* a small pad can be made out just behind the bilobed lower lip, while in the new species there is a distinct callous disc and the lower lip is not bilobed. In *P. discophorus* the ventral surface is more rounded and is absolutely devoid of scales, the head is shorter and narrower and the eyes are distinctly visible from below. The two species also differ in proportions and number of scales. The paired fins in *P. discophorus* are not so expanded as in *P. tentaculatus* and are not provided with muscles on their ventral aspect.

IV NOTES ON FISHES IN THE INDIAN MUSEUM.

II. ON A NEW SPECIES OF *NEMACHILUS* FROM THE NILGIRI HILLS.

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

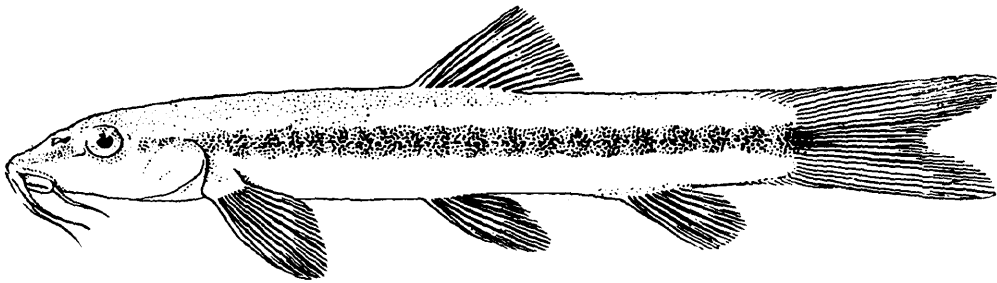
In this paper I give a description of a small loach, obtained by Dr. N. Annandale from the Bhavani River in the Nilgiri Hills. The species is easily distinguished from all previously known by the peculiar moniliform band of black pigment on either side.

***Nemachilus monilis*, sp. nov.**

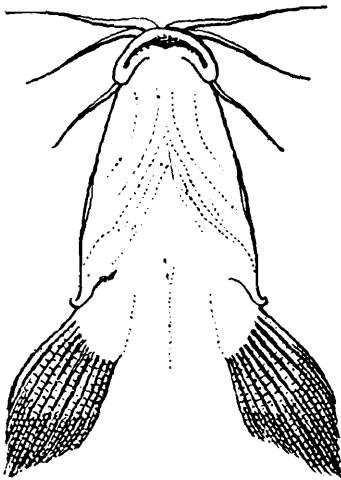
D. 3/7. P. 10. V 8. A. 2/5. C. 19.

In this little loach the head and body are slightly depressed and are almost flat on the under surface; the dorsal profile rises from the tip of the snout to the base of the dorsal fin beyond which it is almost straight; the ventral is straight and horizontal throughout. The head is sharp and bluntly pointed; its length is contained four times in the length of the body without the caudal. The height of the head near the occiput is less than its greatest width and is half the length of the head. The length of the caudal fin is equal to the length of the head and the depth of the body near the origin of the dorsal fin equals its width. The eye is large and its diameter is contained almost four times in the length of the head; it is dorso-lateral in position and is invisible from below. The length of the snout is greater than the post-orbital length of the head and is almost twice the diameter of the eye. The interorbital width is 1.3 times the diameter of the eye. The nostrils are situated considerably nearer to the eye than to the tip of the snout. Close to the antero-inferior border of the orbit there is a short pad-like process covering a pit; it is probably a secondary sexual character of the male. There are three pairs of long, thread-like barbels; the longest is twice the diameter of the eye. The mouth is an inferior, crescentic opening bordered by well-developed prominent lips. The upper lip is raised into a short proboscis in the middle and the lower lip is interrupted in the same region. The origin of the dorsal fin is nearer to the base of the caudal than to the tip of the snout; it is higher than the depth of the body below it. The ventral commences almost below the dorsal

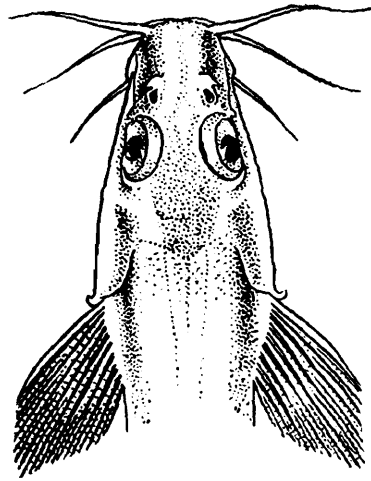
and is likewise in the posterior half of the body. The pectorals are shorter than the head and are separated from the ventrals by a considerable distance. The ventrals do not reach the anus which is situated in the beginning of the last third of the distance between the origin of the ventral and the anal fins. There is a prominent tube running from between the bases of the ventrals backwards and posteriorly ends as the opening of the anus. The caudal fin is emarginate; the lobes are subrounded and equal. The height of the caudal peduncle is slightly less than its length.



a.



b



c

Nemachilus monilis, sp. nov.

- a. Lateral view of type-specimen $\times 1\frac{1}{2}$
 b. Ventral surface of head of same $\times 2$.
 c. Dorsal surface of head of same $\times 2$.

Nemachilus monilis possesses a characteristic colouration and can be easily distinguished from the rest of the species in the genus. There is a well-developed moniliform black band along the lateral line in the middle of the body from the base of the caudal fin to the tip of the snout, interrupted by the eye in its course; those of the two sides meet across the tip of the snout anteriorly. The last of the component spots in the series is more prominent. The band is continued as a black streak along the middle of the caudal fin; otherwise the body is of a dirty white colour

somewhat infuscated along the back. The fins are whitish and some of the barbels are streaked with black.

Type-specimen :—F 9981/1 Zoological Survey of India (*Ind. Mus.*)

Locality :—Two specimens of this species were collected by Dr. N. Annandale in August 1918, at the edge of the Bhavani River, 10 miles from Mettupalaiyam, near the base of the Nilgiri Hills at an altitude of 1,800 ft.

Measurements in millimetres.

	A	B
Length of fish excluding caudal	50·0	25·0
Length of caudal.	12·5	6·0
Depth of body near origin of dorsal	7·5	3·7
Length of head	12·5	7·0
Depth of head . . .	6·0	3·6
Width of head . . .	7·5	4·1
Diameter of eye . . .	3·0	1·8
Length of snout .. .	5·5	2·8
Interorbital width ..	3·7	2·5
Length of caudal peduncle .	7·6	4·0
Minimum height of caudal peduncle .	6·6	3·4
Longest ray of dorsal	9·0	4·5
„ „ of anal	7·8	3·6
Length of pectoral ..	9·0	5·5
„ of ventral	8·5	4·0

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## V. NOTES ON CRYPTOSTOME BEETLES.

By S. MAULIK, *Professor of Zoology, Calcutta University.*

I published two papers on the Cryptostome beetles of the Indian Museum in this Journal, (1) in Vol. IX, Part II, June 1913, page 105, and (2) in Vol. XI, Part V, September 1915, page 367. In July, 1919, I published in the Fauna of British India series a complete review of the Cryptostome beetles of India, Burma and Ceylon, so far as they were known up to that date. In this work the results of my study of the material of these groups sent to me from the Indian Museum were incorporated. It will therefore be unnecessary to report separately on that collection. I shall, however, give here a list of types and cotypes of Hispinae and Cassidinae deposited in the Indian Museum.

The following is the list :—

### HISPINAE.

|                                                  |                                                 |
|--------------------------------------------------|-------------------------------------------------|
| <i>Macrispa krishnālohita</i> , Maulik (cotype). | <i>Asamangulia cuspidata</i> , Maulik (cotype). |
| <i>Anisoderopsis nigra</i> , Maulik (type of ♀). | <i>Dactylispa krishna</i> , Maulik (type).      |
| <i>Leptispa rufithorax</i> , Maulik (cotype).    | <i>Dactylispa peregrina</i> , Maulik (type).    |
| <i>Prionispa himalayensis</i> , Maulik (type).   | <i>Dactylispa harsha</i> , Maulik (type).       |
| <i>Wallacea dactyliferae</i> , Maulik (cotype).  | <i>Dactylispa sadonensis</i> , Maulik (type).   |
| <i>Downesia ratana</i> , Maulik (cotype).        | <i>Dactylispa bindusara</i> , Maulik (type).    |
| <i>Monochirus sthulaçundus</i> , Maulik (type).  | <i>Dactylispa lohita</i> , Maulik (type).       |
| <i>Rhadinosa laghua</i> , Maulik (type).         | <i>Dactylispa variabilis</i> , Maulik (type).   |
| <i>Rhadinosa giriya</i> , Maulik (type).         | <i>Dactylispa pitapada</i> , Maulik (cotype).   |
|                                                  | <i>Dactylispa asoka</i> , Maulik (cotype).      |
|                                                  | <i>Dactylispa kamarupa</i> , Maulik (type).     |
|                                                  | <i>Dactylispa parbatya</i> , Maulik (type).     |
|                                                  | <i>Dactylispa kunala</i> , Maulik (type).       |

### CASSIDINAE.

|                                                |                                                                        |
|------------------------------------------------|------------------------------------------------------------------------|
| <i>Epistictia fulvonigra</i> , Maulik (type).  | <i>Cassida cherrapunjiensis</i> , Maulik (type).                       |
| <i>Aspidomorpha chandrika</i> , Maulik (type). | <i>Cassida circumdata</i> var. <i>dentata</i> , (type Maulik of var.). |
| <i>Cassida stupa</i> , Maulik (type).          | <i>Chirida hina</i> , Maulik (type).                                   |
| <i>Cassida belliformis</i> , Maulik (type).    | <i>Chirida binduta</i> , Maulik (cotype).                              |

During the European war (1914-1919) I was unable to communicate with workers on these groups except Dr. R. Gestro of the Genoa Museum. But since the publication of my book I have been in correspondence with Dr. F. Spaeth. As a result I find it is necessary to publish certain notes on the Cassidinae.

Dr. Spaeth informs me that *Hoplionota modesta*, Wagnen, is found only in the Philippine Islands. The author wrongly re-

ported it from "India Orientalis." It is synonymous with *H chapuisi*, Spaeth and *nitida*, Weise, but has priority over both.

*Epistictia viridimaculata* var. *trivandrumensis*, Maulik, is the same as *Epistictia reicheana*, Guer. When I proposed the variety I had not discovered the type of *reicheana* in the British Museum.

According to Spaeth *Aspidomorpha spaethi* Maulik=*A inuncta*, Boh.

*Aspidomorpha jusconotata*, Boh., is found only in the Philippine Islands.

*Laccoptera quadrimaculata* var. *plagiograptata*, Maulik=*L. fruhstorferi*, Spaeth.

Spaeth's *Chirida mystica* (December, 1919) falls as a synonym of my *Ch. novemkalankita* (July, 1919).

According to Spaeth *Cassida pauxilla*, Boh.=*C. conspurcata*, Boh.

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## VI UN LINGUATULIDE NOUVEAU PARASITE D'UN BATRACIEN.

*Par* L. GEDOELST.

Parmi des matériaux parasitologiques reçus de l'Indian Museum de Calcutta et comprenant essentiellement des larves de diptères, nous avons trouvé un objet d'un particulier intérêt, dont nous donnons la description ci-après.

Longueur : 3.6 mm., largeur maximum : 0.83 mm.

Le corps est cylindroïde, à face ventrale aplatie, à face dorsale fortement bombée ; l'extrémité antérieure est atténuée aux dépens des faces dorsale et latérales, de telle sorte que la face ventrale s'étend sans déviation jusqu'à l'extrême limite antérieure du corps ; l'extrémité postérieure est atténuée progressivement et uniformément sur toutes ses faces et se termine par deux lobes coniques latéraux, à axes divergents. Le tégument est blanc, plus ou moins transparent.

La tête vue par la face ventrale présente un contour triangulaire à sommet légèrement tronqué. Près de celui-ci s'ouvre la bouche, médiane, orbiculaire. Au-devant de celle-ci et sur le bord antérieur de la tête, on voit deux petits appendices papilliformes latéraux, qui représentent les deux renflements antennaires ; en arrière de la bouche sont disposées deux paires de crochets, ceux-ci occupent les angles d'une figure trapézoïdale à grande base postérieure, ces crochets sont simples, hyalins, légèrement jaunâtres, et proéminents au niveau d'un mamelon leur servant de gaine et accosté à droite et à gauche d'un mamelon plus petit hémisphérique. Les crochets antérieurs sont plus petits que les postérieurs ; ils sont écartés l'un de l'autre de  $450\mu$ , les postérieurs de  $720\mu$ , ceux-ci étant situés à  $140\mu$ , en arrière des premiers. A la face dorsale de la tête on observe en avant du niveau occupé par la paire antérieure de crochets une paire d'appendices papilliformes et plus en arrière à la hauteur de la paire postérieure de crochets la cuticule se soulève à droite et à gauche en un renflement vésiculaire hémisphérique.

Le corps est formé de 25 anneaux comptés en arrière de la paire postérieure de crochets, le 25<sup>e</sup> anneau étant constitué par les deux lobes divergents de l'extrémité bifide du corps, entre lesquels s'ouvre l'anus. Le relief des différents anneaux est en général peu accusé. Le pore génital se trouve situé au sommet d'un mamelon médian, court et épais, vers les 3<sup>e</sup>-4<sup>e</sup> anneaux du corps. Le deuxième anneau porte latéralement de chaque côté une petite papille ventrale.

Par ces caractères, cet organisme se range dans la famille des

Linguatulides et plus particulièrement dans le genre *Raillietiella* Sambon, 1910, dont il représente une espèce nouvelle, caractérisée surtout par ses petites dimensions et pour laquelle nous proposons le nom de *Raillietiella indica*. Mais ce qui fait tout l'intérêt de cette observation, c'est que ce parasite a été rencontré dans le poumon d'un *Bufo melanostictus* et constitue par conséquent le premier exemple d'un Linguatulide parasite d'un Batracien.

Le genre *Raillietiella* renferme actuellement les espèces suivantes:—

1. *Raillietiella furcocerca* (DIESING, 1835).

Syn. : *Pentastoma furcocercum* DIESING, 1835.  
*Pentastomum bifurcatum* DIESING, 1850.  
*Porocephalus bifurcatus* SHIPLEY, 1893.  
*Porocephalus boulengeri* VANEY et SAMBON, 1910.  
*Raillietiella boulengeri* SAMBON, 1910.

Hôtes : *Amphisbaena alba* GRAY, 1844.  
*Drymobius bifossatus* RADDE, 1820.  
*Zamenis constrictor* LINNÉ, 1766.  
*Boa constrictor* LINNÉ, 1758.  
*Boa imperator* DAUDIN, 1803.  
*Coluber melanoleucus* DAUDIN, 1803.

2. *Raillietiella bifurcata* var. *orientalis* (HETT, 1915).

Syn. : *Porocephalus bifurcatus* var. *orientalis* HETT, 1915.  
Hôtes : *Zamenis mucosus* LINNÉ, 1766.  
*Naia tripudians* MERREM, 1820.

3. *Raillietiella bifurcata* var. *mediterranea* (HETT, 1915).

Syn. : *Porocephalus bifurcatus* var. *mediterraneus* HETT, 1915.  
Hôte : *Zamenis gemonensis* LAURENTI, 1768.

4. *Raillietiella geckonis* (DIESING, 1850).

Syn. : *Pentastomum geckonis* DIESING, 1850.  
*Raillietiella geckonis* SAMBON, 1910.  
Hôte : Un gecko de Siam (probablement *Gecko verticillatus* LAURENTI, 1768).

5. *Raillietiella indica* (GEDOELST, 1921).

Hôte : *Bufo melanostictus* SCHNEIDER, 1799.

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VII. NOTES ON THE OCCASIONAL ABSENCE OF THE PAIRED FINS IN FRESH WATER FISHES, WITH SOME OBSERVATIONS ON THE TWO APODAL GENERA *CHANNA*, *GRONOW* AND *APUA*, BLYTH

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

Wiley¹ has recently referred to the absence of the ventral fins in a male specimen of *Amia calva* and urges the necessity of recording such observations as they are likely to throw some light on "natural mutations amongst fishes." In the course of my studies on the freshwater fishes of India, I have come across a few "mutations" of this nature and I take this opportunity of bringing them to notice.

(i) While examining a large collection of fish made in Manipur by the Manipur Survey party and myself, I found a specimen of *Barilius barila* (Ham. Buch.), in which both the ventral fins were totally absent. The abnormal specimen was captured in Khurda stream near Thanga, with a large number of normal specimens. It does not seem to have suffered any disadvantage on account of the absence of the ventrals. There is no external mark or scar to show that the condition is the result of an accident or injury. The proper place of the origin of the ventrals is completely covered with scales. Comparison of the arrangement of the scales in a normal and the abnormal specimen is shown in figure 1 (a).

Dissection of the body wall in the region of the pelvic fins under a high power of a binocular microscope, by stripping the different layers one by one, revealed no irregularity of arrangement and no trace of the pelvic girdle was found.

The total length of the abnormal specimen including the length of the caudal fin is 94 mm., while the average length of the species is about 125 mm.

(ii) In the Manipur collection I found another interesting specimen of a new species which I call *Barilius dogarsinghi*, in which the ventral fin of the left side was absent. The place of origin of the ventral fin is here also covered with scales. In a normal specimen there are four scales between the bases of the ventrals. They are longer than the rest and are more pointed posteriorly; they are arranged in such a way as to form a sheath on the inner side of the bases of the ventrals. In the abnormal

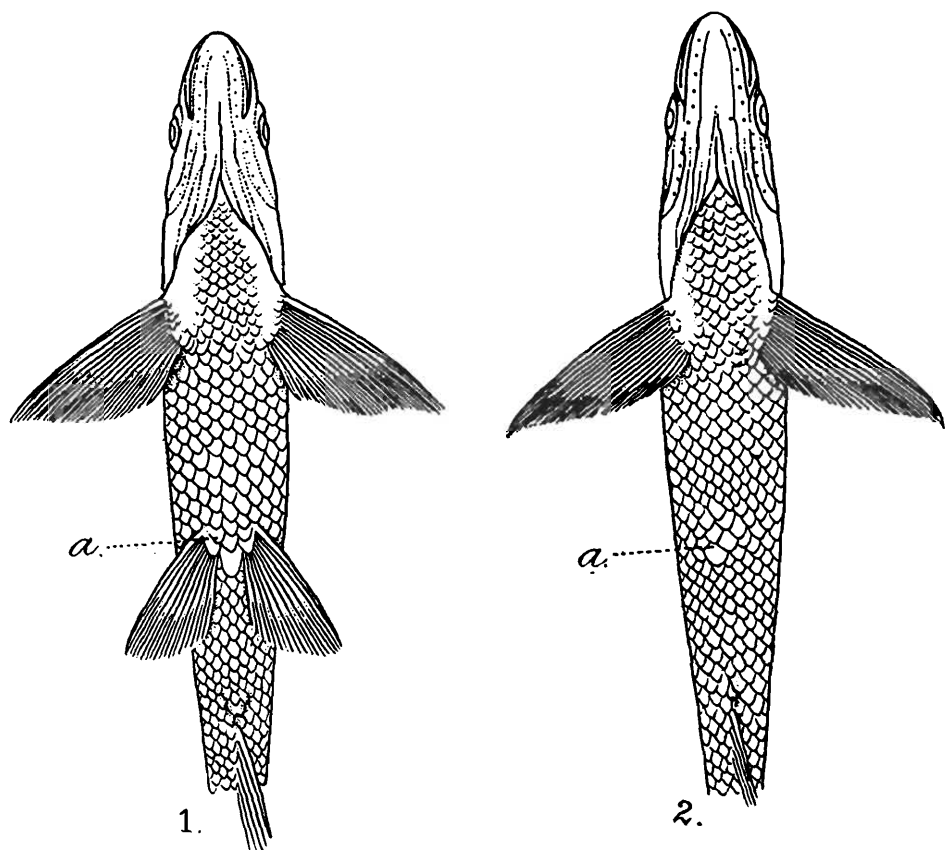
¹ Wiley, *Proc. Zool. Soc. London*, pp. 89—90 (1920).

specimen there are no special scales in the region of the ventrals and the arrangement of these is not interrupted on the left side.

It is rather interesting to note that on dissection of this region the fin muscles and the girdle of the right side only were found to be present, while on the abnormal side no trace of either the muscles or the girdle was observed.

The abnormal specimen is 62 mm. in length and was collected in the Etok stream near Chanderkhong with eleven other normal specimens of the same species. The average length of the species is 85 mm.

(iii) In a specimen of another new species, *Nemachilus kang-*



TEXT-FIG. 1.—Normal and abnormal specimens of *Barilius barila* (Ham. Buch.)

1. Normal specimen $\times 2$. 2. Abnormal specimen $\times 2$.
a = Lepidosis in the region of the ventrals.

jupkhulensis, the ventral fin of the right side is lacking. Even the fin on the other side is not normal. It is distorted in such a way that there appear to be two fins, one immediately behind the other. In the anterior portion of the abnormal fin there are three rays while in the posterior only four. In a normal specimen there are in all six to seven rays in the ventral fin. There is no indication that the absence of the ventral fin is due to any accident or injury. The abnormal specimen was collected in a small hill stream near Bishenpur, Manipur. It is about 43 mm. in length which is the average length of the species.

(iv) The most interesting specimen is that of *Rita rita* (Ham. Buch.), in which the pectoral fin of the right side is absent. The

specimen was collected by Mr. Hamid Khan in the Ravi River near Lahore. He noticed this abnormality and presented the specimen to the Government College Museum, Lahore. I am indebted to Prof. George Matthai for lending me the specimen from the above Museum and for allowing me to dissect it for study of the skeleton and the musculature of the abnormal region.

The pectoral fin in the genus *Rita* is a characteristic structure, as it is provided with a very strong spine. The spine is almost as long as the length of the pectoral girdle. The fish does not seem to have suffered as regards its size; its length including the length of the caudal fin is 32.6 cm., which is the average length of the species at Lahore.

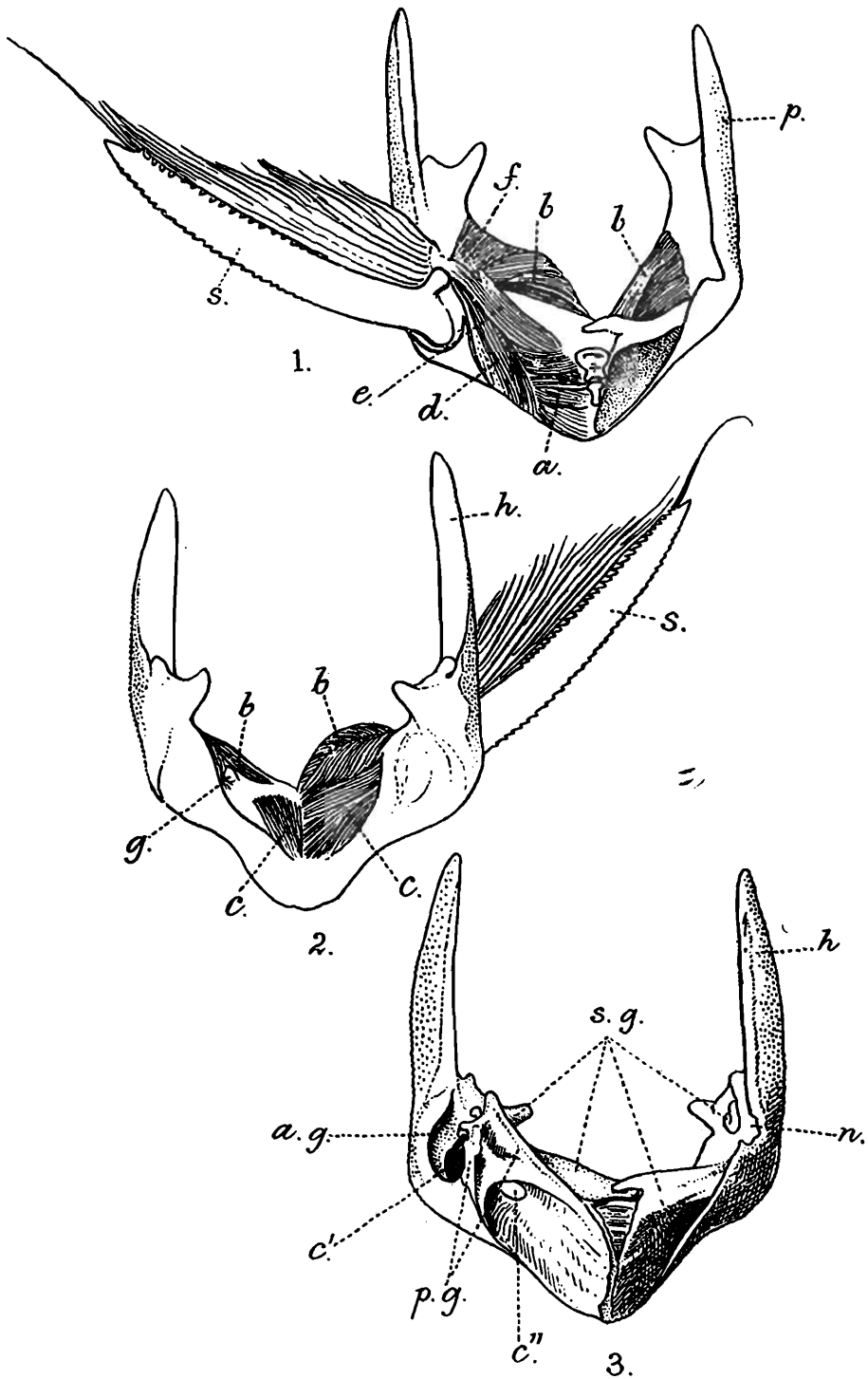
Correlated with the absence of the fin, the various muscles, associated with it are either absent or have undergone considerable degeneration. The abductor and adductor muscles (*e*, *f*) are totally absent. Of the muscles (*a*, *b*, *c*, *d*), which control the movements of the spine, *a* and *d* are not represented, while the other two, *b* and *c*, are greatly reduced. An accessory nodule of bone was found in the course of the greatly reduced muscle of the abnormal side. I am unable to understand its significance as the structure is not represented in the muscle of the opposite side or in other normal specimens.

The shoulder girdle of the abnormal side is considerably shorter in width than that of the opposite side. The primary girdle (*p.g.*), consisting mainly of the scapular and coracoid bones, is either altogether absent on the abnormal side or has so fused with the secondary investing bones of the girdle as to be quite indistinguishable from them. Consequently the canals (*c'*, *c''*) for the passage of the muscles of the spine are wanting, and this to a certain extent may account for the absence or degeneration of the muscles. The deep groove (*a.g.*), for the articulation of the condyle at the base of the spine, formed by the cubito-humeral process (*h*) and the clavicular element (*s.g.*) is represented on the abnormal side only by a notch (*n*) in the cubito-humeral process.

The degeneration of the muscles of the right side and the abnormalities in the skeleton of this region indicate that the absence of the fin is not due to any recent accident or injury. It seems quite probable that all the abnormalities noticed above are the direct or indirect result of the absence of the primary shoulder-girdle of the abnormal side; this will also account for the absence of the right fin. The musculature was probably affected secondarily, while the reduction in the secondary girdle is chiefly due to the disuse of the associated structures.

In almost all such abnormalities, it has been pointed out that the growth of the fish is not effected by them. It is only after careful examination that these abnormal forms can be separated from normal specimens netted with them.

Abnormalities of this nature have been regarded as congenital variations. Willey (*op. cit.*) regards them as mutations and comes to the conclusion "that the presence or absence of such deep-



TEXT-FIG. 2.—Musculature and skeleton of the pectoral girdle in an abnormal specimen of *Rita rita* (Ham. Buch.).

1. Muscles of the pectoral fin seen from above.

2. Muscles of the pectoral fin seen from below.

3. Skeleton of the pectoral arch seen from below.

a = muscle attached above the base of the condyle of the spine. This pulls the spine outwards thus expanding the fin; *b* = muscle that pull the spine inwards, thus folding the fin; *c* = pulls the spine outwards; *d* = folds the fin; *e* = abductor muscle; *f* = adductor muscle; *g* = nodule of bone; *h* = cubito-humeral process; *a.g.* = articular groove; *p.g.* = primary shoulder girdle; *s.g.* = secondary shoulder girdle; *n* = notch in the cubito-humeral process; *s* = spine; *c'*, *c''* = canals for the passage of muscles.

seated characters is linked up with their use or disuse, and that they do not necessarily dwindle away to vanishing point, but may simply drop out of the factorial system." Eigenmann and Cox,¹ who have recorded the absence of the ventrals in *Ameiurus natalis*, consider this character as a prepotent variation and suggest that "it is possible that some of the genera of fishes without ventrals have arisen from such prepotent variants, . . ." Brindley,² who noticed the absence of the ventrals in a specimen of the White Bream (*Abramis blicca*, Bloch.) observed "that the defect is congenital and not the result of accidental injury. . . ." Too much importance seems to have been attached to the variations in the germ-plasm especially when dealing with such cases of abnormalities. Dr. N. Annandale suggests, and I agree with him, that such abnormalities may be the result of some injury to the anlagen of the ventral or the pectoral fins in the developing embryo. There is, however, very little material available at present to come to any satisfactory conclusion.

I will now briefly deal with the two Indian genera of freshwater fishes that are distinguished from their nearest relatives by the absence of the ventral fins. These are *Channa*, Gronov. and *Apua*, Blyth. The genus *Channa*, which was hitherto known from Ceylon, the Philippines, China and Japan, has recently been recorded from Burma by Chaudhuri.³ According to both Günther⁴ and Day⁵ this genus is distinguished from *Ophiocephalus*, Bloch., by the absence of the ventral fins and the pyloric or coecal appendages. In the original description of the genus by Gronovius⁶ the only significant phrase is "*Ventrales nullæ.*" I have examined two species of *Channa*, one described by Chaudhuri (*op. cit.*) and the other contained in Dr. N. Annandale's Chinese collection. In both these species pyloric appendages similar to those of *Ophiocephalus* are present. The only character, therefore, that distinguishes *Channa* from *Ophiocephalus* is the absence of the ventral fins. The occasional absence of the ventrals has been regarded in other genera as an abnormality or a case of genital variation; but in *Channa* this character seems to have become permanent, for large series of specimens with the ventrals absent have been collected from the same locality. Moreover, no species of *Channa* has been described having the same specific characters as any known species of *Ophiocephalus*. Some people attribute the absence of the ventrals to the habits of these fishes, but how far this is true I have no evidence to judge at present.

It is otherwise in the case of the second genus, *Apua*, which was described from two specimens and has not been recorded since. Vinciguerra⁷ doubted the existence of *Apua* and referred his spe-

¹ Eigenmann and Cox, *Amer. Naturalist*, XXXV p. 33 (1901).

² Brindley, *Proc. Zool. Soc. London*, pp. 108-109, pl. x (1891).

³ Chaudhuri, *Rec. Ind. Mus.* XVI, p. 284 (1919).

⁴ Günther, *Cat. Brit. Mus. Fishes* III, pp. 468 and 483.

⁵ Day, *Fishes of India*, II, p. 368.

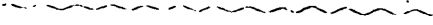
⁶ *Catalogue of Fish in the British Museum*, p. 99 (1854).

⁷ Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova*, XXIX, pp. 348-49 (1889).

cimens to *Acanthophthalmus* from which Blyth's genus is distinguished chiefly by the absence of the ventral fins. I have carefully examined the two unique type-specimens preserved in the Indian Museum and a large series of fresh specimens of *Acanthophthalmus pangia* from Manipur. I do not find any trace of the ventrals or of accidental injury in the former. Moreover, I cannot distinguish Blyth's specimen from *Acanthophthalmus pangia* except by the absence of the ventrals. I am, therefore, led to believe that the specimens of *Apua* were abnormal and that the genus *Apua* cannot stand distinct from *Acanthophthalmus*.

I conclude, therefore, that the cases of *Apua* and *Channa* are not to be considered parallel. *Channa* has been found by numerous collectors at many different places over a very wide area and the ventrals are invariably absent. *Apua*, on the other hand, has only once been collected and only two individuals were then found.

I have carefully dissected a specimen of *Channa burmanica*, Chaudhuri, and have not been able to find any trace of the pelvic girdle.



VIII. REPORT ON A COLLECTION OF BRYOZOA FROM THE BAY OF BENGAL AND OTHER EASTERN SEAS.

By ALICE ROBERTSON, *Ph.D.*

The collection of bryozoa here reported upon was sent me by Dr. Annandale, Superintendent of the Museum at Calcutta, India. It consists of bryozoa obtained, for the most part, at various points on the coast of India and from various depths in the Bay of Bengal and vicinity. Both shore and deep water species are included, the bathymetric range varying from a few to several hundred fathoms.

The specific identification is accompanied with one or two synonyms only, referring both to a description and a plate, the endeavour being simply to make the identification intended unmistakable. In case the plate referred to is not easily accessible, or in those instances in which new species are described, drawings are given together with a description. No attempt has been made to give a complete synonymy, the authority adopted being that of Miss Jelly (1889). Any departure from this has been chiefly on the authority of Waters, especially as given in his recent papers on the Red Sea (1909) and the Zanzibar (1913) faunas.

This collection contains representatives of forty-five genera and ninety-five species. Of these nine species and one variety are thought to be new to science. Two genera, *Kinetoskias* and *Farciminaria*, are of special interest, since not only are they from abyssal depths, but also while possessing undoubted characteristics of these two genera, the two species by which they are represented possess other characters which link them to other but probably related genera in a manner not hitherto shown. Considerable interest attaches to certain membraniporas found in brackish waters. Three such are considered new to science. Their membraniporidan character was early recognized but certain other characters were extremely puzzling, and it was not until the work of Stoliczka (1869) on *M. bengalensis* was discovered that their true nature was revealed. Judging from the work done by Dr. Annandale on brackish water forms together with these river species of *Membranipora*, India abounds in brackish water variational forms of much interest.

Considerable difficulty has been encountered in this investigation since the writer has been unable in most cases to secure actual specimens for comparison. My thanks are specially due to Professor Trevor Kincaid in so cordially lending the facilities of

the Department of Zoology and of the Library of the University of Washington for the furtherance of this work.

LIST OF SPECIES TREATED.

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| 1. <i>Aetea truncata</i> , Landsborough | 37. <i>Smittipora abyssicola</i> , Smitt. |
| 2. <i>Synnotum aviculare</i> , Pieper. | 38. <i>Cribrilina radiata</i> , Moll. |
| 3. <i>Catenaria lafontii</i> , Aud. | 39. „ <i>punctata</i> , Hassall. |
| 4. <i>Scrupocellaria cervicornis</i> , Busk. | 40. <i>Microporella ciliata</i> , Pallas. |
| 5. „ <i>jolloisii</i> , Aud. | 41. „ <i>distoma</i> , Busk. |
| 6. „ <i>pilosa</i> , Aud. | 42. „ <i>impressa</i> , Aud. |
| 7. „ <i>macandrei</i> , Busk. | 43. „ <i>malusii</i> , Aud. |
| 8. <i>Canda retiformis</i> , Pourtales. | 44. „ <i>yarraensis</i> , Waters. |
| 9. <i>Caberea lata</i> , Busk. | 45. <i>Porina tubulosa</i> , Norman. |
| 10. <i>Diploccium simplex</i> , Kirk. | 46. <i>Tubucellaria cereoides</i> , Ell. and Sol. |
| 11. <i>Bugula neritina</i> , Linn. | 47. <i>Schizoporella auriculata</i> , Hassall. |
| 12. „ „ var. <i>minima</i> , Waters. | 48. „ <i>biaperta</i> , Michelin. |
| 13. <i>Beania ostia</i> , sp. nov. | 49. „ <i>brunnescens</i> , Ortmann. |
| 14. „ <i>conferta</i> , MacG. | 50. „ <i>fecilii</i> , Aud. |
| 15. <i>Kinetoskias arabianensis</i> , sp. nov. | 51. „ <i>linearis</i> , Hassall. |
| 16. <i>Farciminaria andamanensis</i> , sp. nov. | 52. „ „ form <i>quincuncialis</i> , Hincks. |
| 17. <i>Cellaria salicornoides</i> , Lamx. | 53. „ <i>nivea</i> , Busk. |
| 18. <i>Farcimia oculata</i> , Busk. | 54. „ <i>pertusa</i> , Esper. |
| 19. <i>Flustra cribriformis</i> , Busk. | 55. „ <i>dutertrei</i> , Aud. |
| 20. „ <i>rizophora</i> , Ortmann. | 56. „ „ var. <i>foliacea</i> , nov. |
| 21. <i>Membranipora cervicornis</i> , Busk. | 57. <i>Lepralia adpressa</i> , Busk. |
| 22. „ <i>curvirostris</i> , Hincks. | 58. „ <i>depressa</i> , Busk. |
| 23. „ <i>incrustans</i> , Waters. | 59. „ <i>feegeensis</i> , Busk. |
| 24. „ <i>lacroixii</i> , Aud. | 60. „ <i>turrita</i> , Smitt. |
| 25. „ <i>perfragilis</i> , MacG. | 61. <i>Escharoides occlusa</i> , Busk. |
| 26. „ <i>simplex</i> , Busk. | 62. <i>Petralia laccadivensis</i> , sp. nov. |
| 27. „ <i>tehuelcha</i> , D'Orb. | 63. „ <i>vultur</i> , Hincks. |
| 28. „ „ var. <i>intertuberculata</i> , Waters. | 64. „ „ var. <i>armata</i> , Waters. |
| 29. „ <i>trifolium</i> var. <i>minor</i> , Hincks. | 65. <i>Smittia landsborovii</i> , Johnston. |
| 30. „ <i>spinostoma</i> , sp. nov. | 66. „ <i>marmorea</i> , Hincks. |
| 31. „ <i>amoyensis</i> , sp. nov. | 67. „ <i>nitida</i> , Verrill. |
| 32. „ <i>devinensis</i> , sp. nov. | 68. „ <i>trispinosa</i> , Johnston. |
| 33. „ <i>hugliensis</i> , sp. nov. | 69. „ „ var. <i>producta</i> , Thornely. |
| 34. <i>Megapora ringens</i> , Busk. | 70. „ <i>latiavicularia</i> , Kirk. |
| 35. <i>Steganopora magnilabris</i> , Busk. | 71. <i>Retepora delicatula</i> , Busk. |
| 36. <i>Thalamoporella rozieri</i> , Aud. | 72. „ <i>porcellana</i> , MacG. |

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| 73. <i>Retepora punctiligera</i> , Ortmann. | 84. <i>Cupularia canariensis</i> , Busk. |
| 74. <i>Reteporella minor</i> , Ortmann. | 85. <i>Crisia</i> sp.? |
| 75. <i>Haswellia australiensis</i> , Haswell. | 86. <i>Filisparsa tubulosa</i> , Busk. |
| 76. <i>Adeonella japonica</i> , Ortmann. | 87. <i>Idmonea atlantica</i> , E. Forbes. |
| 77. „ <i>platalea</i> , Busk. | 88. „ <i>gracillima</i> , Busk. |
| 78. „ <i>marginata</i> , sp. nov. | 89. <i>Entalophora raripora</i> , d'Orb. |
| 79. <i>Lagenipora costazii</i> , Aud. | 90. <i>Lichenopora radiata</i> , Aud. |
| 80. „ <i>tuberculata</i> , MacG. | 91. <i>Domopora truncata</i> , Jameson. |
| 81. <i>Holoporella aperta</i> , Hincks. | 92. <i>Alcyonidium mytili</i> , Dalyell. |
| 82. „ <i>tridenticulata</i> , Busk. | 93. <i>Amathia semiconvoluta</i> , Waters. |
| 83. „ <i>mammillata</i> , Busk. | 94. <i>Zoobotryon pellucidus</i> , Ehrenberg. |
| | 95. <i>Pedicellina cernua</i> , Pallas. |

ABBREVIATIONS USED IN TEXT-FIGURES.

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| <i>av.</i> avicularium. | <i>op.</i> operculum. |
| <i>av.ar.</i> avicularian area. | <i>op.r.</i> opercular rim. |
| <i>av.zoe.</i> avicularian zoecium. | <i>op.sp.</i> opercular spine. |
| <i>b.j.</i> break joint. | <i>p.</i> pore. |
| <i>ba.sp.</i> basal spine. | <i>ped.av.</i> pedunculated avicularium. |
| <i>chi.r.</i> chitinous rim. | <i>pl.</i> plate. |
| <i>de.mus.</i> degenerating muscle. | <i>pr.</i> process. |
| <i>de.poly.</i> degenerating polypide. | <i>pri.mo.</i> primary mouth. |
| <i>emb.</i> embryo. | <i>re.ele.</i> reproductive elements. |
| <i>fer.zoe.</i> fertile zoecium. | <i>ses av.</i> sessile avicularium. |
| <i>l.</i> lobe. | <i>sh.</i> sheath. |
| <i>lat.sp.</i> lateral spine. | <i>sp.av.</i> spatulate avicularium. |
| <i>mus.</i> muscle. | <i>st.</i> stomach. |
| <i>nu.zoe.</i> nutritive zoecium. | <i>t.ba.</i> tubular base. |
| <i>oe.</i> oecium. | <i>um.</i> umbo. |
| <i>oe.zoe.</i> oecial zoecium. | <i>zoe.</i> zoecium. |

CHEILOSTOMATA.

1. *Aetea truncata*, Landsborough.

Aetea truncata, Robertson, 1905, vol. 2, no. 5, p. 246, pl. iv, figs. 5, 6.

A mere fragment growing on a piece of shell together with other Bryozoa. Obtained on the Pearl Banks, Ceylon, depth unknown. This species seems to be a northern form which has strayed south. It is present as a shore form on the coast of Alaska, has been obtained on a holdfast at La Jolla, California, at a depth of two fathoms, and is reported from Zanzibar at eight fathoms.

2. *Synnotum aviculare*, Pieper.

Synnotum aviculare, Hincks, 1886, ser. 5, vol. 17, p. 257.

Synnotum aviculare. Robertson, 1905, vol. 2, no. 5, p. 286, pl. xiv, figs. 84, 85.

Mr. Waters (1913) criticises my identification of *S. aviculare* obtained from the coast of California, considering that the species there obtained is *S. contorta*. After examining the specimen from Madras Harbour I am the more inclined to the opinion that the California species is identical with the species in this collection and that both are *S. aviculare*. A piece of a colony growing with *B. neritina* obtained from Madras Harbour; also found at a depth of 6 to 8 fathoms, growing on cinder at the entrance to Palk Straits.

3. *Catenaria lafontii*, Audouin and Savigny.

Catenaria lafontii, Harmer, 1902, vol. xlv, p. 305, pl. 17, fig. 49.

Obtained at three stations in Madras Harbour, dredged at from 6 to 8 fathoms; also at Mergui, Burma.

4. *Scrupocellaria cervicornis*, Busk.

Scrupocellaria cervicornis, Busk, 1852, pt. i, p. 24, pl. lxii.

Common in Madras Harbour at depths of from 4 to 6 fathoms, obtained also at the entrance to Palk Straits and at Mangalore, west coast of India.

5. *Scrupocellaria jolloisii*, Audouin and Savigny.

Scrupocellaria jolloisii, Waters, 1909, p. 132, pl. 10, figs. 5-10.

A common species in this vicinity obtained at several localities: Mangalore, Gaspar Straits, Malay Archipelago and Mergui, Burma. Also dredged at depths of from 30 to 24 fathoms off the Ganjam coast and at station 387 (off C. Negrais, Burma, 15°25' N., 93°45' E.) at depths of from 49 to 40 fathoms.

6. *Scrupocellaria pilosa*, Audouin and Savigny.

Scrupocellaria pilosa, Waters, 1913, p. 478, pl. lxviii, figs. 3, 4.

Found growing on cinder at depths of from 6 to 8 fathoms, at the entrance of Palk Straits.

7. *Scrupocellaria macandrei*, Busk.

Scrupocellaria macandrei, Busk, 1852, pt. i, p. 24, pl. xxiv, figs. 1-3.

Dredged at 31 fathoms at Mangalore, west coast of India.

8. *Canda retiformis*, Pourtales.

Canda retiformis, Waters, 1913, p. 479, pl. lxix, figs. 1, 2, 6.

Obtained at the Andamans growing on coral; also at station 287 (Arabian Sea, 21°8'30" N. 65°47' E.) and dredged at 34 fathoms in 81°16' E., 6°01' N.

9. *Caberea lata*, Busk.

Caberea lata, Busk, 1852, pt. i, p. 39, pl. xlix.

Obtained off Ganjam, east coast of Madras Presidency, at 24 to 30 fathoms.

10. *Diplœcium simplex*, Kirkpatrick.

Diplœcium simplex Kirkpatrick, 1888, ser. 6, vol. 1, p. 73, pl. vii, fig. 1.

Zoarium consisting of many branches composed of relatively short internodes, the whole forming bushy tufts 25 or 30 mm. in height. *Internodes* separated by chitinous joints which form in place of the two distal zoœcia of the internode, and consisting commonly of eight zoœcia although varying in number from four to twelve. *Branching* dichotomous. *Zoœcia* arranged in pairs, back to back, each pair at right angles to the preceding pair (Fig. 1), tubular, somewhat wider in the middle. Zoœcial wall delicately calcareous, and regularly porous. *Orifices* rounded above with a sinus on the lower margin. Oœcia porous, somewhat flattened, closed by the operculum, lower margin curved so that the orifice of the fertile zoœcium is larger than that of an ordinary zoœcium. In older parts of the colony the rim of the oœcia is somewhat thickened, due probably to increased calcification.

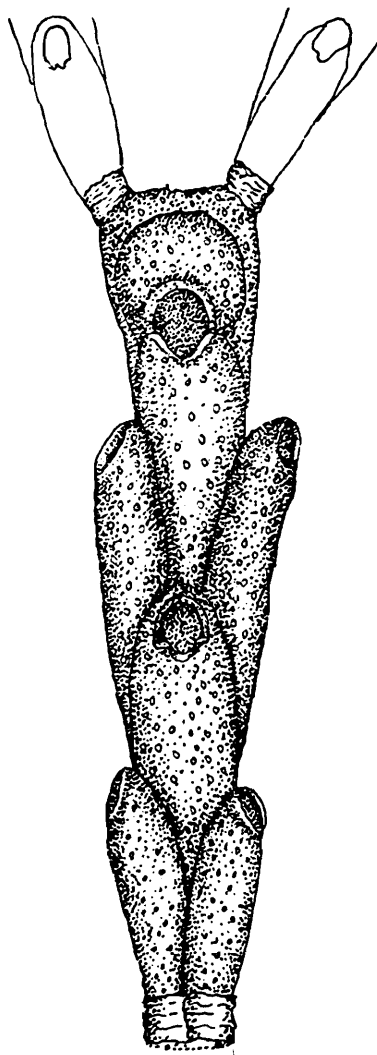


FIG. 1—*Diplœcium simplex* Kirk.
× 40.

The species here identified differs slightly from that described by Kirkpatrick, notably in the greater size of internodes and in the shape of the oœcio-zoœcial orifice. The latter is thought to be an important difference, perhaps of specific value. For the present, however, these differences will be considered mere variations of the original species. This species is a puzzling one and it is doubtful, as Kirkpatrick remarks, just where it belongs in the present classification of the bryozoa.

Obtained at station 47, off mouth of Godaveri R., 5–6 fathoms. Probably dredged or taken in tangles, judging from the condition of the material. Miss Thornely reports this species from the Andamans at 17 fathoms.

11. *Bugula neritina*, Linnaeus.

Bugula neritina, Waters, 1909, p. 135, pl. xi, figs. 1-3.

Abundant in Madras Harbour, often growing in large masses with hydroids and other bryozoa; in one instance entangled in *Zoobotryon pellucidus*. Dredged at depths varying from 4 to 6 fathoms.

12. *Bugula neritina*, var. *minima*, Waters.

B. neritina, var. *minima*, Waters, 1909, vol. xxxi, p. 136, pl. ii. figs. 4, 7.

Small piece of a colony dredged at 31 fathoms, 21 miles S. W by W of Mangalore, west coast of India.

13. *Beania ostia*, sp. nov.

Zoarium forming a flat lace-like mass growing on old pieces of bone. *Zoecia* boat-shaped, each connected with its neighbour by four tubes of approximately equal length (Fig. 2). *Aperture* occupying the whole or almost the whole of the front. Five short *spines* at the distal extremity. In a few instances there are but four spines, the margin between the second and fourth being raised, much curved and bounded by a strong chitinous rim.

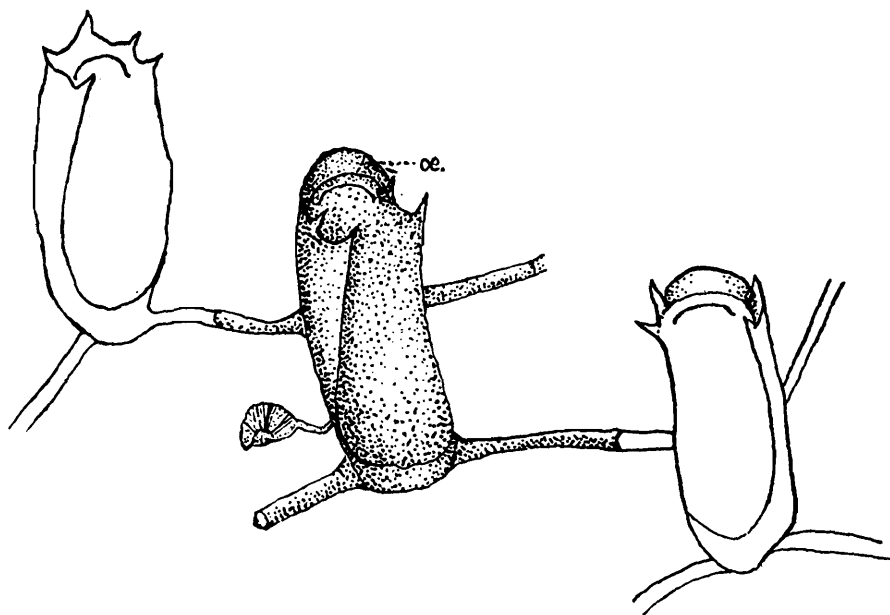


Fig. 2.—*Beania ostia*, sp. nov. $\times 50$.

This is thought to represent the *oæcium* (α). In one instance only has an *avicularium* been found, although many zoecia have been examined. Unfortunately the material became dry before it could be studied, and hence very brittle. On a few zoecia there are indications of the remains of an avicularium but nothing that can be positively so regarded. *Avicularium* small, pedunculated, situated at one side near the base of the aperture.

Obtained at Gopalpore, east coast of India, dredged at depths of from 25 to 28 fathoms.

14. *Beania conferta*, MacGillivray.

Beania conferta, MacGillivray, 1886, vol. xxii, p. 130, pl. i, fig. 5.

A minute quantity growing with *F oculata* on a worm tube, obtained at Gaspar Straits, Malay Archipelago.

15. *Kinetoskias arabianensis*, sp. nov.

Zoarium incomplete, consisting of a single stem with a few branches at the distal end and breaking into a number of rootlets at the attached end. The stem is composed of a number of radical tubes, and of zoöcia which are smaller and stiffer than the zoöcia of the distal branches, the two forming a stalk or stem which is probably flexible in the natural state but sufficiently rigid to hold the crown of branches two or more inches above the ocean-floor. That the substratum in which this specimen grew is similar to that usually described for *Kinetoskias* is shown by the globigerina and other shells, and grains of sand adhering to the finest rootlets. The branches at the distal end consist of zoöcia in two series, the zoöcia of each series forming an acute angle with the zoöcia of the other.

The adult or nutritive zoöcia (Fig. 3, A) are very long and may be considered to consist of two parts or regions, the zoöcia proper (*zoe.*) and the tubular base (*t.ba.*) more or less independent of the former, and into which the polypide does not extend. Indeed, the connection between it and the main body of the zoöcium is easily and frequently broken, in which case the tubular portion remains attached to the zoöcium from which it sprang, while the main portion is lost. Outlining each zoöcium and thus strengthening the rim is a chitinous border. At the point of union of the zoöcium proper and the basal prolongation, the chitinous rim is frequently bent inward forming a weakened place or break joint (*b.j.*). At the distal end of the zoöcium the chitinous margin grows thinner and there forms a blunt point. The wall of the zoöcium is delicate and transparent, the *orifice* is formed by the opening of a broadly semicircular lip bounded by a heavy chitinous bar. Both sessile and pedunculated *avicularia* occur. At the dorso-lateral angle of each zoöcium there is a sessile avicularium (*ses.av.*) with a mandible curved at the extremity and fitting into a chitinous groove. This avicularium is seated on a distinct area on the dorso-lateral wall to which the strong mandibular muscle is attached and which is outlined by a delicate rim (*C, av.ar.*). These avicularia frequently break off, in which case the area is exposed. On a few zoöcia only were frontal pedunculated avicularia found, attached to the lower inner margin (*B, ped.av.*). These have an extremely short peduncle, but the avicularia are relatively large. Through the transparent wall of the zoöcium the polypide is clearly visible especially in stained preparations. Within the zoöcium is found also a large and powerful muscular organ (*A,B, mus.*). This is composed of two groups of muscle fibres lying in the lower part of the zoöcium just above the tubular prolongation and spreading on two sides of the median line like two fans. Viewed from the front, the stomach of the contracted polypide is visible between the two groups of muscle fibres (*A, st.*).

In this colony there is but one fertile zoöcium. It arises as

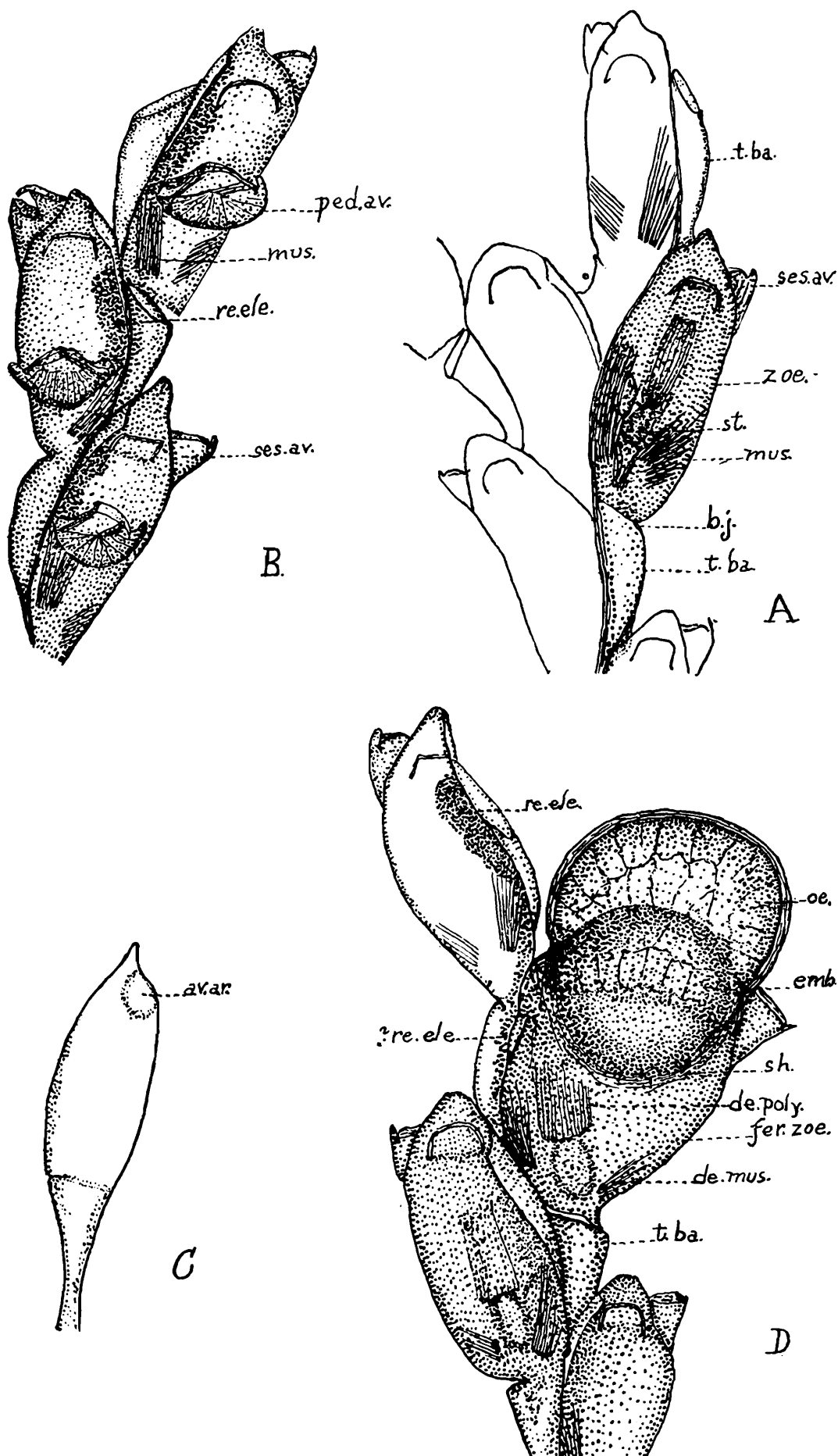


FIG. 3.—*Kinetoskias arabianensis*, sp. nov. $\times 40$.

- (A) Outlines of a few nutritive zoecia showing detail in one.
 (B) Three zoecia possessing both pedunculated (*ped.av.*) and sessile avicularia (*ses.av.*).
 (C) Dorsal surface of a zoecium to show area from which a sessile avicularium has broken away (*av.ar.*).
 (D) Three nutritive and one fertile zoecia (*fer.zoe.*) to show especially the relative position and size of the latter, together with certain details: embryo (*emb.*), oecium (*oe.*), sheath of embryo (*sh.*), degenerating polypide (*de.poly.*) and muscles (*de.mus.*).

do the nutritive zoöcia, and indeed is a transformed nutritive zoöcium. It also consists of two parts, a much enlarged zoöcium proper and a basal prolongation (Fig. 3, D). The zoöcium proper, again, consists of two parts. These may be distinguished by a difference in the texture of the wall, the lower half being membranous, the upper half being thickened and strengthened by delicate calcareous plates (*fer. zoe.*). The calcareous wall of the upper half is bulging and rounded and obviously forms a brood sac or oöcium (*oe.*). The dorsal and ventral walls of this zoöcium unite distally and are bounded by broadly rounded chitinous bars, one forming the distal edge of the dorsal wall, the other forming the distal edge of the ventral wall, the whole closing the mouth of the oöcium through which the developed embryo (*emb.*) or larva eventually escapes. That the chitinous rim of the ventral wall is homologous with the operculum of the nutritive zoöcia is obvious when the muscular attachment of each is studied. The chitinous opercula possess a rather broad expansion at each end to which the opercular muscles are fastened. The chitinous rim of the oöcium possesses a similar expansion at each end to which muscle fibres are attached, and whose action presumably serves to open the oöcium. Conclusive proof that the fertile zoöcium is a transformed nutritive zoöcium is afforded by the presence within the fertile zoöcium of the degenerating remains of a polypide (*de. poly.*) and of parietal muscles (*de. mus.*). Lying above these is the large opaque body of the embryo suspended in a membranous sheath (*sh.*) and only partially enclosed by the calcareous wall of the ovicell. Traces of reproductive elements were found in a few zoöcia (B, *re. ele.*), and in each case these resemble testis rather than ovary. In the zoöcium adjoining the oöcium, what is regarded as testis is also found and it is perhaps significant that similar tissue extends into the basal prolongation of this zoöcium (? *re. ele.*). In no case has undoubted ovary been apparent.

Obtained at station 193, Arabian Sea, 72°28'45" E. 15°11' N., dredged at 931 fathoms.

This interesting specimen was obtained at a depth of 931 fathoms or from a depth of over a mile and is therefore to be regarded as an abyssal form. Considerable difficulty has been encountered in the attempt to identify it because, while it possesses features undoubtedly allying it with *Kinetoskias*, it possesses others which differ markedly from any known species of that interesting genus and which relate it to another family, viz. the Cellulariidæ.

It is allied to *Kinetoskias* by its unique muscular organ coupled with the possession of articulated avicularia, and by its abyssal habitat. It is allied to the Cellularians by the possession of sessile avicularia and by the structure of its peduncle, while the unique structure of the oöcium is unlike that of any Cheilostomatous ovicell known to the writer save one, that of *Cellularia cirrata*, Busk (1884), to which the species under consideration is related if not identical.

According to the discussion of the genus *Kinetoskias* presented by Busk (1881), this genus was originally established to embrace two peculiar abyssal species of bryozoa first described by Danielssen in 1867, later more fully by Koren and Danielssen. Among the Challenger bryozoa, Busk (1884) describes two new species of this genus obtained in the North Atlantic, the one from a depth of 1526 fathoms, the other from 265 fathoms. The distinguishing mark of these four species is the strong "parietal muscle arising near the base of the zoecium and passing obliquely backwards and upwards expanding in a fan-shaped manner to be inserted into its hinder wall to the height of about one-third or one-fourth of the zoecium." To quote further, the author adds, "the action of this muscle must be to draw the entire zoecium downwards and forwards, or in other words, to bend it on itself, and thus by the concurrent action in many zoecia to curl the branches forwards; an action that has in fact been noticed by Koren and Danielssen in the living condition."

It is clearly shown in the various figures that this Arabian species possesses the Kinetoskian muscle developed to a greater degree than it is in any of the species heretofore described. It is seen to arise at two points near the base of the zoecium proper and to spread out in two directions forming a double muscle, that portion lying toward the inner side of the zoecium being somewhat more strongly developed than that lying toward the outer side. The four species hitherto described agree in the possession of pedunculated avicularia, one for each zoecium. One of the puzzling things about the *K. arabianensis* was the apparent lack of these structures. After a close and painstaking search three zoecia were found, each of which possessed one. Whether the rest of the material is mutilated in this respect it is impossible to say. The union between these avicularia and the margin of the zoecia is extremely delicate and may have been broken, leaving no trace. Certain it is that no traces of their former presence are visible. It is further noted that in this species the pedunculated avicularia are attached to the inside border, whereas in other species reported they are attached to the outside border.

In the discussion mentioned above Busk makes a point of the structure of the peduncle, considering it to be a specialized, highly differentiated structure, formed by a coalescence of radicle fibres. In the species he describes, the peduncle consists of transparent, homogeneous tissue, homologous, according to that investigator, with an internode of a root fibre. In the Arabian species the peduncle is a more primitive structure, consisting as does that of some *Bugulas*, its near relatives, of an intermixture of root fibres and zoecia, the former twisting about the somewhat rigid zoecia for a considerable distance before the stem thus formed divides into several branches. One root fibre at least continues upward on the dorsal side of each branch, while at the base the main stem again divides into a few coarse fibres, these into smaller and

smaller branches, the finest rootlets clasping minute objects in the substratum.

In so far the characters of the *K. arabianensis*, while differing somewhat from other members of this genus, do not remove it from the family Bicellariidæ to which Kinetoskias and the Bugulas belong. The two characters remaining to be discussed, viz. sessile avicularia and the peculiar structure of the oœcium are both unknown in that family. The former is a distinguishing mark of the family Cellulariidæ, and except in a slight difference in position the sessile avicularia on the Arabian species are similar to the lateral avicularia found on such Cellularians as *Menipea* or *Scrupocellaria*.

The unique oœcium of this species reveals a wholly unexpected dimorphism previously unknown in either of the two families mentioned above and only rarely occurring in the Cheilostomes. The only other Cheilostomatous bryozoan which shows a similar condition is *Adeonella* and its congeners where a trimorphism exists, resulting in nutritive zoœcia, reproductive or oœcial zoœcia, and zoœcia transformed into avicularia. In *Crisia*, a Cyclostome, there is found a dimorphic condition quite similar to that which obtains in *K. arabianensis*, in which a zoœcium grows to an unusual size and takes on the reproductive instead of the nutritive function. Unlike the oœcium of *Crisia* which never assumes the nutritive functions, the species found in the Arabian Sea first performs the nutritive function, indicated by the presence of a polypide, and only secondarily assumes the oœcial function.

The oœcial condition most nearly resembling that shown by *K. arabianensis* is found in *Cellularia cirrata*, Busk (1884). "The oœcium," as Busk remarks, "is formed by an entire metamorphosed zoœcium, with a wide opening closed by a broad valve having a semilunar chitinous border." At first glance, the occurrence of oœcia so unusual in structure and yet so similar externally would lead one to suspect close relationship between *C. cirrata* and the present species. And indeed for a time the two were thought to be identical. This opinion was strengthened by the facts that both are abyssal and both come from regions geographically similar. Busk, however, makes no mention of internal structure, but remarks that the material was in poor condition and much curled. He evidently found no articulated avicularia and no parietal muscles, and the characters which his specimen disclosed justified him in placing it in the Cellulariidæ. However he expresses a doubt that he is correct and remarks that perhaps a new genus should be established to receive his species. The occurrence of this peculiar oœcium in these two species leads one to wonder if *C. cirrata* and the species from the Arabian Sea are identical, especially when one reflects that the curled condition upon which Busk remarks might be caused by the contraction of parietal muscles and at the same time might make the detection of these muscles impossible.

The facts in regard to the reproductive elements and the reproductive processes which have been ascertained through a study of this material reveal a curious parallel between it and *Crisia* and other Cyclostomes. In both, testis is abundant; while ovary is apparently correspondingly scarce. Is it perhaps true, as has been shown for *Crisia*, that but few ova are produced, or that ova arrive at maturity in but one zoëcium, or in but few zoëcia? Again, since, the ovicells and embryos are of such size and character it seems probable that zoëcia destined to become ovicells are early set apart for that purpose, and likewise possible, as in the Cyclostomes, that the ova are produced in the growing tissues and become secondarily united with a zoëcium. Judging from the size of the embryos together with their small number, the supposition that embryonic fission may occur here is not improbable, and increases the interest in this species as an object of study.

16. *Farciminaria andamanensis*, sp. nov.

Part of a colony consisting of a long stem and numerous branches (fig. 4, A). Stem incomplete, made up of four rows of aborted zoëcia arranged around an imaginary axis, four sided, the corners strengthened by chitinous bars or modified root fibres, from the inner edges of which strong teeth project into the interior of the zoëcia, the four zoëcia in each group at the same level so that the stem has a segmented appearance. At the distal end the stem divides into two branches connected for a short distance by a filmy membrane. The segmented appearance continues for four or six segments above the first branches when the second branching occurs, and the zoëcia from this point contain polypides. The branches, at first biserial, soon become tri- or quadriserial, the zoëcia assuming an alternate arrangement (fig. 4, B).

Branches lose their segmentation, and the zoëcia face outwardly and laterally. *Zoëcia* elongated, area occupying the whole of the front. *Orifice* at the summit closed with a protruding lip. No spines and no avicularia. No oöcia have been observed. In older parts of the colony rounded or oval bodies occur which may be embryos. These are always found, when they occur, in the upper part of the zoëcium, sometimes in company with a degenerating polypide, again with a regenerating one. These are not brown bodies.

Considerable hesitation is experienced in placing this specimen in this genus since the zoëcia are not all arranged around an imaginary axis, as is usually described for *Farciminaria*, but simply folded, as it were, one or two middle rows projecting forward and the two lateral rows turned somewhat, so that the zoëcia when viewed from the front are seen in profile. So many characters, however, both of the zoëcia and of the zoarium as a whole, are Farciminarian that it seems to belong here rather than with any allied genus.

In the absence of spines, avicularia, and oöcia this species resembles *Farciminaria hexagona*, Busk (1884). That species, however, has six series of zoöcia facing around the branch, the two inner rows consisting of sterile zoöcia only. There is also considerable resemblance between it and *Farciminaria simplex*, MacGillivray (1886). The Australian species has a prominent oöcium, and both description and plate are so meagre that identification by their means alone seemed impossible.

Material obtained at the Andamans (1899).

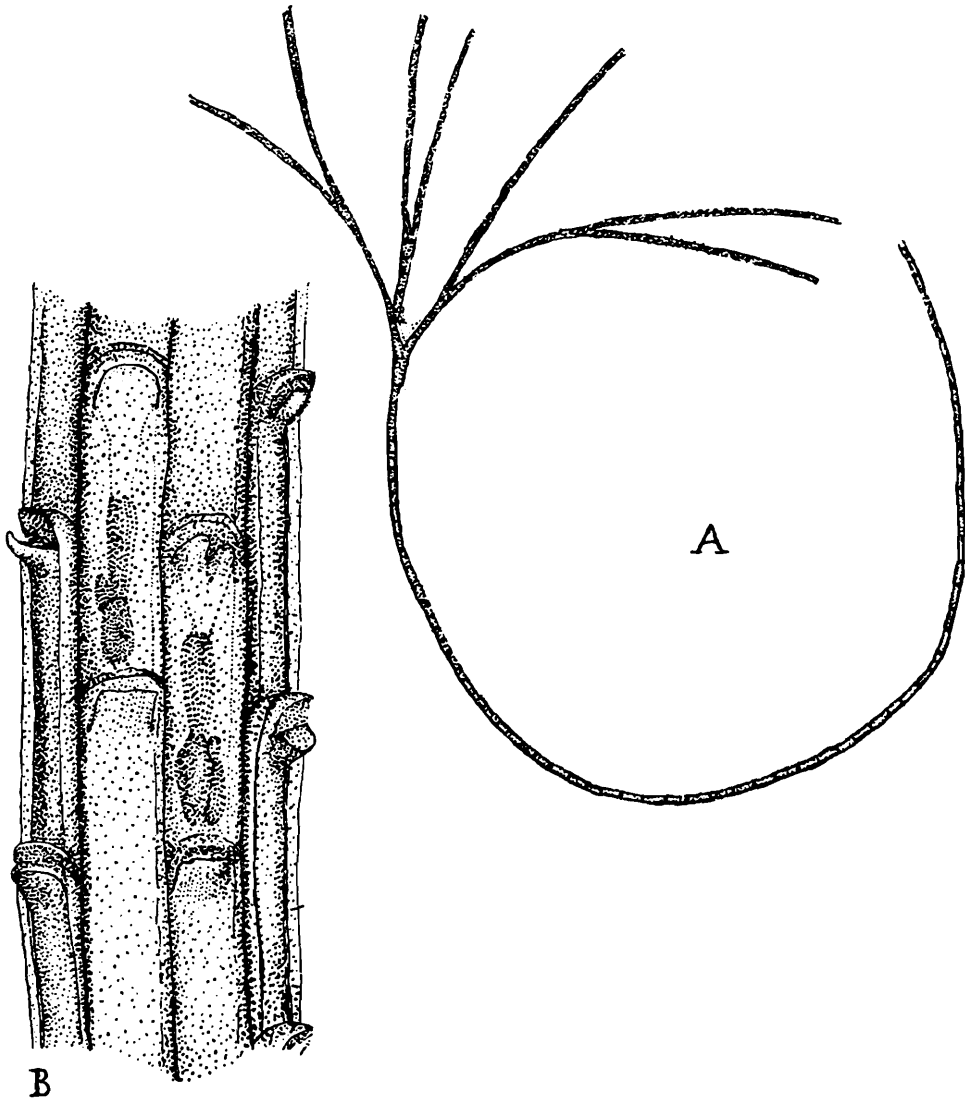


FIG. 4.—*Farciminaria andamanensis*, sp. nov.

A. Habit sketch. $\times 2$.

B. A few zoöcia. $\times 50$.

17. *Cellaria salicornioides*. Lamouroux.

Cellaria johnsoni, Hincks, 1880, p. 112, pl. xiii, figs. 9-12.

Obtained at one locality only, Santapilly, Madras (east coast).

18. *Farcimia oculata*, Busk.

Nellia oculata, Busk, 1852, pt. i, p. 64, fig. 6.

Extremely abundant, obtained at at least nine stations: Mergui; Palk Straits; Mangalore; Gaspar Straits; Ganjam coast; Auncutta Reef, Laccadives, Gopalpore.

19. Flustra cribriformis, Busk.

Carbasa cribriformis, Busk, 1884, vol. x, p. 50, pl. xxx.

Zoarium dry and in fragments, but fenestrated condition very apparent. Zoöcial characters agree with description as given by Busk. This material contained many embryos in various stages of growth. When full grown, the embryos hang suspended in a bag or membrane, the distal end shoved into the shallow oöcium while the larger portion extends into the zoöcium, about filling the upper half.

Obtained at Singapore.

20. Flustra rhizophora, Ortmann.

Carbasa rhizophora, Ortmann, 1890, p. 27, taf. i, fig. 24.

Dredged at 31 fathoms, 21 miles S.W by W of Mangalore, east coast of India.

21. Membranipora cervicornis, Busk.

Membranipora cervicornis, Busk, 1854, pt. ii, p. 60, pl. C, fig. 3.

Obtained at two stations at the entrance to Palk Straits, 3 miles N.N.W of Pt. Pedro, dredged in sand at from 6 to 8 fathoms.

22. Membranipora curvirostris, Hincks.

Membranipora curvirostris, Hincks, 1880, p. 153, pl. xx, figs. 5, 6.

Dredged off the Ganjam coast at from 24 to 30 fathoms.

23. Membranipora incrustans, Waters.

Membranipora incrustans, Waters, 1898, p. 686, pl. 47, fig. 13.

Obtained at entrance to Palk Straits and on Ancutta Reef, Laccadives.

24. Membranipora lacroixii, Audouin.

Membranipora lacroixii, Busk, 1854, pt. ii, p. 60, pl. 69, fig. 1.

Found growing on shells and pieces of bamboo at Puri beach, Orissa coast. Also growing on crab.

25. Membranipora perfragilis, MacGillivray.

Membranipora perfragilis, Hincks, 1884, ser. 5, vol. xiv, p. 278, pl. viii, fig. 4.

Abundant in this collection, being found at nine or ten stations: Madras; Mergui, on the Brig "Cassandra;" off Akyab, Arrakan coast at 17 fathoms; Puri beach and Black Pagoda, Orissa coast; Virkalay, Travancore coast; at Andamans Is.,; off Carwar and Molki, and Gopalpore. Also at stations 468 (Andaman Is., Port Blair Harbour); st. 387 (off C. Negrais, Burma, 15°25' N., 93°45' E.) at 49 to 40 fathoms, and st. 532 (Mergui Archipelago, 12°15'20" N., 97°10'10" E.), 62 fathoms.

26. *Membranipora simplex*, Busk.

Nellia simplex, Busk, 1852, pt. i, p. 19, pl. lxx, fig. i; pl. lxx (bis), fig. 3.
Obtained at Santapilly and at Madras.

27. *Membranipora tehuelcha*, D'Orbigny.

Membranipora tehuelcha, Robertson, 1908, p. 265, pl. 15, figs. 16, 17;
pl. 16, fig. 18.

More or less abundant at Puri beach, Orissa coast on bits of wood, also at station 380 (off Akyab, Burma, 19°8' N., 92°59' E.), said to be dredged at 530 fathoms, but since the specimens were growing on sea weed this is thought to be doubtful. [The weed on which it grew commonly floats on the surface. N. A.]

28. *Membranipora tehuelcha* var. *intertuberculata*, Waters.

M. tehuelcha var. *intertuberculata*, Waters, 1898, p. 676, pl. 48, figs. 1, 2.

Obtained from two localities, Puri beach, Orissa coast and from tide pools at Kyauk-Phyu, Burma. In the adult stage this variety assumes a most fantastic appearance due to the elevated, folded, spinous walls. The tubercles are often more numerous and fantastic than represented by Waters, mere seasonal or environmental variations, probably, of this cosmopolitan species.

29. *Membranipora trifolium* var. *minor*, Hincks.

Membranipora trifolium var. *minor*, Hincks, 1885, ser. 5, vol. 15, p. 255, pl. viii, fig. 7.

Obtained at Mangalore at 31 fathoms, and at the Andamans; also off Ceylon at 703 fathoms, growing on shell.

30. *Membranipora spinostoma*, sp. nov.

Zoarium loosely incrusting a stem. *Zoæcia* irregularly quadrangular with a broad calcareous border crenulated on the inner margin (fig. 5, A). *Aperture* membranous, occupying the whole of the front. *Operculum* large, with a heavy chitinous rim, opening close to the calcareous border. The spinal adornment of operculum and area constitutes the unique feature of this species. Spines occur in three locations: (1) on the margin of the area, (2) on the operculum; (3) below and at each extremity of the operculum. *Spines* on the margin of the area, delicate, finely pointed, varying in number from 12 to 15 placed regularly, to a few at irregular intervals. *Spines* on the operculum (fig. 5, A, C) heavy, chitinous, arranged in two rows, alternate, at least six, usually eight in number, one springing from near the base of the operculum, the other about half way from the base, stiff, longer than the width of the operculum, directed upward or toward and beyond the distal border (C, *op.sp.*). Two *lateral spines* at the extremities of the opercular bar invariably present. These grow in sockets and are movable in two directions, upward and downward.

(A, B, C, *lat.sp.*). In their slenderness, length and mobility they resemble vibracula. In the space between these lateral spines or vibracula, other spines, from one to four in number, are sometimes found springing from the top of the area and extending stiffly downward. These are more or less inconstant being apparently easily broken.

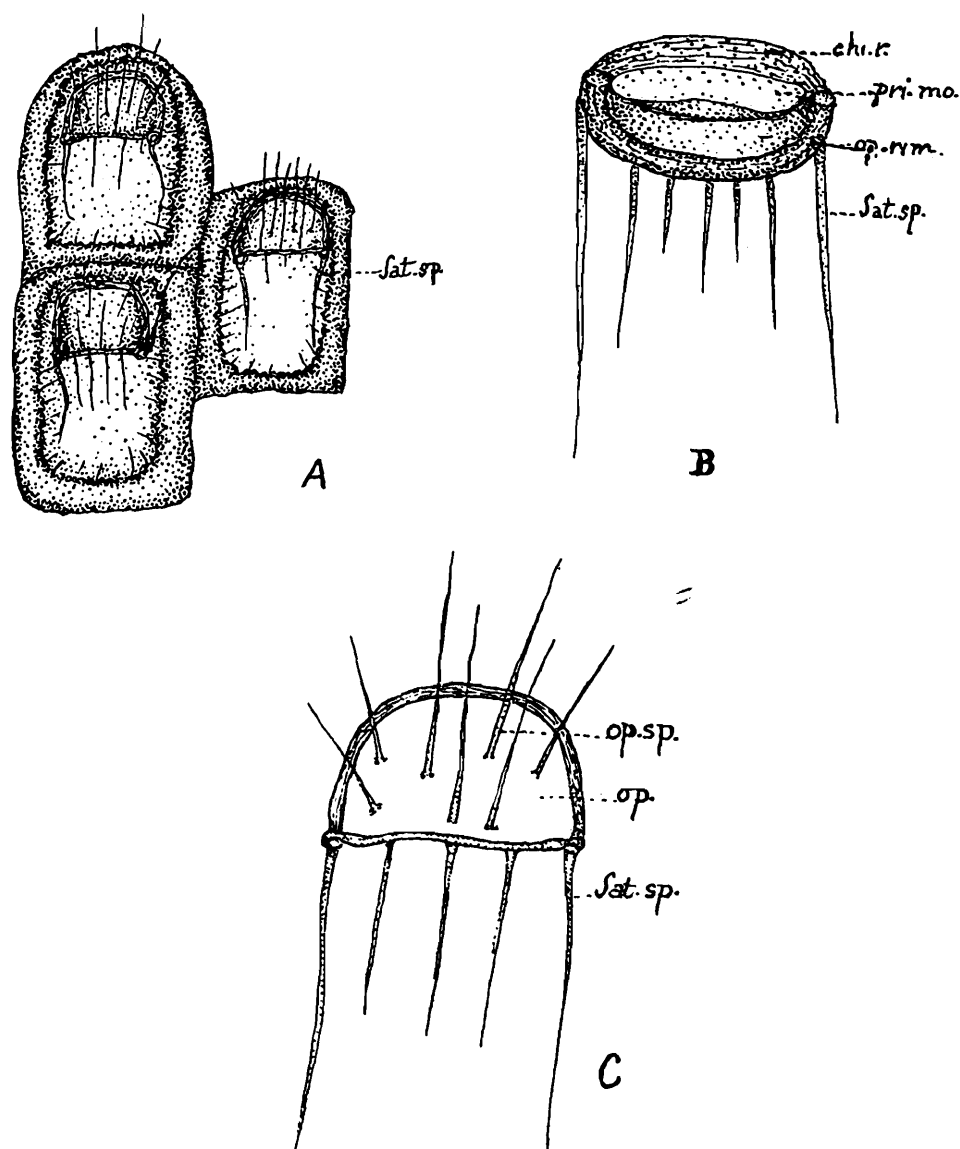


FIG. 5.—*Membranipora spinostoma*, sp. nov.

A. Three zoecia, $\times 25$.

B. Operculum thrown widely open showing the inner surface, primary mouth (*pri.mo.*) and chitinous rim above it. $\times 100$.

C. A magnified view of operculum and opercular spines. $\times 100$.

Obtained at station 352, Persian Gulf, $29^{\circ}20'$ N., $48^{\circ}47'$ E., at a depth of 13 fathoms.

The material upon which these observations are made is dry, hence brittle and difficult to study. The upstanding spines on the operculum serve to catch and hold debris, thus increasing this difficulty. In Figure 5, B, showing the operculum thrown back and revealing the inner surface, the primary mouth (*pri.mo.*)

seems to consist of a slit or opening under the operculum. Above and close to the calcareous margin is a rather broad, delicate, semi-chitinous rim (*chi. r.*) against which the spiny operculum closes. The space formed by the opening of the operculum constitutes a secondary mouth. Moreover the heavy operculum frequently tears away from the delicate membrane of the area, leaving an opening between operculum and area having the appearance of a mouth. This was confusing until, after soaking small pieces in oil for a few hours, then teasing on a slide, instances were found in which the operculum was thrown back and opened as in fig. 5, B. It is important that this species be examined further, either fresh or preserved in alcohol.

BRACKISH WATER MEMBRANIPORA.

The three species of *Membranipora* which follow belong to brackish-water forms similar to *Membranipora bengalensis* described by Stoliczka (1869). That investigator found this species in a tank of water only one-fifth as saline as sea-water. Later he found it distributed throughout that region of India known as the Sunderbans, incrusting old pieces of wood, or trunks of trees at the mouths of rivers and on the shores of salt lakes, but never in fresh water. In his description of this species, Stoliczka remarks that he has observed similar forms incrusting shells and fragments of wood in various places along the coast of Bengal Bay, but had not succeeded in obtaining specimens which were in a good state of preservation.

In this collection there are three species of *Membranipora* which have proved most puzzling until the description and plates of *M. bengalensis* were obtained. These three species resemble each other and *M. bengalensis* in several features: (1) in the loose connection existing between the zoaria and the substratum, and often between the zoecia themselves; (2) in the possession of delicate chitinous rather than calcareous lateral walls, together with an extremely delicate calcareous wall over portions of the front of the zoecia, (3) in the development, as a rule, of conspicuous spines which are highly characteristic and distinct for each species. Like *M. bengalensis* also, all grow on wood more or less sodden or on shells of brackish-water mollusks.

31. *Membranipora amoyensis*, sp. nov.

Zoarium loosely incrusting a shell and in places forming bilaminar folds. *Zoecia* large, quadrangular, alternate, separated by thickened lines (fig. 6). *Aperture* occupying more than half the front. *Operculum* semicircular, large, situated close to the top. Aperture surrounded by a calcareous margin from which project numerous small calcareous *spines*, 17 or 18, or perhaps 10 to 12, depending on the size of the zoecium. On young zoecia a single stout spine on each side at the upper angles. On older

zoëcia this spine becomes trifid, one branch usually extending outward, one upward and one downward. No oæcia have been found.

This species was obtained from Amoy, China. No other data given. The material incrusts a shell which is judged to be from water only slightly saline since, while calcareous, it is extremely soft and chalk-like and not of the ordinary marine type.

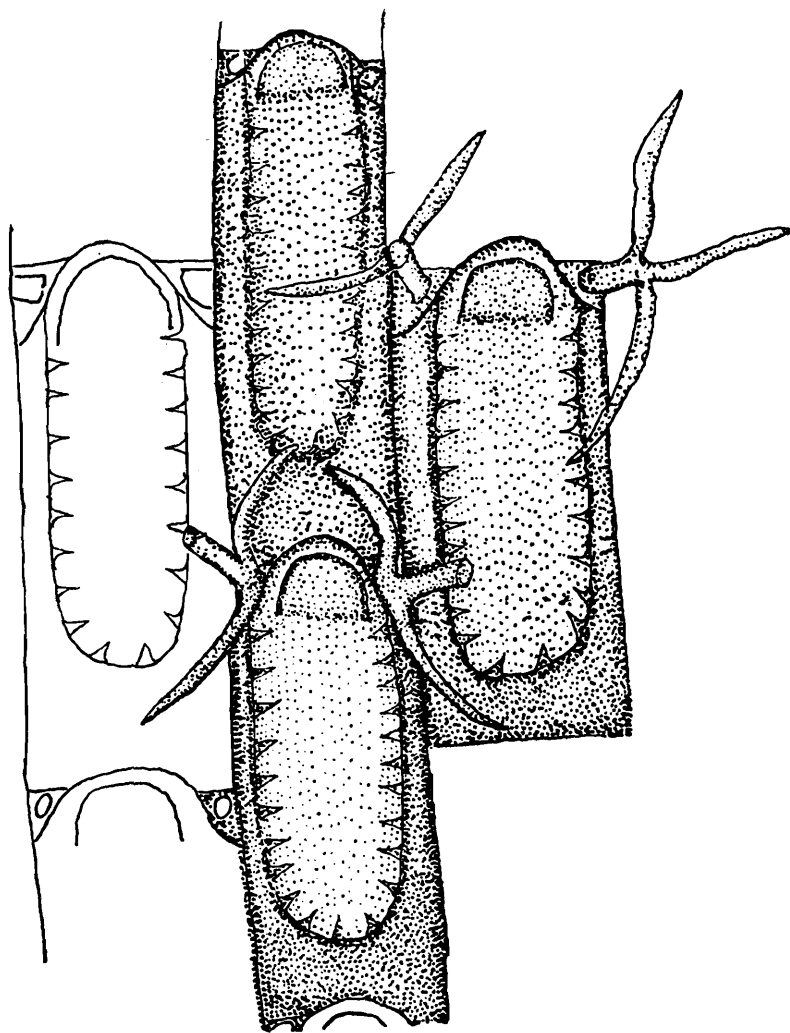


FIG. 6.—*Membranipora amoyensis*, sp. nov. $\times 90$.

32. *Membranipora devinensis*, sp. nov.

Zoarium incrusting bark of sodden wood, loosely attached. *Zoëcia* elongated, sometimes of extreme length and connected together loosely (fig. 7). *Aperture* occupying almost all of the front, the margin beset with a large number of spines which meet across the front. *Operculum* semicircular, large at the top of the aperture. The portion of the zoëcium below the aperture covered with a delicate calcareous wall marked by two large pores. Sometimes two zoëcia form in the place of one, when each zoëcium possesses but one pore. In no case has a spine been found projecting from these pores. *Oæcium* small, projecting over the zoëcium above, almost to its pores.

Obtained on the Orissa coast at the mouth of the Devi river, Bay of Bengal, dredged at depths varying from 23 to 25 fathoms.

33. *Membranipora hugliensis*, sp. nov.

Zoarium growing in a single layer on chips of wood to which hydroid stems adhere and encircling these stems, where it forms small bilaminate expansions.

Zoecia elongated, aperture occupying three-fourths of the front or more, surrounded by a delicate calcareous border crenulated on the inner margin (fig. 8). The lower part of the front of the zoecia covered with a calcareous layer. The distal portion of each zoecium projecting over the zoecium above almost to the crenulated margin of the aperture. Where the zoecia are crowded, the aperture much reduced and may become almost circular.

That part of the zoarium growing flat and single layered is without spines, while

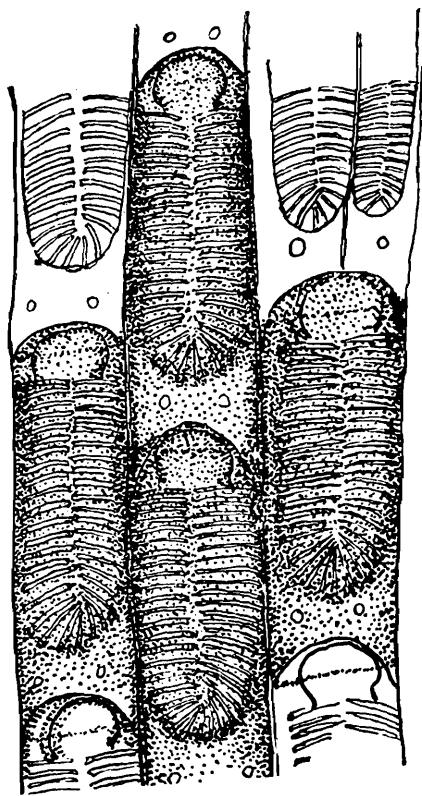


FIG. 7.—*Membranipora devinensis*, sp. nov. $\times 50$.

that part which climbs on the hydroid stems and sends out bilaminate folds, possesses many conspicuous basal spines. Usually each zoecium in the spinous region possesses two or more spines situated on the calcareous layer of the front wall just below the aperture. In some cases where the zoecia are narrowed below, but one process may occur, usually then in the middle of the lower front wall. In still other instances no spines occur on the double layered portion. These *spines* (*sp.*) are tall, hollow, tapering processes formed of a transparent membrane, and lined with a delicate epithelium

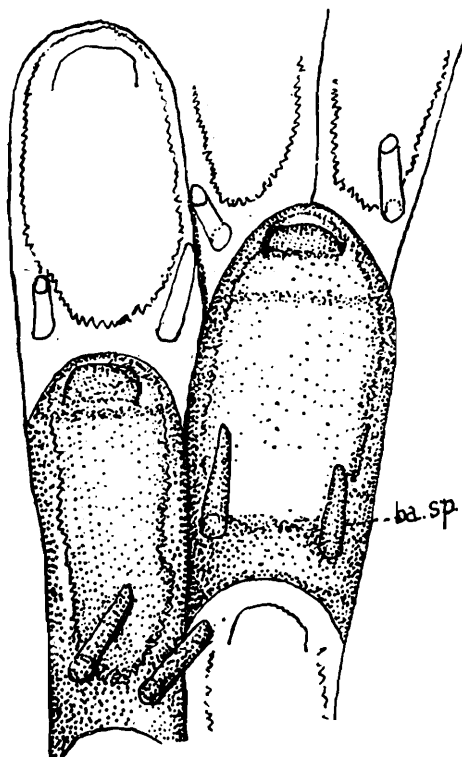


FIG. 8.—*Membranipora hugliensis*, sp. nov. $\times 90$.

continuous with that of the parietal lining of the zoecium. They are not articulated but bend easily, the membranous layer simply wrinkling on one side. No oecia were found.

Obtained in considerable abundance at the mouth of the Hugli river, Bay of Bengal.

34. *Membranipora ringens*, Busk.

Megapora ringens, Hincks, 1880, p. 172, pl. xxii, fig. 1.

Obtained at entrance to Palk Straits, 3 miles N.N.W. of Point Pedro, dredged at 6 to 8 fathoms. Incrusting a coral mass with sponge and other bryozoa.

35. *Steganoporella magnilabris*, Busk.

Steganoporella magnilabris, Busk, 1884, pt. xxx, p. 75, pl. xxiii, fig. 2.

Obtained at four rather widely separated localities showing that the species is abundant in the Bay of Bengal. Found at the Andamans growing over masses of coral; on Ancutta Reef, Laccadives; off Ceylon at 703 fathoms, and at station 384 (off C. Negrais, Burma, 16°0' N., 93°37' E.), dredged at 40 fathoms, growing over roots and debris.

36. *Thalamoporella rozieri*, Audouin.

Thalamoporella rozieri, Robertson, 1908, vol. 4, no. 5, p. 277, pl. 17, figs. 27, 28, 29.

Obtained at one locality only, Pedro Shoal, Palk Straits.

37. *Smittipora abyssicola*, Smitt.

Vincularia abyssicola, Smitt, pt. ii, p. 6, pl. i, figs. 60, 61.

Obtained at the entrance to Palk Straits, dredged at 6 to 8 fathoms, also at station 387 (off C. Negrais, Burma, 15°25' N., 93°45' E.), dredged at 40 to 49 fathoms.

38. *Cribrilina radiata*, Moll.

Cribrilina radiata, Hincks, 1880, p. 185, pl. xxv, figs. 1-9.

Abundant in this collection. Obtained at Palk Straits, dredged at 6 to 8 fathoms; Andamans; Laccadives; Puri, Orissa coast; off Ceylon at 703 fathoms; off Gopalpore at 25 to 28 fathoms; at station 522 (Mergui Archipelago, 12°35' 15" N., 98° 16' E.); at station 387 (off C. Negrais, Burma, 15°25' N., 93°45' E.).

39. *Cribrilina punctata*, Hassall.

Cribrilina punctata, Hincks, 1880, p. 190, pl. 26, fig. 3.

Obtained at two points: off Gopalpore at 25 to 28 fathoms and in the Bay of Bengal at 15 to 30 fathoms.

40. *Microporella ciliata*, Pallas.

Microporella ciliata, Hincks, 1880, p. 206, pl. xxviii, figs. 1-8.

Abundant in this collection: obtained at Gopalpore at 24 fathoms; Palk Straits at 6-8 fathoms; Andamans, Bay of Bengal at 15 to 30 fathoms; at station 387 (off C. Negrais, Burma, 15°25' N., 93°45' E.) dredged at 40 to 49 fathoms.

41. *Microporella distoma*, Busk.

Adeonella distoma, Busk, 1884, pt. xxx, p. 187, wood cuts, 56, 57.

Rather widely distributed. Obtained at the Andamans, North Sentinal I., station 387 (off C. Negrais, Burma, 15°25' N., 93°45' E.) dredged at 40 to 49 fathoms, at Cape Bluff dredged at 375 fathoms.

42. *Microporella impressa*, Audouin.

Microporella impressa, Hincks, 1880, p. 214, pl. xxvi, figs. 9-11.

Obtained off Ceylon, growing on a dead shell dredged at 703 fathoms.

43. *Microporella malusii*, Audouin.

Microporella malusii, Hincks, 1880, p. 211, pl. xxviii, fig. 11.

Dredged at 6-8 fathoms at the entrance to Palk Straits.

44. *Microporella yarraensis*, Waters.

Eschara lichenoides, Busk, 1854, pt. ii, p. 90, pl. cvi, figs. 1, 2, 3.

Obtained 21 miles S.W. by W. of Mangalore, west coast of India, dredged at 31 fathoms, growing on a shell.

45. *Porina tubulosa*, Norman.

Porina tubulosa, Hincks, 1880, p. 230, pl. xxxii, figs. 6-9.

Obtained at the Andamans and dredged at the entrance to Palk Straits at 6-8 fathoms.

46. *Tubucellaria cereoides*, Ellis and Solander.

Tubucellaria cereoides, Waters, 1907, p. 130, pl. xv, fig. 8.

A small piece of a colony about an inch in height obtained by the "Investigator" at the Andamans at 20 fathoms.

47. *Schizoporella auriculata*, Hassall.

Schizoporella auriculata, Hincks, 1880, p. 260, pl. xxix, fig. 4.

Dredged in the Bay of Bengal (off C. Negrais, Burma, 15°25' N., 93°45' E.) at 15 to 30 fathoms, also at station 237 (Andaman Sea, 13°17' N., 93°7' E.) at 90 fathoms, at station 387 at 40 to 49 fathoms and off Ceylon at 703 fathoms. Obtained also at the Andamans.

These specimens conform to the description and plates given by Hincks except in a variation in position and size of avicularia.

Most of the zoœcia possess the avicularium just below the sinus. This is lacking in other instances but replaced apparently by another avicularium, somewhat larger usually, but placed somewhere else on the front wall, most generally on the lower part with mandible directed transversely. Occasionally both kinds of avicularia are found on the same zoœcium.

48. *Schizoporella biaperta*, Michelin.

Schizoporella biaperta, Hincks, 1880, p. 255, pl. xl, figs. 7-9.

Obtained at two stations at the Andamans.

Slight variations occur in these specimens differing from those described by Hincks. The oœcia possess two transparent areas on the front instead of an area with radiating lines. The mammillated avicularia possess a spatulated mandible, not a triangular one, as does the British species.

49. *Schizoporella brunnescens*, Ortmann.

Schizoporella brunnescens, Ortmann, 1890, p. 50, pl. 4, fig. 2.

Obtained on the Ceylon Pearl Banks, and Marble Rock, Mergui. Also at $11^{\circ}33\frac{1}{2}'$ N. and $98^{\circ}20\frac{1}{2}'$ E.

50. *Schizoporella ceciliai*, Audouin.

Schizoporella ceciliai, Hincks, 1880, p. 269, pl. xliii, fig. 6.

Obtained at the Andamans.

51. *Schizoporella linearis*, Hassall.

Schizoporella linearis, Hincks, 1880, p. 247, pl. xxxviii, fig. 5.

Dredged at 31 fathoms 21 miles S.W. by W. off Mangalore; at 29 fathoms, off Carwar and Molki, off Ceylon; 26 miles W. S.W. of Honawar, at 28 fathoms, west coast of India.

52. *Schizoporella linearis*, Hassall, form *quincuncialis*, Hincks.

Schizoporella linearis, form *quincuncialis*, Hincks, 1881, ser. 5, vol. 7, p. 158, pl. ix, fig. 3.

A small colony growing on the inside of sea-urchin's test, obtained at "Investigator" stations 532 (Mergui Archipelago, $12^{\circ}15'20''$ N., $97^{\circ}10'10''$ E.) and 534 (Mergui Archipelago, $12^{\circ}59'$ N., $96^{\circ}48'30''$ E.).

53. *Schizoporella nivea*, Busk.

Schizoporella nivea, Busk, 1884, pt. xxx, vol. x, p. 163, pl. xvii, fig. 1.

Dredged at 6-8 fathoms at entrance to Palk Straits, 3 miles N.N.W. of Pt. Pedro. Obtained also at Santapilly.

54. *Schizoporella pertusa*, Esper.

Lepralia pertusa, Hincks, 1880, p. 305, pl. xliii, figs. 4, 5.

Obtained at Santapilly, and dredged off Ganjam coast at 24-30 fathoms.

55. *Schizoporella dutertrei*, Audouin.

Mastigophora dutertrei, Hincks, 1880, p. 279, pl. xxxvii, fig. 2.

Dredged off Gopalpore at 25 to 28 fathoms growing on *Ostrea imbricata*. Obtained also at "Investigator" station 384 (off C. Negrais, Burma, 16°0' N., 93°37' E.).

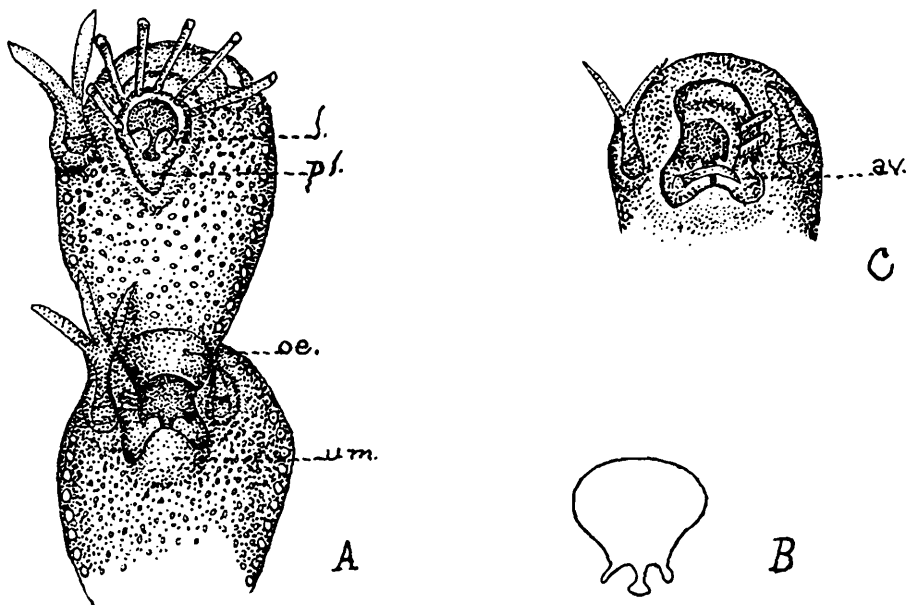


FIG. 9.—*Schizoporella dutertrei*, var. *foliacea*, nov.

A. Two zoecia showing detail, $\times 40$.

B. Operculum much magnified, $\times 90$.

C. Distal portion of older zoecium showing an avicularium (*av.*) on umbo below orifice, $\times 40$.

56. *Schizoporella dutertrei* var. *foliacea*, nov.

Zoarium loosely attached to coral conglomerate. *Zoecia* flat, surface finely porous. *Orifice* surrounded by a thickened calcareous border from which six or eight spines extend (fig. 9, A). Upper margin of orifice arched, lower margin with a deep narrow sinus which widens suddenly at the lowest part. *Operculum*, assuming the shape of the orifice, resembles a flat rounded plate with a handle (fig. 9, B). The zoecial wall projecting on each side of the narrow neck or handle in two conspicuous calcareous lobes (fig. 9A, *b.*), the thickened border of the orifice uniting below into a flat triangular platform (*pl.*). In older zoecia an umbo forms below the orifice (*um.*) hiding the stem-like portion of the operculum. Occasionally this umbo supports an avicularium (fig. 9 C, *av.*) with mandible directed horizontally. On each side of the orifice a sessile avicularium with mandible directed

upward. In at least one of these the mandible is prolonged into a branching process sometimes bifid, sometimes trifid, each branch assuming the form of a rather broad thin blade, reminding one of the wings of maple seed or of the membranous wings of an insect. The avicularium on the other side small, with a triangular mandible directed upward. *Oæcium* shallow, widely open, two or three spines on each side projecting in front of it (fig. 9, A, *æ.*).

Dredged at 25 to 28 fathoms off Gopalpore, Ganjam district, east coast of India.

57. *Lepralia adpressa*, Busk.

Lepralia adpressa, Busk, 1854, pt. ii, p. 82, pl. cii, figs. 3, 4.

Obtained at "Investigator" station 532, at 62 fathoms, Mergui Archipelago (12°15' 20" N., 97°10' 10" E.).

58. *Lepralia depressa*, Busk.

Lepralia depressa, Busk, 1854, pt. ii, p. 75, pl. xl, figs. 3, 4.

Many avicularia possess mandibles long and tapering, almost vibraculoid in character, others possess stout mandibles which terminate in a three parted process resembling the claws of a gallinaceous bird. Commonly the avicularia are similar to those represented by Busk.

Growing on a mass of conglomerate, dredged at 15 to 30 fathoms in the Bay of Bengal, and at 70 fathoms off Ceylon.

59. *Lepralia feegeensis*, Busk.

Lepralia feegeensis, Busk, 1884, pt. xxx, vol. x, p. 144, pl. xxii, fig. 10.

Loosely incrusting coral conglomerate obtained from coral reefs of Kilakarai, Ramnad district, G. of Manaar.

60. *Lepralia turrita*, Smitt.

Lepralia turrita, Smitt, 1873, pt. ii, p. 65, pl. xl, figs. 226, 228.

Dredged at 24 fathoms on the Ganjam coast, also at 6 to 8 fathoms at the entrance to Palk Straits. Obtained off Gopalpore, and at Galle, Ceylon.

61. *Escharoides occlusa*, Busk.

Lepralia occlusa, Waters, 1909, vol. xxxi, p. 152, pl. 14, figs. 1, 2.

A fine specimen obtained in Gaspar Straits, Malay Archipelago. Small, broken and somewhat imperfect specimens obtained at the Andamans and dredged at 112 fathoms off Port Blair, Andamans.

62. *Petralia laccadivensis*, sp. nov.

Material consisting of several small colonies incrusting sponge or small shells. Adult *zoæcia* with front wall rounded, porous,

heavily calcified, ornamented with numerous outstanding processes (Fig. 10). Orifice rounded above, possessing in young zoecia three distinct denticles on the lower margin, the middle one forming a relatively broad mucro. Below the orifice a plain non-porous platform (*pl.*) which in older zoecia tends to grow thicker and to extend up each side of the orifice to form the supports of small elevated, sessile, lateral avicularia (*av.*). Frequently one of these lateral avicularia is replaced by an elongated one of considerable size with spatulate mandible directed downward. (*sp.av.*). From the

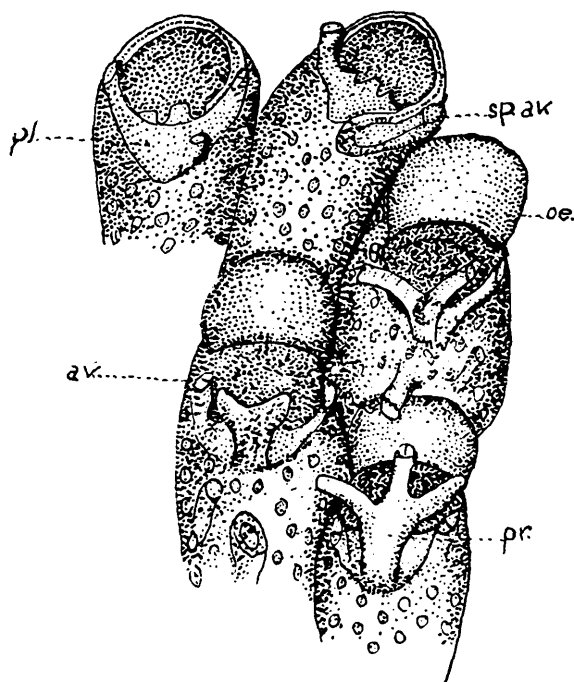


FIG. 10—*Petralia laccadivensis*, sp. nov. $\times 40$.

platform below the orifice there springs a tall process which may become bi- tri- or even quadrifid, almost completely obliterating the orifice (*pr.*). The tips of the branches of these frontal processes may acquire small rounded avicularia. Other processes of considerable height, usually tipped with an avicularium, may decorate any part of the front wall. *Oecia* rounded, wall granular or pierced with minute pores.

A species easily recognized by the unusual number of fantastic processes scattered over the surface of the zoarium. Obtained at Ancutta Reef, Laccadives, at Santapilly, Madras, and dredged at 24 to 30 fathoms off the Ganjam coast.

63. *Petralia vultur*, Hincks.

Mucronella vultur, Hincks, 1882, (5), vol. x, p. 167, pl. viii, fig. 2.

Identification tentative since no comparison with identified specimens has been possible and since certain variations occur here not noted by Hincks. These consist chiefly of numbers of large avicularia found mainly in older parts of the colonies, with mandibles of much variety of form. The mandibles of these avicularia are sometimes long and narrow, sometimes duck-bill shaped, and others again are forked at the extremity. Material fairly abundant. Obtained off Gopalpore, Ganjam district, Madras Presidency, at depths varying from 24 to 30 fathoms; near Mangalore at 31 fathoms; also at Black Pagoda, Orissa coast, at 15 fathoms.

Other material found at Santapilly and at station 296 (Per-

sian Gulf, $26^{\circ}4' N.$, $56^{\circ}2' E.$) in 47 fathoms, agrees with the description of *P. vultur* in most respects, but differs in showing a variable number of upstanding processes around the orifice, often a median triangular one and several smaller lateral ones, all of which may or may not support small avicularia. These it is thought are only of variational value.

64. *Petralia vultur*, var. *armata*, Waters.

Petralia vultur, var. *armata*, Waters, 1913, p. 518, pl. lxx, fig. 18.

Material loosely incrusting small oyster-shells dredged at 160 fathoms, Java Sea, Malay Archipelago (Eastern Telegraph Co.).

65. *Smittia landsborovii*, Johnston.

Smittia landsborovii, Hincks, 1880, p. 341, pl. xlviii, figs. 6-9.

Obtained near Puri, Orissa coast, and at Black Pagoda, Orissa coast, dredged at 15 fathoms.

66. *Smittia marmorea*, Hincks.

Smittia marmorea, Hincks, 1880, p. 350, pl. xxxvi, figs. 3-5.

Obtained at the Andamans and dredged at 40 to 49 fathoms at station 387 (off C. Negrais, Burma, $15^{\circ}25' N.$, $93^{\circ}45' E.$).

67. *Smittia nitida*, Verrill.

Smittia nitida, Hincks, 1881, ser. 5, vol. 7, p. 159, pl. x, fig. 5.

Obtained off Gopalpore, Ganjam coast, dredged at 24 fathoms.

68. *Smittia trispinosa*, Johnston.

Smittia trispinosa, Hincks, 1880, p. 353, pl. xlix, figs. 1-8.

This species rather widely distributed: obtained at the Andamans, the entrance to Palk Straits at 6 to 8 fathoms; Black Pagoda, Orissa coast, at 15 fathoms; off Gopalpore at 25 to 28 fathoms at station 532 (Mergui Archipelago, $12^{\circ}15'20'' N.$, $97^{\circ}10'10'' E.$) at 62 fathoms.

69. *Smittia trispinosa* var. *producta*, Thornely.

Smittia trispinosa var. *producta*, Waters, 1909, p. 173, pl. xvii, fig. 5.

Obtained at Santapilly and at station 528 (Mergui Archipelago, Elphinstone I., Port Maria).

70. *Smittia latiavicularia*, Kirkpatrick.

Smittia latiavicularia, Kirkpatrick, 1888, ser. 6, vol. 1, pl. x, fig. 3.

Obtained off the Ganjam coast, dredged at 24 to 30 fathoms.

71. *Retepora delicatula*, Busk.

Retepora delicatula, Busk, 1884, pt. xxx, vol. x, p. 124, pl. xxvi, fig. 3.

Obtained off the Ganjam coast, dredged at 24 to 30 fathoms, and at station 387 (off C. Negrais, Burma, $15^{\circ}25' N.$, $93^{\circ}45' E.$) dredged at 40 to 49 fathoms.

72. *Retepora porcellana*, MacGillivray.

Retepora crassa, Busk, 1884, pt. xxx, vol. x, p. 115, pl. xxvi, fig. 10; pl. xxvii, fig. 3.

Obtained at $6^{\circ}01' N.$ $81^{\circ}16' E.$ at 34 fathoms; also in the Bay of Bengal, dredged at 15 fathoms.

73. *Retepora punctiligera*, Ortmann.

Retepora punctiligera, Ortmann, 1890, p. 35, taf. ii, fig. 24.

Obtained off Gopalpore, Ganjam coast, dredged at 24 to 30 fathoms.

74. *Reteporella minor*, Ortmann.

Reteporella minor, Ortmann, 1890, p. 37, taf. ii, fig. 28.

Obtained at station 532 (Mergui Archipelago, $12^{\circ}15'20'' N.$, $97^{\circ}10'10'' E.$) in 62 fathoms.

75. *Haswellia australiensis*, Haswell.

Haswellia australiensis, Busk, 1884, pt. xxx, vol. x, p. 172, pl. xxiv, fig. 8.

Obtained off Port Blair at 112 fathoms, also dredged at 8 fathoms in $136^{\circ} E.$, $10' S.$, and at 49 fathoms in $142^{\circ} E.$, and $8' S.$

76. *Adeonella japonica*, Ortmann.

Adeonella japonica, Ortmann, 1890, p. 54, taf. iv, fig. 11.

Obtained at Santapilly and at station 464 (S. of Ceylon, $6^{\circ}2' 30'' N.$, $81^{\circ}29' E.$) in 52-68 fathoms.

77. *Adeonella platalea*, Busk.

Adeonella platalea, Busk, 1884, pt. xxx, vol. x, p. 184, pl. xxi, figs. 4, 4a and text figure 50.

Fine specimen obtained at Mergui, Burma.

78. *Adeonella marginata*, sp. nov.

Zoarium consisting of numerous flat strap-like branches, two or more inches in height. Mode of attachment not known, the material consisting of fragments only. To the naked eye each fragment or branch is seen to consist of a somewhat flattened middle portion with a border or margin of large zoecia forming irregularly radiating lines. The two surfaces of each branch are

almost exact duplicates of each other. This may be seen readily if one inspects the margins, and especially a cross section of a branch. As is characteristic of this genus, the zoëcia are polymorphic consisting of three kinds of individuals: 1, the ordinary nutritive zoëcia (fig. 11, A and B, *nu. zoe.*), 2, the oöcial zoëcia (B, *oe. zoe.*), 3, the avicularian zoëcia (B *av. zoe.*). The middle portion of each branch is occupied by six or eight rows of nutritive zoëcia regularly alternate (A, *nu. zoe.*). Bordering these on each side are two or more rows of large reproductive zoëcia, and outside these a row of large avicularian zoëcia.

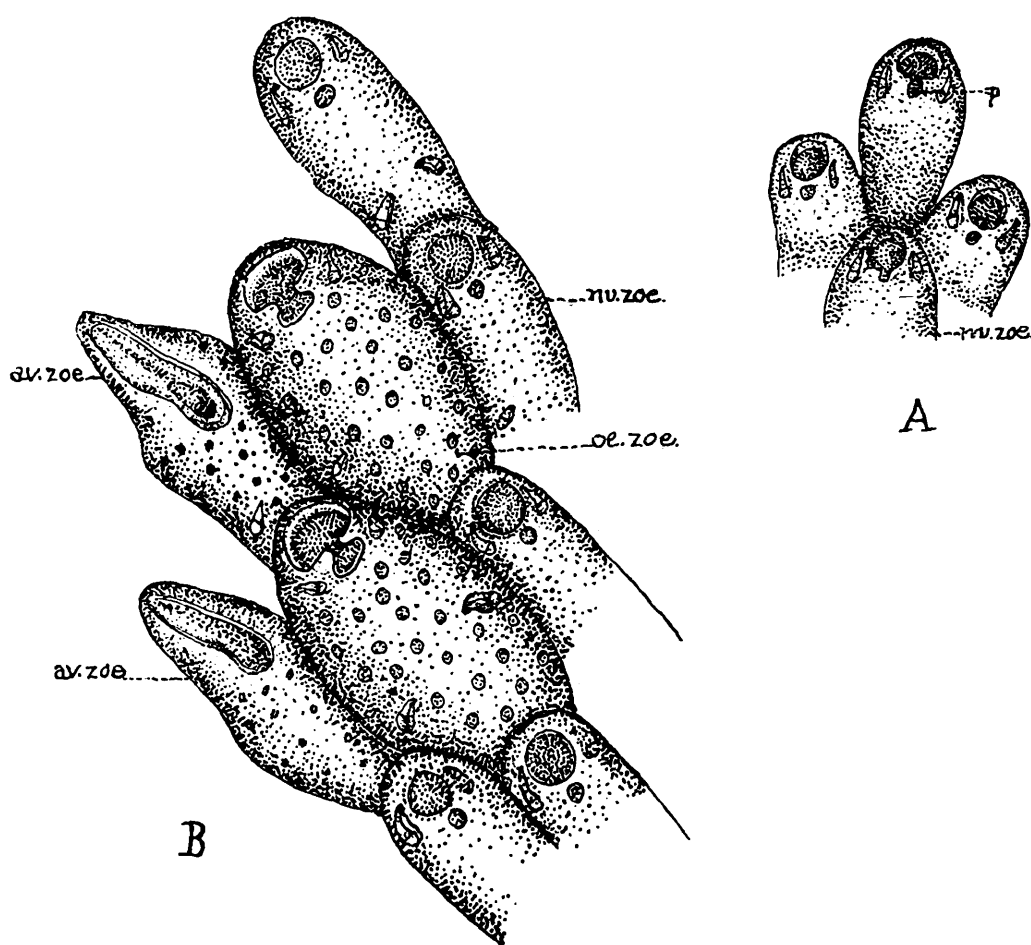


FIG. 11.—*Aedeonella marginata*, sp. nov. × 40.

A. Four young zoëcia in middle portion of a branch.

B. To show the three kinds of zoëcia on the margin of the colony.

At the tips of the branches, the young nutritive zoëcia (fig. 11, A) are more than half immersed although the whole of the outline may be detected while the matrix is thin. Front wall hyaline, non-porous. Orifice round with a deep wide sinus, the upper edges of which soon close to form a large pore (p.). On each side of the pore an avicularium with triangular mandible directed upward. Lower down, somewhat to one side of the median line, another avicularium with mandible directed transversely (B). In older zoëcia avicularia increase in number and with increase in calcification may increase or decrease in size.

Even nutritive zoecia tend to become larger as they approach the margin (B, *nu. zoe.*). A relatively small number of zoecia attain a very large size (B *oe. zoe.*), whose wall becomes highly calcified and porous. These are the reproductive zoecia characteristic of this genus. The outermost row of the margin consists of zoecia which function only as avicularia (*av. zoe.*); mandible directed obliquely upward and outward.

Dredged at 65 fathoms near Mergui Archipelago, station 535 (13°4'30" N., 96°44' E.).

79. *Lagenipora costazii*, Audouin.

Cellepora costazii, Hincks, 1880, p. 411, pl. lv, figs. 11-14.

Found quite commonly, incrusting stems of seaweed: Mangalore, off Carwar and Mulki, at Cheval Paar, Colombo; dredged at 10-15 fathoms at Seven Pagodas, Madras, and at 34 fathoms by the "Investigator" at 6°01' N., 81°16' E.; also dredged off Gopulpore at 28-25 fathoms and Ganjam at 25 fathoms.

80. *Lagenipora tuberculata*, MacGillivray.

Lagenipora tuberculata, MacGillivray, 1882, p. 209, pl. 156, figs. 1, 2.

Identification tentative. Material obtained at two localities growing on coral conglomerate: Laccadives, and dredged at 34 fathoms by the "Investigator" in 6°01' N. and 81°16' E.

81. *Holoporella aperta*, Hincks.

Holoporella aperta, Waters, 1909, p. 161, pl. 18, figs. 20-23.

Dredged at 24-30 fathoms off the Ganjam coast.

82. *Holoporella tridenticulata*, Busk.

Cellepora tridenticulata, Busk, 1884, pt. xxx, vol. x, p. 195, pl. xxix, fig. 5.

Obtained at Cinque Island, Andamans, "Investigator"; also near Puri, Orissa coast.

83. ? *Holoporella mammillata*, Busk.

? *Cellepora mammillata*, Busk, 1854, pt. ii, pl. cxx, figs. 3, 4, 5.

In most points this species agrees with the description given by Busk, but this identification considered somewhat doubtful. Common, found at depths ranging from 15 fathoms to 703 fathoms at eight stations in the Bay of Bengal.

84. *Cupularia canariensis*, Busk.

Cupularia canariensis, Busk, 1859, vol. 7, p. 66, pl. 23, figs. 6-9.

Several colonies of various sizes obtained at the Andamans. The largest colony is about 11 mm. in diameter and 2 mm. high at the apex. The others vary from 8 to 5 mm. in diameter. The

material is dry, but it is thought to have contained living colonies when collected.

CYCLOSTOMATA.

85. *Crisia* sp.

Material consists of several fragments of *Crisia* which contain no ovicells, hence impossible to identify. Obtained off Ganjam coast at 24 to 30 fathoms, also from Gaspar Straits, and from station 152 (11½ miles S. 83° W of Colombo Lt., Ceylon) at 26½ fathoms.

86. *Filisparsa tubulosa*, Busk.

Filisparsa tubulosa, Waters, 1910, p. 235, pl. xxv, figs. 16, 17.

Obtained in Gaspar Straits growing with *F. oculata*.

87. *Idmonea atlantica*, E. Forbes.

Idmonea atlantica, Hincks, 1880, p. 451, pl. lxv, figs. 1-4.

Obtained in Gaspar Straits and at station 47 (off mouth of Godaveri R., Bay of Bengal) in 5-6 fathoms.

88. *Idmonea gracillima*, Busk.

Idmonea gracillima, Ortmann, 1890, p. 60, pl. iv, fig. 26.

Beautiful specimen obtained 4 miles south of Ganjam at 25 fathoms.

89. *Entalophora raripora*, d'Orbigny.

Pustulopora proboscidea, Busk, 1886, pt. 4, vol. xvii, p. 19, pl. lv, fig. 1.

Several colonies obtained at Santapilly, also at station 152 (11½ miles S. 83° W of Colombo Lt.) at 26½ fathoms.

90. *Lichenopora radiata*, Audouin.

Lichenopora radiata, Hincks, 1880, p. 476, pl. lxxviii, figs. 9, 10.

A single colony growing on the inside of a shell obtained by the "Investigator" at station 384 (off C. Negrais, Burma, 16°0' N., 93°37' E.) in 40 fathoms.

91. *Domopora truncata*, Jameson.

Domopora truncata, Hincks, 1880, p. 485, lxxiii, figs. 5-9.

A single specimen growing on a mass of coral conglomerate obtained at entrance to Palk Straits, 3 miles N.N.W of Point Pedro, in 6 to 8 fathoms.

CTENOSTOMATA.

92. *Alcyonidium mytili*, Dalyell.

Alcyonidium mytili, Hincks, 1880, p. 498, pl. lxx, figs. 2, 3.

Obtained at Puri beach, Orissa coast, growing on twigs.

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