

hump is not yet exhausted. Mouth and fore-gut also have now become more spacious than before, and the mucous membrane of the latter exhibits distinct longitudinal folds. Moreover, the fore-gut by this time (eighteenth day) possesses a layer of distinct circular muscle-fibres, which appear to me to be in no way derived from cells of the mesenchyma, but from the enterocœle-cells which lie closely upon the fore-gut. From the mid-gut an anterior portion is constricted off, which becomes the stomach of the adult, but as yet possesses muscular fibres in its wall just as little as does the remainder of the mid-gut. In the later stages also which were examined by me I failed to trace muscle-fibres in stomach and mid-gut, while in the end-gut from the forty-fifth day onwards longitudinal muscle-fibres were distinctly recognizable.

LII.—*Natural History Notes from H.M. Indian Marine Survey Steamer 'Investigator,' Commander R. F. Hoskyn, R.N., commanding.*—Series II., No. 1. *On the Results of Deep-sea Dredging during the Season 1890-91.* By J. WOOD-MASON, Superintendent of the Indian Museum, and Professor of Comparative Anatomy in the Medical College of Bengal, and A. ALCOCK, M.B., Surgeon I.M.S., Surgeon-Naturalist to the Survey.

[Continued from p. 362.]

[Plate XVII.]

Phylum **ECHINODERMA.**

Class **ASTEROIDEA.**

The Asteroidea form a good collection, which we have arranged under twenty-three species, sixteen genera, and eight families. Of these twenty-three forms nine appear to correspond with species described in the 'Challenger' Report, while fourteen seem to be new to science.

Except as regards life-coloration and distribution we have not been able to learn anything very new concerning the Asteroidea of the deep sea. Most of them appear to live, like their shallow-water relatives, upon Mollusca. In the stomachs of some of our specimens the carapaces of Crustacea have been found. The Porcellanasteridæ, so far as our rather limited

observation goes, seem to live, like many Holothurians, on the organic matter to be found in ocean mud.

Several illustrations of the wideness of ocean-range of deep-sea species are furnished by our collection of Asteroidea.

We must here express our indebtedness to Mr. Percy Sladen's very valuable Report on the 'Challenger' Asteroidea, without which indeed we should hardly have ventured upon the examination of our collection.

Order PHANEROZONIA.

Family Archasteridæ.

PARARCHASTER, Sladen.

1. *Pararchaster semisquamatus*, Sladen.

Pararchaster semisquamatus, Sladen, 'Challenger' Asteroidea, p. 7, pl. ii. figs. 1 and 2, pl. iv. figs. 7 and 8.

One specimen from Station 111, 1664 fathoms.

Colour in the fresh state uniform salmon-red.

PONTASTER, Sladen.

2. *Pontaster hispidus*, sp. n.

Near *Pontaster mimicus*, Sladen.

Rays 5. $R = \text{nearly } 7 r$.

Rays elongate, tapering; abactinal surface plane; inter-brachial arcs acute.

Abactinal surface of disk and rays covered with close-set paxillæ of two forms; the majority are small and are surmounted by a few small granules, but a large number on the disk and along the central axis of the ray are larger and are surmounted by numerous small granules surrounding a long central spine.

Marginal plates closely covered with capillary spinelets; the supero-marginals, about 44 in number, are almost confined to the lateral aspect of the ray, are tumid above the general abactinal plane, and are armed each with a long stout spine; the infero-marginals, which are larger than the supero-marginals, alternate with these, and are armed each with a long stout spine, and sometimes with a smaller finer spine below this.

Adambulacral plates with a prominent semicircular furrow, margin bearing about ten widely radiating spinelets, and with a strong actinal boss bearing a long stout spine. Mouth-

plates short, broad, tumid, each plate edged with about seven spinelets, which increase in length from periphery to centre, and armed actinally with about six unequal irregular spinelets.

Actinal interradiar areas small, the plates covered with capillary spinelets; there are one or two inconspicuous multi-valve pedicellariæ in each area. Similar pedicellariæ, but smaller, occur in the interbrachial arcs between the supero- and infero-marginal plates.

Anal aperture subcentral, surrounded by paxillæ with long central spinelets, which form a close palisade.

Papularia compact, well-defined, tumid, each with from 12 to 16 very close-set papulæ.

Madreporiform body small, round, convex, situated close to the margin of the disk, with a single large paxilla to its central side.

Colour in the fresh state uniform pale orange-pink.

Station 106, 1091 fathoms, and Station 108, 1043 fathoms; numerous specimens, of all stages of growth.

DYTASTER, Sladen.

3. *Dytaster exilis*, Sladen.

Dytaster exilis, Sladen, 'Challenger' Asteroidea, p. 65, pl. ii. figs. 3 and 4.

Several specimens from Station 117, 1748 fathoms, and Station 118, 1803 fathoms. This species was also dredged in the year 1888 in the Bay of Bengal in 1924 fathoms.

Colour in the fresh state salmon-pink.

4. *Dytaster anacanthus*, sp. n.

Rays 5. $R=6.25 r$.

Disk small, irregularly inflated; rays long and tapering; interbrachial arcs rather acute.

Abactinal surface densely crowded with paxillæ formed of narrow tabulæ surmounted by close-set granules; those in the centre of the disk and in a narrow band along the middle of each ray are smaller than elsewhere.

The supero-marginal plates, about 45 in number, are entirely vertical and lateral, and are uniformly covered with papilliform granules without any large spines or tubercles. The infero-marginal plates correspond in number and arrangement with the supero-marginals, which are exactly superposed; they are uniformly covered with papilliform granules

and bear medially, except in the peripheral third of the ray, each a long adpressed styliform spine.

Adambulacral plates rather long, each with a furrow-series of six obtuse spinelets, and with a mass of small spinelets, which form often three longitudinal series, actinally. Mouth-plates large, prominent, the suture between each pair widely open; the innermost mouth-spine of each plate much enlarged; actinally each plate is covered with numerous small spinelets in about three longitudinal series.

Actinal interradiar areas small, the plates covered with small papilliform spinelets.

Madreporiform body situated near the margin of the disk and almost entirely concealed by paxillæ.

Anal aperture small, central.

Colour in the fresh state uniform light rose-madder.

Station 117, 1748 fathoms.

PERSEPHONASTER, gen. nov.

Allied to *Plutonaster*, Sladen.

Disk rather large, flat; rays rigid.

Marginal plates more or less covered with papilliform spinelets, and bearing each one or more strong rigid spines; the supero-marginals, which form a broad massive border on the abactinal surface of the ray, directly superposed on the infero-marginals, plate to plate.

Abactinal area with close-set paxillæ, which on the rays are arranged in transverse rows without any definite median series; papulæ distributed everywhere between the paxillæ.

Actinal interradiar areas large, with intermediate plates extending far along the ray.

The adambulacral plates bear a furrow-series of obtuse, compressed, slightly radiating spinelets, and actinally two or more longitudinal series of papilliform spinelets.

Madreporiform body small, rather concealed, situated distant from the margin of the disk.

Anal aperture subcentral.

No pedicellariæ.

5. *Persephonaster croceus*, sp. n.

Plutonaster, sp., Wood-Mason and Alcock, Ann. & Mag. Nat. Hist. 1891, vii. p. 13.

Rays 5. $R=4.5 r$.

Rays moderately long, rigid.

Abactinal surface of disk and rays with close-set spinose paxillæ, which become small and crowded towards the subcentral anal aperture; those of the rays are somewhat obscurely arranged in transverse series.

The whole abactinal surface is perforated with close-set papulæ. The supero-marginal plates are 31 in number and are directly superposed on the infero-marginals, plate to plate; each plate is coarsely granular in the middle and covered near the margin with capillary spinules, and bears two rigid spines, one at the abactinal, the other near the actinal end, the former being the smaller and often bifid. The infero-marginals correspond, plate to plate, with the supero-marginals; they are uniformly covered with papilliform granules, which are largest in the middle of the plate, and each bears near its abactinal end a stout rigid spine, beneath which is an obliquely vertical row of three or four slender movable spines.

Adambulacral plates with a slightly convex furrow-margin, armed with a comb of six or seven longish compressed spines; actinally there are two longitudinal series of small, inflated, longitudinally-grooved (barleycorn-shaped) spines, four in each series. Mouth-plates small, tumid, with close suture; each plate with a furrow-series of about seven spines, the most adcentral of which is of enormous relative size, and with two longitudinal series of close-set papilliform spinelets on the actinal surface.

Actinal interradi al areas large, the intermediate plates extending halfway along the rays; each plate closely covered with "barleycorn" spines.

Madreporiform body small and inconspicuous, situated about two diameters from the margin of the disk.

Ambulacral groove extremely broad and open; tube-feet large, conical.

Colour in the fresh state olive-yellow, marginal plates pink, tube-feet red.

Station 109, 738 fathoms.

6. *Persephonaster rhodopeplus*, sp. n.

Rays 5. $R=3.5 r$.

Rays rather short, rigid.

Abactinal surface of disk and rays covered with very close-set tabulate paxillæ surmounted by numerous flat-topped granules; the paxillæ are very small and crowded towards the subcentral anal aperture; those of the rays are arranged

in transverse curved rows. The whole abactinal surface perforated with close-set papulæ.

The supero-marginal plates number about 28, and are directly superposed on the infero-marginals, plate to plate; they are covered with granules, which are largest in the middle of the plate, and are armed with rigid spines—those in the interradia with one, those along the rays with one, two, or three in a vertical series. The infero-marginals correspond, plate to plate, with the supero-marginals; they are almost smooth in the middle and covered with papilliform granules round the edge, and are armed with from two to four stout adpressed spines, situated in a median vertical series, of which the most abactinal is the largest.

Adambulacral plates with a strongly convex furrow-margin which is armed with six or seven short, truncated, longitudinally-grooved spinelets; the actinal surface with two longitudinal series of similar spinelets—about five in each series; these spinelets are almost clavate sometimes. Mouth-plates small, very narrow, with widely open suture; each plate with a furrow-series of about ten small spinelets, the most adcentral of which is much enlarged; the actinal surface with eight or nine truncated, longitudinally-grooved spinelets in a single longitudinal series.

Actinal interradii areas large, the intermediate plates extending much more than halfway along the ray; in the interradii areas each plate has a clump of from six to eight truncated or clavate grooved spinelets; along the rays the intercalated plates have usually two longitudinal series of similar spinelets—about four in each series.

Madreporiform body small and inconspicuous or concealed, situated about midway between the centre and the margin of the disk.

Ambulacral groove very broad and open; tube-feet large, conical.

Colour in the fresh state "crushed-strawberry," sometimes with a golden suffusion; marginal plates pink, tube-feet blood-red.

Stations 107 and 109, 738 fathoms.

PSEUDARCHASTER, Sladen.

7. *Pseudarchaster mosaicus*, sp. n.

Near *P. tessellatus*, Sladen.

Rays 5. $R=4r$.

Disk large; rays tapering; interbrachial arcs wide, rounded.

Abactinal area covered with hexagonal tabulate paxillæ, which in the centre and in the interradian areas of the disk are much smaller than elsewhere, and which on the rays are arranged in longitudinal rows, those of the central row being of predominant size. The papulæ surround the paxillæ.

The marginal plates are short and broad. The supero-marginals, about 42 in number, occupy on each side more than one third of the abactinal surface of the ray, and are uniformly covered with large granules without other armature. The infero-marginals correspond in number, size, and disposition with the supero-marginals, plate to plate, and are uniformly covered with spine-like granules, of which two or three in a longitudinal row near the suture with the supero-marginal plate are enlarged.

Ambulacral plates with a furrow-comb of five long radiating spines, and actually two irregular longitudinal series of small spines, of which one in each series is much enlarged, except in the distal half of the ray, where one in the outer series only is enlarged; outside these is a third irregular row of very minute spinelets. Mouth-plates small and inconspicuous, each with a furrow-series of six equal moderate-sized spinelets, and with numerous irregularly arranged spinelets on the actinal surface, one of these being much enlarged.

Actinal interradian areas large, the intermediate plates extending to about the tenth infero-marginal; they are arranged in columns, and their surface is covered with spines, of which one in each plate is much enlarged.

Anal aperture small, subcentral.

Madreporiform body very small, situated midway between the margin and the centre of the disk.

Colour in the fresh state uniform pink.

Station 115, 188 to 220 fathoms.

Family Porcellanasteridæ.

PORCELLANASTER, Wyville-Thomson.

8. *Porcellanaster cæruleus*, Wyville-Thomson.

Porcellanaster cæruleus, Wyville-Thomson, Voy. Chall. Atlantic, vol. i. p. 378, figs. 97 and 98; Sladen, 'Challenger' Asteroidea, pp. 134-138, pl. xx.

One specimen from Station 113, 683 fathoms.

Colours in the fresh state:—Abactinal membrane dull blue, epiproctal tube and marginal plates light orange-pink, tube-feet and cribriform organs bright orange.

9. *Porcellanaster*, sp. prox. *cæruleus*, Wy.-Thoms.

Numerous small specimens from Station 111, 1664 fathoms, and Station 117, 1748 fathoms, may perhaps be the young of *P. cæruleus*. The epiproctal tube is of great length, the abactinal membrane, which is fragile, has the spinelets confined to a very narrow band in the middle of each interradi- al space, and the supero-marginal plates, though strongly bossed, are unarmed.

STYRACASTER, Sladen.

10. *Styracaster horridus*, Sladen.

Styracaster horridus, Sladen, 'Challenger' Asteroidea, pp. 150-152, pl. xxiii. figs. 5-7, pl. xxvii. figs. 17-20.

Specimens from Stations 117, 1748 fathoms, and 118, 1803 fathoms.

In our specimens only a few of the adambulacral plates, near the adcentral end of the ray, have four spines in the furrow-series, the majority have three, and the most distal only two. Specimens with the stomach distended show no epiproctal elevation; but those with the stomach empty have a distinct elevated cone, in one case bilobed.

Colour in the fresh state pale yellowish pink.

11. *Styracaster clavipes*, sp. n.

Agrees with *S. armatus* very closely, but differs in the following particulars:—There are five cribriform organs in each interbranchial arc; the infero-marginal plates are not much longer than broad; the terminal plate of the ray is markedly inflated; the median spines of the coalescent supero-marginal rays are comparatively short and blunt.

In general "habit" it is well distinct from *S. armatus*, Sladen, of which species there are in the 'Investigator' collection two fine specimens dredged in 1888, in 1840 to 1924 fathoms, in the Bay of Bengal.

Colour in the fresh state pale yellowish pink.

One specimen from Station 117, 1748 fathoms.

HYPHALASTER, Sladen.

12. *Hyphalaster tara*, sp. n.

Rays 5. $R=2r$.

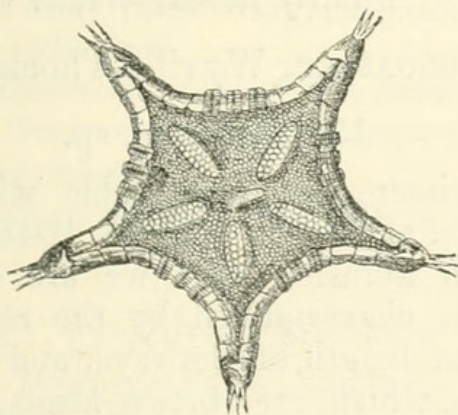
Rays short, squat, slightly inflated terminally. Disk large, strongly inflated, with a short, tapering, epiproctal tube.

Interbranchial arcs extremely wide, each with three large papillar cribriform organs.

Abactinal area covered with a toughish membrane, beset with numerous paxillæ of two kinds. Those in the middle of the radial areas of the disk are large and are surmounted by ten to fifteen or more granular spinelets; they extend in a tapering band from near the base of the epiproctal tube to near the base of the ray, and the five tapering bands show as a conspicuous rosette on the disk. The paxillæ elsewhere are small and are surmounted by but three or four spinelets. There are apparently no papulæ.

Marginal plates highly granular, unarmed, forming a perpendicular wall. Supero-marginals 6, excluding the terminal; they hardly meet in the middle line along the ray; the last plate, like the last infero-marginal, is a very small inconspicuous triangular scale, wedged in almost beneath the large upturned terminal plate; this last forms a tumid boss armed with four large acute spines. The infero-marginals correspond in number and arrangement with the supero-marginals, but are rather smaller.

Fig. 11.



Hyphalaster tara, natural size.

Adambulacral plates large, each with a furrow-series of five or six compressed lanceolate spinelets arranged in a fan-like comb. Mouth-plates large, tumid actinally, the suture widely open; the margin of each bears seven compressed lanceolate spinelets, of which the adoral one is much enlarged.

Actinal interradiar areas extensive, with broad scale-like imbricating plates arranged in about nine columns parallel to the radial axis; some of the plates have small deciduous spikelets.

Ambulacral furrows broad.

Madreporiform body marginal.

Colour in the fresh state white, tube-feet pink.

Station 110, 1997 fathoms; Station 117, 1748 fathoms.

Family **Pentagonasteridæ**.

PARAGONASTER, Sladen.

13. *Paragonaster*, sp. prox. *ctenipes*, Sladen.

Young and rather mutilated examples from Station 117, 1748 fathoms.

Colour in the fresh state pale yellowish pink.

14. *Paragonaster*, sp.

A remarkable species in a mutilated condition was taken at Station 117, 1748 fathoms.

It is characterized by having the papulæ aggregated into distinctly circumscribed inflated papularia, one at the base of each ray. The paxillæ over the papularia are singularly large and prominent.

Order **CRYPTOZONIA**.Family **Zoroasteridæ**.

ZOROASTER, Wyville-Thomson.

15. *Zoroaster*, sp.

A single specimen, not identifiable with any described species, was taken at Station 108, in 1043 fathoms. It has suffered so much abrasion that we are unwilling now to describe it. It is characterized by the relative smallness of the disk and great length of the rays, and by its very numerous pedicellariæ, which are of two kinds, the smaller ones occurring in clusters and bunches.

In the fresh state it was coloured orange-pink, and was covered with a thick coat of mucus.

Family **Asteriadæ**.

ASTERIAS, Linn.

16. *Asterias mazophorus*, sp. n.

Disk small, circular, marked off from the rays by a deep transverse groove. Rays long, semicylindrical, much constricted laterally at the base; their abactinal surface with small plates in longitudinal and transverse rows, the spaces between the plates being filled with papulæ in oval plots of

five to nine. The plates are covered with membrane, widely placed on which are beautiful forceps-like pedicellariæ. Near the middle of each plate is a long, stout, acute, movable spine, the base of which is buried in a large, fleshy, papillose eminence.

Marginal plates distinct, clothed and armed like the abactinals, and separated by similar groups of papulæ.

Actinal aspect of the rays almost completely occupied by the ambulacral groove, a single series of very narrow distant plates intervening between the adambulacrals and the infero-marginals. The intervals between these intermediate plates are filled each with a large papula, round which is a ring of forceps-like pedicellariæ.

Adambulacral plates very small, each armed with two spines which form a double palisade along the margin of the wide ambulacral groove. Inside this, *i. e.* within the ambulacral groove, is a more or less regular row of forceps-like pedicellariæ.

The mouth-plates are recognizable by their longer furrow-spines. In the angle of each extremely narrow interbranchial arc, behind the mouth-plate, is a crowd of pedicellariæ.

Madreporiform body rather large, radially striated.

Anal aperture indistinct.

Tube-feet quadriserial, ending in a sucker.

Colour in the fresh state deep orange-yellow, with large chestnut-brown blotches.

One specimen from Station 115, 188 to 220 fathoms.

Family Pterasteridæ.

MARSIPASTER, Sladen.

17. *Marsipaster hirsutus*, Sladen.

Marsipaster hirsutus, Sladen, 'Challenger' Asteroidea, p. 487, pl. lxxviii. figs. 3 and 4, pl. lxxix. figs. 4-6.

One small specimen with ova in the nidamental cavity.

Colour in the fresh state transparent hyaline grey.

Station 110, 1997 fathoms.

HYMENASTER, Wyville-Thomson.

18. *Hymenaster nobilis*, Wyville-Thomson.

Hymenaster nobilis, Wyv.-Thoms. Journ. Linn. Soc., Zool. vol. xiii. p. 73, fig. 11; Sladen, 'Challenger' Asteroidea, p. 495, pl. lxxxvii. figs. 1-3.

A magnificent specimen, with a major diameter of nearly 8 inches, from Station 117, 1748 fathoms.

Colour in the fresh state plum-purple.

Family Echinasteridæ.

DICTYASTER, gen. nov.

Disk large, and flat like the short rays.

Abactinal surface covered with tough membrane, beneath which are narrow plates bearing stout spinelets, and forming a wide-meshed irregular network, the meshes of which are occupied by large groups of papulæ.

Marginal plates, especially the supero-marginals, small and inconspicuous, the infero-marginals each with a short comb of stout spines; the intervals between the plates with groups of papulæ.

Actinal interradiar areas large, covered with a smooth thick membrane, beneath which is a reticulum of irregular plates.

Adambulacral armature forming a double palisade along the furrow. Tube-feet in a double row, their tips ending in a sucker.

Madreporiform body small. Anal aperture subcentral. No pedicellariæ.

19. *Dictyaster xenophilus*, sp. n.

Plectaster, sp., Wood-Mason and Alcock, Ann. & Mag. Nat. Hist. Jan. 1891, p. 14.

Rays 5. $R = 2.5 r$.

The whole animal invested in a thick coriaceous membrane.

Disk and rays flat and broad; interbrachial arcs wide.

Abactinal surface with narrow plates, bearing large coarse spines solitary or in rows of two or three, and forming a wide-meshed reticulum, the meshes of which are occupied by papulæ in large crowded groups.

Infero-marginal plates alone at all distinct, not in contact one with another; each bears a hinged comb of from three to five large coarse spines along its actinal margin.

Adambulacral plates covered by the general thick coriaceous investment; the narrow ambulacral groove is bounded on each side by a double series of stout palisade-like spines, those in the outer series being about half as numerous but about twice as big as those in the inner series. Mouth-plates hardly differentiated.

Actinal interrarial areas large, with an irregular network of unequal plates beneath the smooth coriaceous membrane. A symbiotic Chætopod is often found on the interrarial areas on which also it often lays its eggs.

Madreporiform body small, somewhat sunken, situated almost in the centre of an interbrachial arc.

Anal aperture small, subcentral.

Tube-feet in a double row, their tips ending in a sucker.

Colour in the fresh state chestnut-brown.

From Station 115, 188 to 220 fathoms.

This remarkable species has been frequently found by us in the Andaman Sea at about 250 fathoms.

Family Brisingidæ.

BRISINGA, Asbjornsen.

20. *Brisinga insularum*, sp. n.

Allied to *B. coronata*, Sars.

Rays 13, long, stout, with ovarian regions much inflated, and the transverse calcareous ridges well developed. Disk comparatively large.

Ambulacral tube-feet separated by a pair of horizontal spines.

Colour in the fresh state bright cinnabar-red.

Station 108, 1043 fathoms.

21. *Brisinga bengalensis*, sp. n.

Rays 14, long, slender, with hardly conspicuous ovarian inflations, and little developed transverse calcareous ridges. Disk small, margin strongly bevelled, depressed abactinally.

Ambulacral tube-feet separated by a pair of horizontal spines. Mouth-spines very long and broad, dagger-shaped, closely felted with pedicellariæ.

Colour in the fresh state bright cinnabar-red.

Station 112, 561 fathoms.

22. *Brisinga andamanica*, sp. n.

Rays 15, long, slender, with hardly conspicuous ovarian inflations, and transverse calcareous ridges little developed. Disk of moderate size.

Ambulacral tube-feet separated by a pair of horizontal

spines. Mouth-spines of moderate length, narrow, closely felted with pedicellariæ.

Colour in the fresh state bright cinnabar-red.

Station 116, 405 fathoms.

FREYELLA, Perrier.

23. *Freyella benthophila*, Sladen.

Freyella benthophila, Sladen, 'Challenger' Asteroidea, p. 641, pl. cxi. figs. 5-8.

Specimens from Stations 110, 1997 fathoms, and 118, 1803 fathoms.

Colour in the fresh state bright cinnabar-red.

This species was taken in 1888 in the Bay of Bengal, in 1520 and 1590 fathoms.

Class ECHINOIDEA.

Order CIDAROIDA.

Family Cidaridæ.

1. POROCIDARIS, Desor.

A small specimen with a test of 8 millim. diameter from Station 116, 405 fathoms.

Colour : madder, with white points.

Order DIADEMATOIDA.

Family Echinothuridæ.

2. PHORMOSOMA, Wyville-Thomson.

Scores of fine specimens of a large species were taken in the Andaman Sea at Stations 115 and 116, in 188 to 405 fathoms.

Family Arbaciidæ.

PODOCIDARIS, A. Agassiz.

3. *Podocidaris ?prionigera*, A. Agassiz.

Porocidaris prionigera, A. Agassiz, 'Challenger' Echinoidea, p. 59, pl. xxxiv. figs. 14 and 15.

Specimens from Station 112, 561 fathoms.

The same species was dredged in the Bay of Bengal at 1590 fathoms in the year 1888.

Family Temnopleuridæ (?).

PRONECHINUS, A. Agassiz.

4. *Prionechinus Agassizii*, sp. n.

This species differs from *Prionechinus sagittiger* in the following particulars:—The test is thick; there are five complete pairs of buccal tentacles; and the ambulacral plates have three pairs of pores and one primary tubercle to each plate. The pairs of pores are in one simple vertical series in triplets concentric with their tubercle, so as to be slightly wavy, especially below the ambitus, where in the region of the actinostome they are very distinctly zigzag.

Both ambulacra and interambulacra are made up of two rows of simple plates, those of the ambulacra being of the same height, but only between one half and one third the breadth of those of the interambulacra.

The median interambulacral grooves and the slightly depressed poriferous zones divide the test into segments like those of a peeled orange.

Diameter of test 13·8 millim., of actinostome 6·5 millim., of periproct 3 millim.

From Station 111, 1644 fathoms.

Two fine specimens were dredged in the Bay of Bengal, at 1840 fathoms, in the year 1888.

Order SPATANGOIDA.

Family Spatangidæ.

HOMOLAMPAS, A. Agassiz.

5. *Homolampas glauca*, sp. n. (Pl. XVII.)

Differs from *Homolampas fulva*, A. Agassiz, (1) in being more depressed, (2) in having the posterior end of the test truncate and unnotched, and (3) in the narrower ventral plastron.

Colour in the fresh state brownish green.

Four specimens from Station 111, 1644 fathoms, the largest measuring 93 millim. in length.

Class **HOLOTHUROIDEA.**

Of Holothurians very numerous specimens of twelve species and nine genera were obtained, and they have in large part been identified by Surgeon I. H. Tull Walsh, I.M.S., who has given a list of most of the 'Investigator' deep-sea Holothuroidea in the Journ. As. Soc. Beng. vol. lx. pt. ii., 1891, pp. 197-204, to which we refer for names of species and notices of two new genera.

In the Andaman Sea *Benthodytes* appears to live in large colonies at moderate depths; and besides *Benthodytes*, *Pannychia*, *Eupyrigus*, and a new type of Deimatidæ, according to Mr. Walsh, were found.

On the *Globigerina*-ooze of the greater depths of the Bay of Bengal Holothurians, especially of the bathybial order Elasipoda, seem to find an optimum, and specimens of the following were trawled:—*Peniagone* (1803 fathoms), *Deima*, two species (1644 to 1803 fathoms), *Orphnurgus* (561 fathoms), *Euphronides* (1803 fathoms), *Benthodytes*, two species (1748 to 1803 fathoms), and *Apodogaster* (561 fathoms), the last being a new genus of the Psychropotidæ established by Mr. Walsh.

In the Laccadive Sea numerous Holothurians were taken between 738 and 1091 fathoms—*Deima*, *Benthodytes*, and *Eupyrigus*.

Class **OPHIUROIDEA.**

Of this class numerous specimens, of thirteen species and seven genera, were collected.

In the Andaman infra-littoral down to 400 fathoms, just as in the Andaman littoral zone, brittle-stars have been found to be in this, as in previous seasons, very numerous, especially where the bottom contains many *Globigerina*-shells and much coral-detritus. A beautiful pink *Ophiothrix* is very common here, the swabs often coming up completely encrusted with it.

In the opener parts of the Bay of Bengal, where, along with increasing depth and distance from land, the bottom comes to be made up largely of the shells of Foraminifera, a good many Ophiuroids were taken, up to the greatest depth in which the trawl was worked.

In the Andaman Sea, besides the multitude of *Ophiothrix*, were found *Ophioglypha* (405 fathoms) and a beautiful species of *Ophiernus* with disk of deep purple and rays of bright scarlet (683 fathoms).

In the Bay of Bengal four species of *Ophioglypha* were taken in 561 to 1803 fathoms, two species of *Ophiomusium* in 1748 to 1997 fathoms, a species of *Ophiomastus* in 1997 fathoms, and two species of *Ophiacantha* in 1644 to 1803 fathoms.

In the Laccadive Sea brittle-stars were seldom seen ; two good specimens of the same beautiful purple and scarlet *Ophiernus* as that recorded from the Andaman Sea were taken in 1043 fathoms, and a single small specimen of a species of *Amphiura* in 1091 fathoms.

Class CRINOIDEA.

On muddy bottoms in the Andaman Sea some small and rather damaged specimens of two species of Comatulæ were trawled. These were *Eudiocrinus*, from 922 fathoms, and *Antedon*—a ten-armed species—from 188 to 220 fathoms.

Phylum MOLLUSCA.

Branch A. GLOSSOPHORA.

Class GASTROPODA.

Family Naticidæ.

1. *Sigaretus*, sp.

Numerous specimens were found at Station 119, in 95 fathoms, and a few at Station 120, in 240 fathoms. This species is characteristic of the infra-littoral of the Bay of Bengal at and near the 100-fathom line from the Mahánadi to the Kistna. The operculum is without a basal prolongation.

2. *Natica* (*Naticina*), sp.

Specimens were met with in the Andaman Sea at 405 fathoms, in the Bay of Bengal in 240 to 276 fathoms, and in the Laccadive Sea at 738 fathoms. This species has twice been found in the stomach of a starfish.

3. *Natica*, sp.

Three dead shells from the Andaman Sea, 683 fathoms.

Family Trochidæ.

4. *Solariella metallica*, sp. n.

A brilliantly nacreous species, ornamented with two spiral rows of conical tubercles and four smooth carinæ on the base, exclusive of a faintly granulated one which bounds the umbilicus. From 738 fathoms in the Gulf of Manaar (Station 109). The glistening metallic lustre of the whole exterior is largely though not entirely due to the erosion of the delicate external layer of the shell.

Fig. 12.



Solariella metallica.—*a*, from the front; *b*, from the base. Natural size.

Family Strombidæ.

5. *Rostellaria delicatula*, Nevill.

Rostellaria delicatula, Nevill, Journ. As. Soc. Beng. vol. l. (1881) pt. 2, p. 262; Wood-Mason and Alcock, Ann. & Mag. Nat. Hist. (6) vii. p. 16.

Many specimens in various stages of growth from Station 119, 95 fathoms.

This form, already noticed to be characteristic of the Bay of Bengal infra-littoral at and near the 100-fathom contour from Arrakan to the Godávári, is now found off the Kistna Delta, about seventy miles further south.

Family Pleurotomidæ.

6. *Pleurotoma symbiotes*, sp. n.

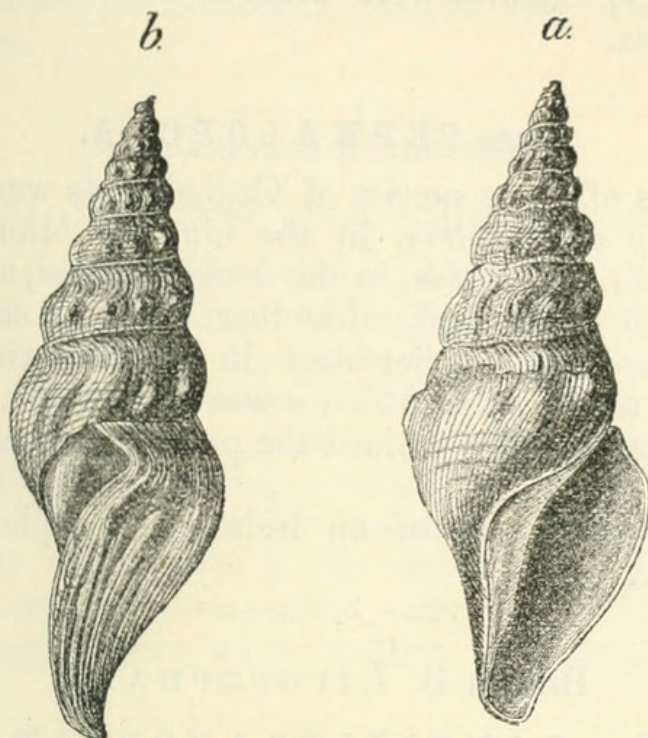
Two living specimens from the Laccadive Sea, 1043 fathoms (Station 108).

They were encrusted all over with an *Epizoanthus*.

The shell is remarkable for its peculiar glistening white

outer layer, with which is most beautifully contrasted the pale cinnamon interior.

Fig. 13.



Pleurotoma symbiotes.—*a*, from in front; *b*, from the side. Natural size.

Dead and eroded shells of four species of Pleurotomids were taken at the following stations:—112, 561 fathoms; 113, 683 fathoms; 115, 188 to 220 fathoms.

Family Pterotracheidæ.

7. *Carinaria*, sp.

At Station 118, 1803 fathoms. Probably from the surface.

Family Pleurobranchidæ.

8. *Pleurobranchus*, sp.

At Station 116, in 405 fathoms, a species coloured dark purple.

Family Pleurophyllidiidæ.

9. *Pleurophyllidia*, sp.

At Station 120, 240 to 276 fathoms.

Class **SCAPHOPODA.**

Dead shells of two species of (10) *Dentalium* and of a species of (11) *Cadulus* were dredged at Station 113 in the Andaman Sea.

Class **CEPHALOPODA.**

Specimens of three species of Cephalopods were obtained, namely (12) *Cirroteuthis*, in the Gulf of Manaar, at 738 fathoms; (13) *Iniotheuthis*, in the Andaman Sea, at 188 to 120 fathoms; and (14) a *Loligo*-like form from the same station.

The *Cirroteuthis* was jet-black in colour during life, and imparted to the spirit in which it was preserved a purple hue, which has permanently stained the paper label accompanying the animal.

The *Iniotheuthis* was of an iridescent purple and green colour in life.

Branch B. **LIPOCEPHALA.**Class **LAMELLIBRANCHIATA.**Family **Pectinidæ.**15. *Amussium*, sp.

Specimens of *Amussium* were obtained in the Andaman Sea at 683 and 922 fathoms, in the Bay of Bengal at 561, 1748, and 1803 fathoms, and in the Laccadive Sea at 738 fathoms. They appear to belong to four species.

Family **Arcidæ.**16. *Arca* (*Barbatia*), sp. conf. *pteroessa*, Smith, or *ectobarbata*, Dall.

Five specimens from Station 111, 1644 fathoms.

17. *Limopsis*, sp.

Two species were dredged, one in the Andaman Sea in 683 fathoms, the other in 1043 fathoms in the Laccadive Sea.

Family **Ledidæ.**18. *Malletia*, cf. *arrouana*, Smith.

From the Laccadive Sea at 1091 fathoms.

Family Cuspidariidæ.

19. *Cuspidaria*, sp.

Four species, all from the Andaman Sea between 188 and 405 fathoms.

Family Verticordiidæ.

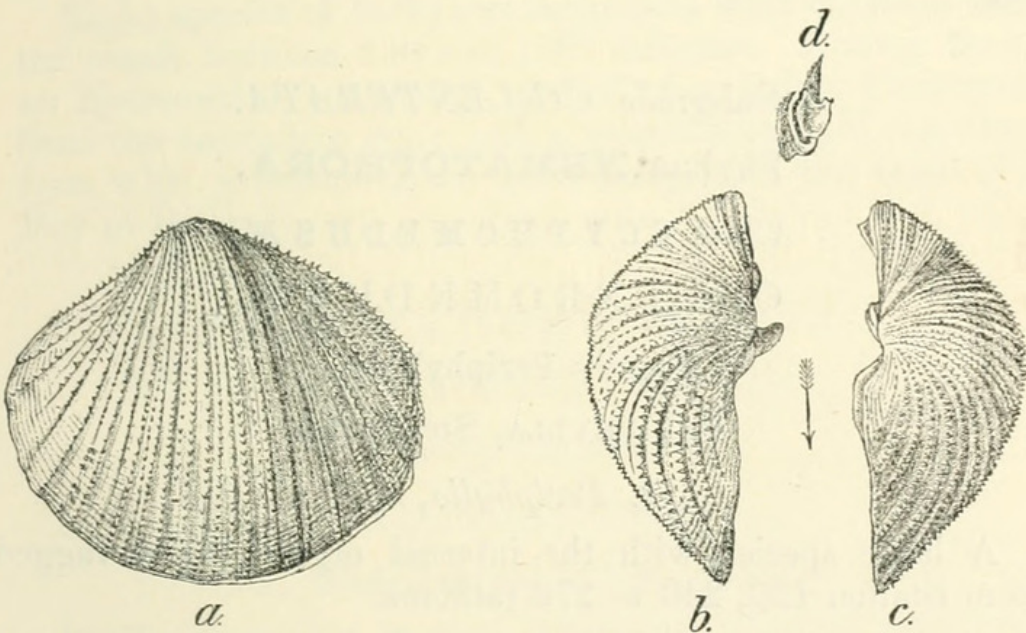
20. *Verticordia* (*Euciroa*) *eburnea*, sp. n.

Allied to *Euciroa elegantissima*, Dall.

The shell in the dry state is of a beautiful ivory-white externally, discoloured slightly at the ventral margin by the epidermis; internally it rivals *Trigonia* in its pearly lustre.

The external surface is traversed from beak to ventral margin with numerous ridges which bear sharp fluted conical spinelets. These ridges are best and most regularly developed about the middle of the shell, being few and wide apart and ventrally incomplete anteriorly, while posteriorly they are irregularly crowded together. The intervals between

Fig. 14.



Verticordia (*Euciroa*) *eburnea*.—*a*, from the left side; *b*, dorsal view of the right valve; *c*, the same of the left valve; *d*, ossicle still attached to the ligament of the right valve. All natural size.

the ridges are finely granulated. The left valve is slightly smaller than the right, into which it fits ventrally, and has only one tooth—a posterior lateral. The right valve has a posterior lateral tooth, which is anterior to that of the opposite

valve, and an anterior tooth in the form of a broad and stout-based projecting massive hook, which is received into a notch of the left valve lying beneath the umbo between the ligamentary fossa and the lunule. Except for a mere film joining the valves externally in the usual position the ligament is internal. A stout, convex, posteriorly-bifid ossicle connects the ligaments of the valves with one another.

Most striking is the curious lunule, which suggests in-turned ears.

A fine living specimen from Station 115, 188 to 220 fathoms, measuring in length 37 millim., in height 33·2 millim., and in thickness 26·8 millim.

21. *Verticordia*, sp.

From the Bay of Bengal, in 1997 fathoms.

Family Tellinidæ.

22. *Tellina*, sp.

Two species were dredged, one from the Bay of Bengal at 561 fathoms, the other from 922 fathoms in the Andaman Sea.

Subgrade CŒLEENTERATA.

Phylum NEMATOPHORA.

Class SCYPHOMEDUSÆ.

Order PEROMEDUSÆ.

Family Periphyllidæ.

PERIPHYLLA, Steenstrup.

1. *Periphylla*, sp.

A large species, with the internal organs rather ragged, from Station 120, 240 to 276 fathoms.

Order DISCOMEDUSÆ.

Family Ephyridæ (COLLASPIDÆ).

ATOLLA, Hæckel.

2. *Atolla Wyvillii*, Hæckel.

Atolla Wyvillii, Hæckel, 'Challenger' Deep-sea Medusæ, pp. 113-123, pl. xxix.

Two specimens from Station 116, 405 fathoms, and one from Station 120, 240 to 276 fathoms.

Class **ANTHOZOA.**

Subclass **ALCYONIOMORPHA.**

Order **PENNATULIDA.**

At Station 115, 188 to 220 fathoms, a fine specimen of a *Pennatula* was obtained; it is of a remarkable rich orange colour, the pigment being insoluble in alcohol.

At the same Station was dredged a large specimen of an *Umbellula* near to *U. Carpenteri*, Kölliker.

At Station 118, in 1803 fathoms, some small specimens of an *Umbellula* of a bright pink colour occurred.

Subclass **ACTINIOMORPHA.**

Order **ACTINIARIA.**

Family **Actinidæ.**

Eight species of bathybial Actiniaria were obtained during the season between 240 and 1997 fathoms. Among them is an *Epizoanthus* encrusting a shell of a living Pleurotomid, from the Laccadive Sea; and a remarkable rigid cup-shaped form with a non-retractile peristome, from the mud of the Bay of Bengal.

Order **MADREPORARIA.**

MADREPORARIA APOROSA.

Family **Turbinolidæ.**

FLABELLUM, Lesson.

1. *Flabellum japonicum*, Moseley.

Flabellum japonicum, Moseley, 'Challenger' Deep-sea Madreporaria, p. 168, pl. vii. figs. 3, 3 a, pl. xvi. fig. 12.

A series of ten specimens (five living and five dead)—the smallest of which measures $\cdot 95$ by $\cdot 85$ of an inch, the largest 3 by 2.25 inches in the diameters of the calicular orifice—was taken at Station 109, 738 fathoms.

In the smaller specimens the corallum is wide and shallow, with the primary and secondary costæ well marked, the columella abundant and formed of contorted fascicles, the fifth

cycle of septa incomplete and inconspicuous, and the pedicle very prominent.

In the larger specimens the calicle is deep and more compressed, the primary and secondary costæ are inconspicuous, while in the other cycles in place of costæ there are shallow furrows, the columella is a small smooth dense plug in the very bottom of the calicle, the fifth cycle of septa is complete, and the pedicle is a small obtuse point.

The difference between the two extremes is so marked that, but for the possession of a fairly well-graded series, it might fairly have been regarded as specific. The inside of the dry corallum is, like the soft tissues of the polyp, of a dark madder-colour.

2. *Flabellum laciniatum*, Philippi.

Phyllodes laciniatum, Philippi, Neues Jahrb. für Mineral. &c., 1841, pp. 663 and 664, pl. xi. B. fig. 2.

Flabellum laciniatum, Edw. & H., Ann. Sci. Nat. (3) ix. p. 273; Hist. Nat. Corall. ii. p. 92.

Flabellum laciniatum, Seguenza, Mem. Ac. Torin. (ii.) xxi. p. 485, tav. x. fig. 7.

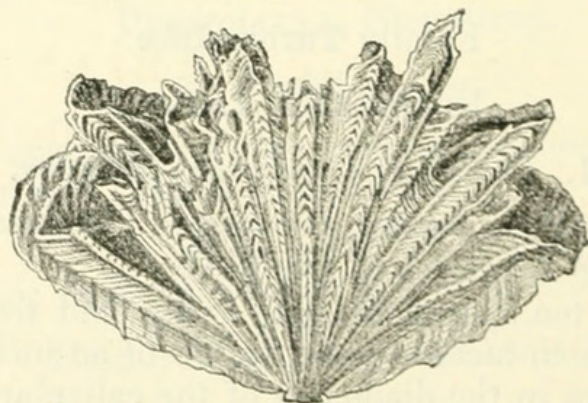
? *Flabellum laciniatum*, Duncan, Proc. Roy. Soc. xviii. p. 293; id. Trans. Zool. Soc. viii. p. 323, pl. xxxix. figs. 11, 14-18.

? *Flabellum laciniatum*, Lindström, Svensk. Ak. Handl. xiv. ii. p. 12.

A single specimen, in very fair preservation, from Station 116, 405 fathoms, which we name with some confidence from Philippi's description.

We are not able, however, to identify it with Prof. Martin Duncan's figures, which appear to represent young and therefore not unequivocally determinable forms of *Flabellum*.

Fig. 15.



Flabellum laciniatum, Phil., natural size.

We agree with Prof. Moseley ('Challenger' Deep-sea Madreporaria, p. 170) in considering that his *Flabellum ala-*

bastrum is specifically quite distinct from *Flabellum laciniatum*. In the latter the calicle is more wedge-shaped, not laterally compressed in the middle, and less conspicuously pedunculate, and its margin is much more deeply indentated between the septa; the columella is a mere rudiment in the bottom of the calicle, and the lateral costæ are much more nearly horizontal and are extremely prominent, forming with their corresponding septa conspicuous lateral wings. The dry corallum, like the living polyp, is of a dark madder-colour.

Our specimen measures about 2 inches in the major and 1·2 in the minor diameter of the calicular orifice.

Phylum **PORIFERA.**

Class **SILICOSPONGIÆ.**

In the Andaman Sea, Station 115, 188 to 220 fathoms, proved a harvest-field for Sponges, as for Fishes, Crustaceans, and Echinoderms. Here a large number of *Hexactinellida* was obtained, including numerous huge specimens, over two feet in length, of a *Semperella*, a large *Pheronema*, and two species of *Hyalonema*.

The depths of the Bay of Bengal yielded many Hexactinellid forms, among which we recognize (1) an Asconematoid forming a thin-walled, shallow, broad-lipped cup, composed of a felt of long spicules, from 1997 fathoms, (2) a fine specimen of an *Aulochone* from 1803 fathoms, (3) a small *Hyalonema* from 1997 fathoms, and (4) several species of Euplectellids.

Grade A. **PLASTIDAZOA.**

Class **RETICULARIA.**

In such examination as has been made of the ocean-deposit brought up by the sounding-tube and trawl during the season the only notable Foraminifer discovered is a large species of *Hormosina*, which combines some of the characters of *Hormosina ovicula*, H. B. Brady, with some of those of *Hormosina monile*, H. B. Brady. The test, which is long, slender, and tapering, is composed of numerous subpyriform segments arranged in a straight line in a very close-set diminishing series; the walls are smooth, thick, and strong, with a compact finely arenaceous texture; colour red-brown.

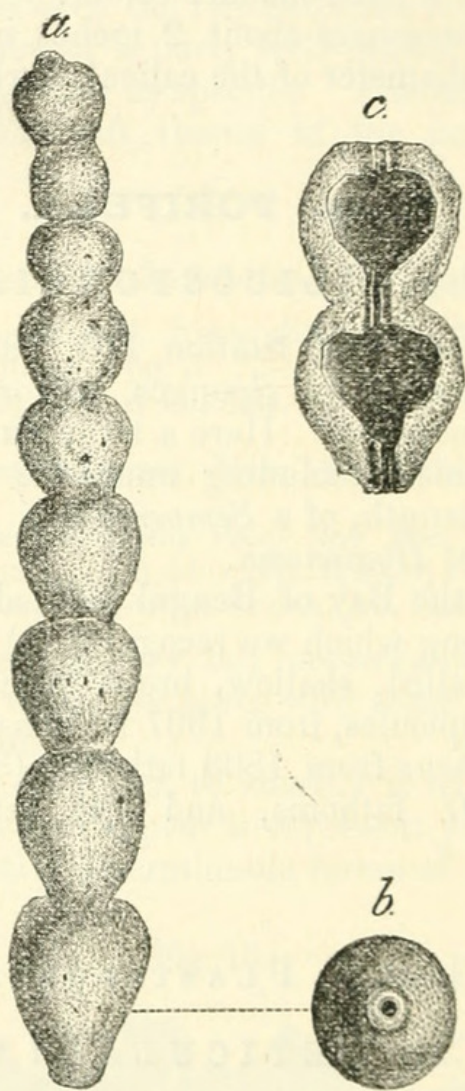
The largest fragment measures 8·5 millim. in length.

The cavities of the chambers have the form of a short, flat-topped pear.

Several specimens from the Bay of Bengal at 561 fathoms (Station 112).

For this species we propose the name *Hormosina Bradyi*, after our late friend Dr. H. B. Brady, F.R.S.

Fig. 16.



Hormosina Bradyi.—*a*, lateral view ; *b*, oral view ; *c*, two consecutive chambers in longitudinal section. \times .

EXPLANATION OF PLATE XVII.

Fig. 1. Homolampas glauca, from the abactinal side. Nat. size.

Fig. 2. Ditto, from the actinal side. Nat. size.

[To be continued.]



Wood-Mason, James. and Alcock, A. 1891. "LII.—Natural history notes from H.M. Indian Marine Survey Steamer 'Investigator,' Commander R. F. Hoskyn, R.N., commanding.—Series II., No. 1. On the results of deep-sea dredging during the season 1890–91." *The Annals and magazine of natural history; zoology, botany, and geology* 8, 427–452.
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