REPORT

ON THE

FORAMINIFERA

COLLECTED BY

PROFESSOR HERDMAN, AT CEYLON, IN 1902.

BY

W. J. DAKIN, B.Sc.,

ZOOLOGICAL DEPARTMENT, UNIVERSITY OF LIVERPOOL.

[WITH ONE PLATE AND TEXT-FIGURES.]

THE collection of deposits from the various places where dredgings were taken during the Ceylon expedition has revealed, in most cases, a great abundance of Foraminifera, and this is especially true with regard to a few species which in some cases make up the greater part of the deposit. The material which I have worked through for the purpose of this report had been taken mainly from (1) several stations in the Gulf of Manaar, (2) Palk Bay (north of Adam's Bridge), (3) off Trincomalee, and (4) off Galle, to the south of the island. The material from the different dredgings in the Gulf of Manaar has yielded the greatest abundance of species, and that from Galle and the south of the island generally the most interesting forms, especially where, from the 100-fathom line, about 12 miles off the land, the bottom was composed of a unique marine foraminiferal deposit, composed solely of a new species of the genus *Romulina*. In the shallower waters off Galle, however, foraminifera were much less abundant than at corresponding depths in the Gulf of Manaar.

The deposits examined were mostly from depths of less than 40 fathoms, and the collection consists, therefore, mainly of shallow-water species, and there is but little difference between the various samples, except as regards the numerical proportions in which certain forms occur. One of the most interesting points is the great

abundance of *Heterostegina depressa*, which makes up as much as 40 per cent. of one deposit, and often attains a size of 18·5 millims., and *Amphistegina lessonii* is not far behind this in point of numbers. A considerable range of individual variation was noticed, especially as regards the surface markings in such a case as *Amphistegina lessonii*, and this has occasionally given rise to some difficulty in the determination of species.

The total number of species and varieties recorded is 131, belonging to 51 genera, and of these 49 species are recorded for the first time from the seas around India and Ceylon, most of the previous records being from the reports by MURRAY and CHAPMAN on the deposits obtained by H.M.S. "Investigator" in the Bay of Bengal and the Arabian Sea. Only 15 species have actually been recorded previously from Ceylon, consequently nearly all those mentioned in this report are additions to the fauna of that colony.

In conclusion, I have to thank Professor HERDMAN for the opportunity given me to examine this interesting collection, and also for his very valuable advice throughout the work.

NOTE ON A NEW RAMULINA DEPOSIT.

Along the 100-fathom line, about 12 miles south of Galle, the dredge brought up quantities of a remarkable and unique foraminiferal deposit, consisting of masses varying in size from a hazel nut to a small apple 5 centims. in diameter, and formed of many stout calcareous tubules. At first sight it would hardly oe taken to be of Protozoan origin; and, as a matter of fact, a few other animals occur with it. Worm tubes extend into the crevices and wind about the tubules: masses of *Polytrema* and colonies of Polyzoa use the foraminifer as a support, and corals are embedded by its vigorous growth. The result is a substantial marine deposit, which cannot be of small importance in the building up of the ocean floor, and is still another, and probably the most important case in the district, of the part played by foraminifera in contributing to the form of the earth's surface, and in affecting the metabolism of the ocean. This organism has been identified as a very luxuriant and complex growth of a new species of *Ramulina*, which I desire to name after Professor HERDMAN, by whom it was found and first identified as a *Ramulina* (see "Narrative," this Report, Part I., 1903, p. 51).

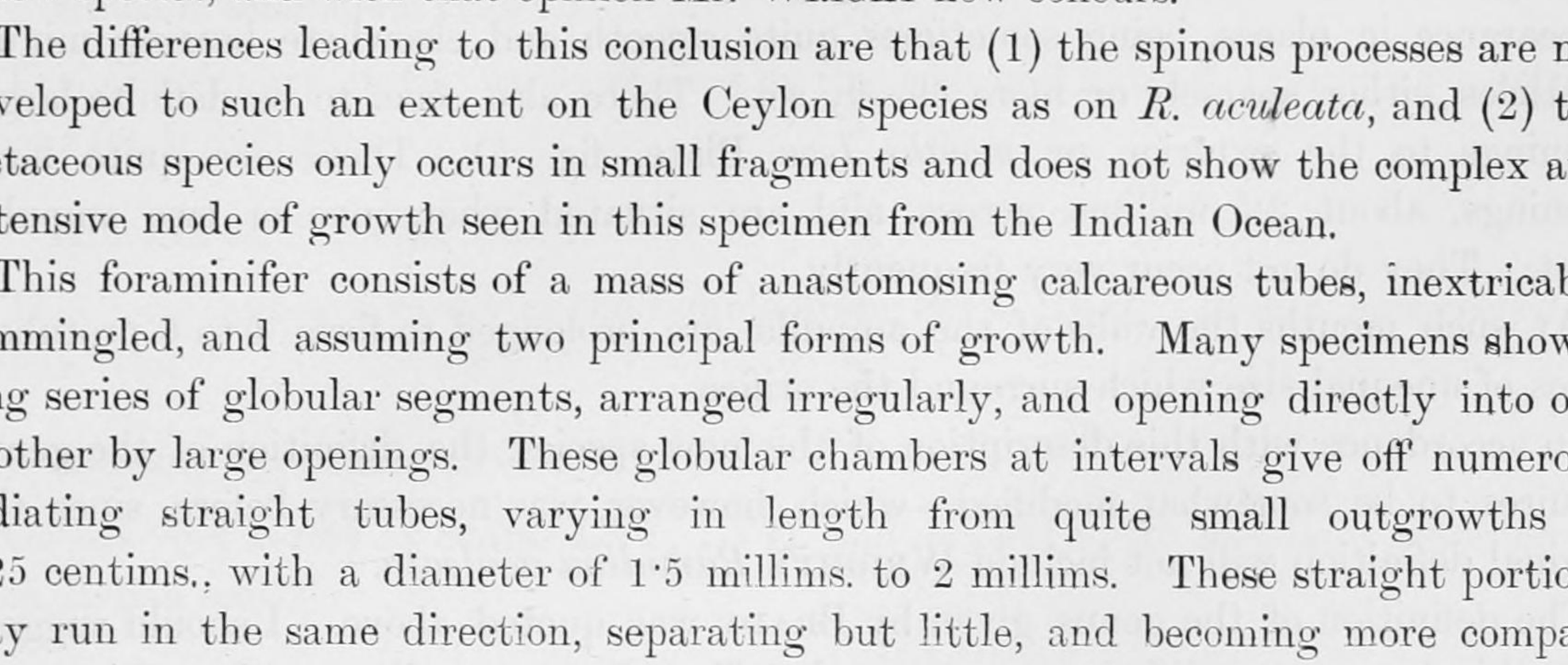
The genus *Ramulina* of RUPERT JONES, 1875, is defined by BRADY in the "'Challenger' Report' as follows: -"Test free, branching; consisting of a calcareous tube, swollen at intervals so as to form more or less definite, often irregular segments, from which lateral stolons or branches are given off. Texture hyaline." Some alteration will, however, have to be made in this definition of the genus, since this new species is certainly not hyaline. The species described by BRADY is *R. globulifera*, and from the description it appears that the swellings referred to in the definition of the genus arise only at intervals, and are connected by tubular portions. In our

Ceylon species, on the other hand, there may be a whole series of globular segments opening directly one into the other.

The generic name was first applied in the 'Report and Proc. Belfast Nat. Field Club,' 1873, by Joseph Wright, to two fragmentary specimens, and no definitions were then given. Later, the name was definitely given to the genus by Rupert Jones, in 1875. Brady, in 1884, named and described the species *R. globulifera*, and Wright, also in 1884, figured another species, *Ramulina aculeata*, from specimens found in the cretaceous rocks of Kerry, Ireland. Mr. Wright, who was consulted by Professor Herdman, at first recognised the resemblance of this species from Ceylon to his *R. aculeata*; but further investigation suggested that it is a new species, and with that opinion Mr. Wright now concurs.

The differences leading to this conclusion are that (1) the spinous processes are not developed to such an extent on the Ceylon species as on *R. aculeata*, and (2) the cretaceous species only occurs in small fragments and does not show the complex and extensive mode of growth seen in this specimen from the Indian Ocean.

This foraminifer consists of a mass of anastomosing calcareous tubes, inextricably commingled, and assuming two principal forms of growth. Many specimens show a long series of globular segments, arranged irregularly, and opening directly into one another by large openings. These globular chambers at intervals give off numerous radiating straight tubes, varying in length from quite small outgrowths to 1·25 centims., with a diameter of 1·5 millims. to 2 millims. These straight portions may run in the same direction, separating but little, and becoming more compact (see text-fig., C), or they may at once diverge and radiate from a common centre.



A. B. C.

Three masses of *Ramulina herdmani*. Natural size.

Eventually they reach either the globular chambers or other straight tubules with which they fuse, the cavities becoming continuous (see also Plate, figs. 1–6).

The radiating straight tubes I shall term the *pipes*, and the globular chambers

ampullæ. These masses of *Ramulina herdmani* may be in places predominantly ampullate in their mode of growth, as in text-fig. C, which shows an irregular mass of ampullæ opening into one another at different angles, and not lying simply in one and the same plane. In fig. A, on the other hand, the ampullæ are arranged in definite planes (not parallel to one another), and between these planes pass the pipes opening into the ampullæ at either end. The larger piece, shown in fig. B, is almost wholly composed of pipes, with only a suggestion of ampullæ, or perhaps two or three where several pipes open near each other.

The walls of the pipes and ampullæ are strong, calcareous, but not hyaline, and in some places as much as 0·065 millim. in thickness; but about 0·05 millim. is the average. All these walls are uniformly perforate, but the external surface differs in appearance in places, being sometimes quite smooth and elsewhere bearing minute denticles, either sparsely or more closely set. There also seem to be definite larger openings to the exterior, or *mouths* (see Plate, fig. 5). These are quite large openings, about 2·5 millims. across, and are situated where one or two ampullæ meet. They do not occur very frequently.

At such mouths the walls of the ampullæ are prolonged to form 4 to 6 protuberances of unequal size which surround the orifice.

In accordance with this description of the new species, the definition of the genus requires to be somewhat modified—which, however, was necessary before, since the original definition will not include WRIGHT'S *Ramulina aculeata*.

The definition of the genus given by BRADY was quoted above. I should suggest that this be now modified so as to read:—Test free, *or adherent*, branching and *anastomosing;* consisting of a calcareous tube, swollen at intervals to form more or less definite, often irregular segments (*ampullæ*), *opening into one another and being contiguous, or separated and connected by tubules. From these segments straight tubes* (*pipes*) *are given off.* Texture hyaline *or opaque.*

The alterations or additions are printed in italics. The definition of the new species will be given at its systematic position in the catalogue that follows.

LIST OF SPECIES.

FAMILY: MILIOLIDÆ.

Biloculina ringens (LAMARCK).

This form occurs rarely in the deposit from Stat.* LXVIII. It has been recorded (2),† (4) from the Indian seas.

Biloculina ringens, var. **striolata,** BRADY.

Of very rare occurrence in material from Stat. LXIV., south of Modragam Paar, depth 5 fathoms. This variety has also been recorded from the Indian seas (2).

* For particulars as to the Stations see "Narrative," this Report, Part I., 1903, p. 17.

† These numbers refer to the bibliography at the end.

Biloculina ringens, var. **denticulata,** BRADY.

Of very rare occurrence in material from Stat. LVIII., Gulf of Manaar—a new record for Indian seas.

Biloculina lævis (DEFR.).

Of rare occurrence in the Gulf of Manaar. This is a new record for Indian seas.

Miliolina cultrata, BRADY.

Occurs frequently at Stats. LVI. to LVIII., near Karativo Paar, 8 to 26 fathoms. Previously recorded by BRADY (1) from Ceylon.

Miliolina seminulum (LINN.).

This is common at the same stations as the last, and also off Trincomalee—a new record for Indian seas.

Miliolina scrobiculata, BRADY.

This form appears rarely in the sample from Stat. LVII. It is a new record for Indian seas.

Miliolina tricarinata (D'ORB.).

Occurs very rarely at Stats. LVI., LVII. and LXVIII. It has been recorded (2) from Indian seas.

Miliolina auberiana (D'ORB.).

Found in samples from Stats. LVI., LVII. and LVIII., and also from Welligam Bay—previously recorded (2) from Indian seas.

Miliolina insignis, BRADY.

This form occurs in material from Stats. LVII. and LXIV. previously recorded from Ceylon (1) and Indian seas (2).

Miliolina valvularis (REUSS).

Occurs in material from Stat. LVIII., outside Karativo Paar, depth about 20 fathoms. This is a new record for Indian seas.

Miliolina ferussacii (D'ORB.).

Occurs very rarely in the same sample as the last, and is also a new record for Indian seas.

Miliolina circularis, BORNEMANN.

This form was also present in the material from Stat. LVIII.—recorded previously from Indian seas (2).

Miliolina fichteliana (D'ORB).

Present sparingly at Stat. LVIII., and also at Stat. LVI., off Kodramallai Point, depth 8 or 9 fathoms—a new record for Indian seas.

Miliolina parkeri, BRADY.

Found at Stat. LVIII. This form is usually found associated with coral banks—recorded previously from Indian seas (2).

Miliolina rupertiana, BRADY.

Occurs frequently in material from Stat. LVI.—previously recorded for Ceylon (1).

Miliolina oblonga (MONTAGU).

This form occurs rarely in two samples from the Gulf of Manaar, Stats. LXIV. and LXVIII., both under 20 fathoms; and also at Welligam Bay—previously recorded from Ceylon (1).

Miliolina agglutinans (D'ORB.).

Very rare, and occurs only at Stat. LXIV. This is a new record for Indian seas.

Miliolina reticulata (D'ORB.).

Occurs sparingly between E. and W. Cheval paars at about 6 to 7 fathoms—previously recorded from Indian seas (2).

Miliolina terquemiana, BRADY—Plate, figs. 9 and 10.

This species, described by BRADY for the first time in the '"Challenger" Report' (1), is noted as being exceedingly rare, and known only from Calpentyn, Ceylon, and the East Coast of Madagascar. It has been recorded so far from no other place in the Indian Ocean. One specimen only was present in our collection, and it was found in a deposit from the southern part of the Gulf of Manaar, only a few miles to the north of Calpentyn, where it was originally found. It is in excellent preservation and is rather larger than BRADY's specimen, the length being 0·76 millim. This rare Ceylon specimen is shown in figs. 9 and 10 on the Plate.

Spiroloculina grata, TERQUEM.

This is common in deposits from Stats. LVI. and LXIV. It is a coral bank species, and has been previously recorded from Indian seas (2).

Spiroloculina limbata, D'ORB.

Frequent in deposits from Stats. LVIII. and LVI.—previously recorded from Indian seas (2).

Spiroloculina fragilissima, BRADY.

One specimen in material from Stat. LVIII.—a new record for Indian seas.

Spiroloculina arenaria, BRADY.

This species occurs in material from Stat. LVIII.—previously recorded from Indian seas (**2**).

Spiroloculina crenata, KARRER.

Of very rare occurrence in the deposit from Stat. LVI.—a new record for Indian seas.

Hauerina ornatissima, KARRER.

Very rare in material from Stat. LXIV., S. of Kodramallai. This is a new record for Indian seas.

Hauerina complanata, n. sp.—Plate, fig. 7.

This species has the characteristic planospiral porcellaneous test, milioline only in the very early convolutions. It is very thin, with practically circular convolutions. Four of these, with indications of a fifth, are present; the outer, or last, consisting of four chambers. Diameter of specimen, 0·62 millim. This species differs from *H. compressa* in being more regular and even more compressed; the number of convolutions also appears to be greater and a larger number of chambers is present. Several specimens occur in deposits from Stat. LVIII., Gulf of Manaar.

Articulina sagra, D'ORB.

Occurs frequently in deposits from Stats. LXVIII., LXIV. and LVII. This is a new record for Indian seas.

Vertebralina striata, D'ORB.

Occurs rarely in the Gulf of Manaar—a new record for Indian seas.

Peneroplis pertusus, var. **arietinus,** BATSCH.

This occurs very commonly in the deposit from Stat. LVII., and less frequently at Stat. LVI.

Peneroplis pertusus, var. **planatus** (FICHTEL and MOLL).

This variety is much less common than the above, and occurs rarely at Stat. LVII. These are both new records for Indian seas.

Orbiculina adunca (FICHTEL and MOLL).

This species is of somewhat rare occurrence in the Gulf of Manaar -previously recorded for the Indian Ocean (**1**).

Orbitolites marginalis (LAMK.).

One of the most common of foraminifera in the shallower deposits, but less frequent

in the deeper ones. It is common, however, in all. Previously recorded from the Indian Ocean (2).

Orbitolites duplex, Carpenter.

Occurs rarely at Stat. LVII—a new record for Indian seas.

Alveolina melo (Fichtel and Moll).

This is exceptionally common in the shallow-water deposits, and makes up a large percentage of the material. In most cases also the size is above the average, the length reached being 22·5 millims. It occurs at Stats. LXIV., LVI., LVIII.; off Trincomalee and Chilaw; but is especially common in the deposit from Stat. LXVIII.

Alveolina boscii (Defr.).

This is frequent in the same deposits as the species *A. melo*. Both have been previously recorded from the Indian Ocean (2).

Family: ASTRORHIZIDÆ.

Technitella legumen, Norman.

Of very rare occurrence from the Gulf of Manaar—a new record for the Indian seas.

Saccammina spherica, Sars.

Of rare occurrence at Stats. LVI. and LVIII.—previously recorded from Indian seas (2).

Rhizammina, sp.?

One specimen from Gulf of Manaar. The species *R. indivisa* has been previously recorded from Indian seas (2).

Sagenella frondescens, Brady.

Of rare occurrence in deposits off Chilaw. This is a new record for Indian seas.

Family: LITUOLIDÆ.

Reophax difflugiformis, Brady.

Occurs somewhat frequently in Gulf of Manaar—previously recorded from Indian seas (2).

Haplophragmium canariense (d'Orb.).

Only one specimen in material from Stat. LVIII.—previously recorded from Indian seas (2).

Carterina spiculotesta (CARTER).

One specimen was found in the deposit from Stat. LXIV. in Gulf of Manaar. This is of interest since the specimens described by CARTER came from the same place (**1**).

FAMILY: TEXTULARIIDÆ.

Textularia gramen, D'ORB.

Occurs in deposits from Stats. LVIII., LVII., LXIV., and LXVIII.—previously recorded from Indian seas (**2**).

Textularia agglutinans, D'ORB.

Of frequent occurrence at Stats. LVIII., LVII., and LVI.—previously recorded from Indian seas (**2**).

Textularia transversaria, BRADY.

Occurs rarely at Stat. LVIII. A new record for Indian seas.

Textularia quadrilatera, SCHWAGER.

Occurs rarely at Stat. LVII. This also is a new record for Indian seas.

Textularia sagittula, DEFRANCE.

Occurs rarely in the Gulf of Manaar, at Stat. LVI.—previously recorded from Indian seas (**2**).

Textularia sagittula, var. **fistulosa,** BRADY.

This variety is of more frequent occurrence than the above, and is probably a tropical variation of it. It was found in the Gulf of Manaar—previously recorded from Indian seas (**2**).

Verneuilina spinulosa, REUSS.

Occurs rarely at Stats. LVII. and LVI. in Gulf of Manaar—previously recorded from Ceylon (**1**).

Chrysalidina dimorpha, BRADY.

Found sparingly at Stat. LVIII.—recorded previously from Ceylon (**1**).

Clavulina communis, D'ORB.

Very rare at Stat. LVIII. Has been previously recorded from Indian seas (**2**).

Gaudryina subrotundata, SCHWAGER.

This is of moderate frequency in several deposits in the Gulf of Manaar—previously recorded from Indian seas (**2**).

Bulimina elegantissima, var. **seminuda**, TERQUEM.

This form is of rare occurrence at Stat. LVIII.—has been previously recorded from Ceylon (1).

Bolivina punctata, D'ORB.

This is of fairly frequent occurrence at Stats. LVI. and LXIV. It has been already recorded from Indian seas (1), (2).

Bolivina textularioides, REUSS.

Of rare occurrence in the Gulf of Manaar—previously recorded from Indian seas (2).

Bolivina limbata, BRADY.

Of rare occurrence in the deposit from Trincomalee, W.N.W. of Foul Point, 8 fathoms—previously recorded from Indian seas (2).

FAMILY: LAGENIDÆ.

Lagena sulcata (WALKER and JACOB).

Of very rare occurrence at Stat. LVI.—recorded previously from Indian seas (2).

Lagena globosa (MONTAGU).

Rare in deposit from Stat. LVI.—recorded previously from Indian seas (2).

Lagena lævis (MONTAGU).

Of very rare occurrence in deposit from Stat. LXIV., and also from Welligam—recorded previously from Indian seas (2).

Lagena lagenoides (WILLIAMSON).

This is of very rare occurrence in the deposit from Stat. LXVIII.—recorded previously from Indian seas (2).

Lagena castrensis, SCHWAGER.

This form is very rare in the deposit from Stat. LVIII., and also from Welligam Bay—recorded previously from Indian seas (2).

Lagena orbignyana (SEGUENZA).

This form is also very rare in the Gulf of Manaar.

Lagena staphyllearia (SCHWAGER).

Of very rare occurrence in the Gulf of Manaar.

Lagena marginata, var. **semimarginata**, REUSS.

Of very rare occurrence in the Gulf of Manaar deposits. The last three species of *Lagena* have all been previously recorded from the Indian seas (2).

Lagena elcockiana, Millet (3).

Only one specimen found in a deposit from the Gulf of Manaar. This is a new record for Indian seas. Previous occurrence in the Malay Archipelago (3).

Nodosaria obliqua (Linn.).

This species occurs sparingly at Stat. LVIII., but is more frequent at Stat. LVI., both in the Gulf of Manaar. Recorded previously from Indian seas (2).

Nodosaria cylindracea, n. sp.—Plate, fig. 8.

The test of this species is elongate, and cylindrical, 0·85 millim. in length, and terminates in a rounded apex. Chambers, about nine in number, arranged in a straight line, and separated by unconstricted sutures, which have the appearance of a series of depressions. Surface with fine longitudinal ribs, about eighteen in number, and marked with minute striæ between them. Aperture, a round opening with a slight lip in the centre of the last segment.

It is possible that this is a new species of the genus *Sagrina*, in which the early spiral arrangement has been lost, but no trace of this is seen in the specimen.

Of very rare occurrence in the Gulf of Manaar.

Nodosaria raphanus (Linn.).

This form occurs somewhat frequently in the Gulf of Manaar. Recorded previously for Indian seas (2).

Nodosaria intercellularis, Brady.

Occurs sparingly at Stats. LVIII., LVII., and LVI. This is also previously recorded from Indian seas (2).

Nodosaria perversa, Schwager.

Of rare occurrence in the Gulf of Manaar—a new record for Indian seas.

Nodosaria simplex, Silv.

Of very rare occurrence in Gulf of Manaar at Stat. LXIV.—a new record for Indian seas.

Nodosaria hispida, d'Orb.

This species is of rare occurrence in the Gulf of Manaar. This is also a new record for Indian seas.

Nodosaria scalaris, var. **separans,** Brady.

Rare in the deposit from Stat. LXIV. This has been recorded from the Indian seas already (2).

Cristellaria tricarinella, Reuss.

Of very rare occurrence in the deposit from Stats. LVIII. and LVI. This is a new record for the Indian seas.

Cristellaria rotulata (Lamk.).

This is of rare occurrence in the Gulf of Manaar—previously recorded from Indian seas (2).

Cristellaria orbicularis (d'Orb.).

Occurs very rarely in the samples from Stat. LVI.—previously recorded from Indian seas (2).

Cristellaria vortex (Fichtel and Moll).

This is of rare occurrence in the deposit at Stat. LXIV. This is a new record for Indian seas.

Polymorphina regina, Brady, Parker and Jones.

Occurs very rarely in material from Stat. LXIV.—a new record for Indian seas.

Uvigerina aculeata, d'Orb.

This is of frequent occurrence at Stat. LXIV. in some hauls—previously recorded from Indian seas (2).

Uvigerina asperula, Czjzek.

Of rare occurrence at Stat. LVIII. This species is previously recorded from Indian seas (2).

Uvigerina pygmæa, d'Orb.

Found sparingly at Stat. LVII., and also at Welligam Bay. Also recorded before from Indian seas (2).

Sagrina raphanus, Parker and Jones—Plate, fig. 11.

Found sparingly at Stat. LVI., and also off Trincomalee—previously recorded for Ceylon (1). The specimen figured differs from the normal type by having the test bent almost at right angles in the fifth chamber from the terminal one. This appears due to greater growth having taken place on one side than on the other during the formation of this chamber.

Sagrina striata, Schwager.

Of rare occurrence in the Gulf of Manaar—a new record for Indian seas.

Ramulina herdmani, n. sp.—Plate, figs. 1–6, and also text-figs., p. 227.

Tubules anastomosing so as to form a large adherent mass. Chambers or ampullæ

numerous, connected by tubules or contiguous and aggregated. Walls strong, calcareous, not hyaline, and only slightly spinose on the surface. Length of an average pipe 1 centim., diameter of an average ampulla 1·8 millims., masses up to 9 centims. in length. (See also p. 226.)

FAMILY: GLOBIGERINIDÆ.

Globigerina bulloides, D'ORB.

This is a common form in all the deposits examined—previously recorded from Indian seas (2) (4).

Globigerina sacculifera, BRADY.

Of very rare occurrence at Stat. LVI.—previously recorded from Indian seas (2) (4).

Globigerina cretacea, D'ORB.

Of very rare occurrence at Stats. LXVIII. and LVI.—previously recorded from Indian seas (2).

Orbulina universa, D'ORB.

Rare, found in material from Stat. LVI.

Hastigerina pelagica, D'ORB.

Of very rare occurrence at Stat. LVII. Both the two last named have been previously recorded from Indian seas (2) and (4).

FAMILY: ROTALIIDÆ.

Spirillina limbata, BRADY.

Common in deposits from Stat. LVII.—a new record for Indian seas.

Spirillina obconica, BRADY.

Of rare occurrence from Galle and Station LXIV.—a new record for Indian seas.

Spirillina inæqualis, BRADY.

Of rare occurrence at Galle and Stat. LVI.

Spirillina vivipara, EHRENBERG.

This occurs rarely in deposits from Stats. LVIII. and LVII.—previously recorded from Indian seas (1).

Spirillina decorata, BRADY.

Of very rare occurrence at Stat. LVI. With the exception of *S. vivipara*, these are all new to Indian seas. They have all been recorded by EGGER (5) from Mauritius.

Cymbalopora poeyi (D'ORB.).

Occurs rarely at Stat. LVI., and also off Trincomalee—previously recorded from Indian seas (2).

Discorbina rosacea (D'ORB.).

Occurs frequently at Stats. LVIII. and LXIV. This has been recorded from Indian seas (2).

Discorbina orbicularis (TERQUEM).

Of common occurrence at Stats. LVII., LXIV., and LXVIII., in the Gulf of Manaar. This is a new record for Indian seas.

Discorbina bertheloti, var. **baconica**, HANTK.

Found sparingly in deposits from Stats. LVII. and LVI., and, like the last, is a new record for Indian seas.

Discorbina patelliformis, BRADY.

Found rarely in the Gulf of Manaar. It has been already recorded from Ceylon (1).

Discorbina saulcii (D'ORB.).

Occurs rarely in the Gulf of Manaar—a new record for Indian seas.

Discorbina vilardeboana (D'ORB.).

This occurs very rarely in the Gulf of Manaar, and is probably a variety of *D. rosacea*. It is a new record for Indian seas.

Truncatulina ungeriana (D'ORB.).

Of rare occurrence in the deposits from the Gulf of Manaar—previously recorded from Indian seas (2).

Truncatulina rostrata, BRADY.

Occurs rarely in deposits from Stat. LVIII. in the Gulf of Manaar—a new record for Indian seas.

Truncatulina lobatula (WALTER and JACOB).

This species is very rare in the deposit from Stat. LXVIII.—already recorded from the Indian seas (2).

Truncatulina tenera, BRADY.

This species occurs somewhat frequently in the Gulf of Manaar. It is also a new record for Indian seas.

Anomalina ammonoides (REUSS).

Occurs frequently in deposits from Stats. LVII. and LVIII.—previously recorded from Bombay (**1**).

Anomalina gosserugosa (GÜMBEL).

This species is much more rare than *A. ammonoides*, but occurs in the same deposits—previously recorded from Indian seas (**2**).

Anomalina ariminensis (D'ORB.).

Of very rare occurrence at Stat. LVI.—a new record for Indian seas.

Pulvinulina menardii (D'ORB.).

Very common at Stats. LVI., LVII., LVIII., LXIV. and LXVIII.—previously recorded from Indian seas (**2**), (**4**).

Pulvinulina brongniarti (D'ORB.) (**4**).

This species occurs rarely in the deposit from Stat. LVII.—previously recorded from Mauritius (**5**) and Malay Archipelago (**3**)—a new record for Indian seas.

Pulvinulina umbonata, REUSS.

Occurs rarely in material from Stat. LVIII. This is a new record for Indian seas—previously recorded from Mauritius (**5**).

Pulvinulina oblonga (WILLIAMSON).

Of rare occurrence at Stats. LXVIII. and LVI.—previously recorded from Indian seas (**2**).

Rotalia calcar, D'ORB.

This species is of very common occurrence at Stats. LVI., LVII., LVIII., and also from Welligam Bay and Galle—recorded already from Ceylon (**1**) and Indian seas (**2**).

Calcarina hispida, BRADY.

Of very common occurrence in all samples examined from Stats. LVIII., LVII., LVI., LXIV., and LXVIII., also off Galle and Trincomalee—previously recorded from Indian seas (**2**).

Calcarina defrancii, D'ORB.

This occurs somewhat sparingly at Stats. LVI. and LVIII.—a new record for Indian seas.

Calcarina spengleri, LINN.

Of rare occurrence at Stat. LVIII. This is also a new record for Indian seas, but has been recorded from Mauritius (**5**).

Planorbulina larvata, PARKER and JONES.

Occurs sparingly at Stats. LXIV. and LVII. It has been recorded from Indian seas previously (2).

Planorbulina mediterranensis, D'ORB.

This is of rare occurrence at Stats. LXVIII. and LVIII.—a new record for Indian seas; recorded previously from Mauritius (5).

Gypsina inhaerens (SCHULTZE).

Occurs rarely at Stat. LVII. This is a new record for Indian seas; recorded from islands south of New Guinea and from the European coast (1).

Carpenteria utricularis, CARTER.

Occurs on calcareous Algæ from the Gulf of Manaar and also off Galle. Recorded previously from the Gulf of Manaar (7).

Polytrema miniaceum, LINN.—Plate, fig. 12.

Of very frequent occurrence, and forming at Stat. LXVIII. quite a large proportion of the foraminifera. Also found at Stats. LVI., LVII., LVIII., and LXIV. A fine specimen is figured. Recorded previously from Ceylon (CARTER, 7).

Polytrema miniaceum, var. **alba,** CARTER.

Of rare occurrence in deposits from Stat. LVIII.—recorded previously from Gulf of Manaar by CARTER.

FAMILY: NUMMULINIDÆ.

Nonionina boueana, D'ORB.

Of very rare occurrence, from stations in the Gulf of Manaar. This is the first record for Indian seas; previously recorded from the Red Sea (1) and Mauritius (5).

Polystomella crispa (LINN.).

Very common in all the deposits examined from Stats. LVIII., LVI., LVII., LXIV. and LXVIII., also from Trincomalee, Welligam Bay and Galle—previously recorded from Indian seas (2).

Polystomella craticulata (FICHTEL and MOLL).

Of very rare occurrence at Stat. LVII. This is the first record for Indian seas; recorded already from Mauritius (5) and Red Sea (1).

Amphistegina lessonii, D'ORB.—Plate, fig. 13.

This is extremely abundant in all the deposits, and forms about 25 per cent. by weight and volume of the deposit from a haul at Stat. LXIV. Its surface

markings are extremely variable; one of the varieties is figured and this specimen was not in any way water worn. Noted from Stats. LVI., LVII., LVIII., LXVIII., and other hauls at Stat. LXIV., also off Galle, Trincomalee and Chilaw. Recorded from the Indian seas previously (2).

Amphistegina radiata (Fichtel and Moll).

Rather rare, from Gulf of Manaar. Recorded by Chapman (2) from Arabian seas.

Heterostegina depressa, d'Orb.—Plate, fig. 14.

This is the most abundant foraminifer at practically all the stations. Its size is on the whole above the average, often attaining a diameter of 18·5 millims., and it gives therefore the chief character to the deposit. On these grounds a figure is given here (fig. 14) from one of the most perfect specimens. Occurs at Stats. LVI., LVII., LVIII., LXIV., LXVIII., and off Galle, Trincomalee and Chilaw. Previously recorded from Ceylon (1) and Indian seas (2).

Operculina complanata (Defr.).

Occurs sparingly at Stats. LVII. and LXIV.—previously recorded from Indian seas (2).

Operculina complanata, var. **granulosa,** Leymerie.

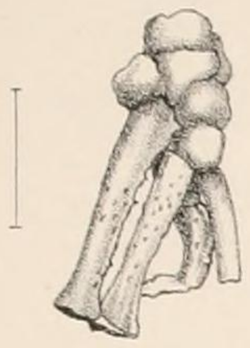
This variety occurs somewhat frequently in the Gulf of Manaar. Like the previous species, it has been already recorded from Indian seas (2).

LIST OF WORKS REFERRED TO.

(1.) BRADY.—Report on the Foraminifera collected by H.M.S. "Challenger."
(2.) CHAPMAN.—"Foraminifera obtained by H.M.S. 'Investigator' near the Laccadive Islands." 'Proc. Zool. Soc.,' 1895, pt. i.
(3.) MILLET.—"Foraminifera of the Malay Archip." 'Journ. Microscop. Soc.' 1889–1902.
(4.) MURRAY.—"List of Forams. collected in Bay of Bengal." 'Scottish Geographical Mag.' 1889.
(5.) EGGER—'Abhandl. k. Bayer. Akad. Wiss. München.' 1893.
(6.) FLINT.—"Recent Foraminifera." 'Report U.S. Nat. Mus. for 1897.'
(7.) CARTER.—'Ann. and Mag. Nat. Hist.' June and July, 1880.

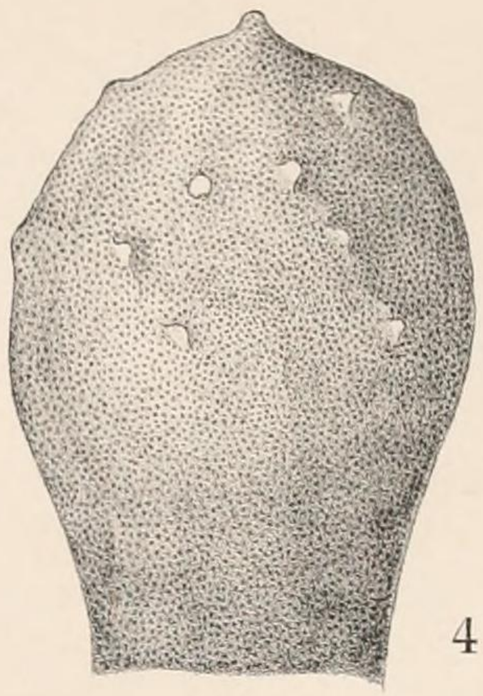
EXPLANATION OF THE PLATE.

Fig. 1. Specimen of *Ramulina herdmani*, n. sp., showing relation of ampullæ to pipes. × 2.
„ 2. Another specimen, showing a series of ampullæ. × 2.
„ 3. Specimen to show ampullæ in two planes connected by pipes. × $\frac{3}{2}$.
„ 4. An ampulla, to show surface. × 19.
„ 5. "Mouth" on an ampulla, showing processes. × 16.
„ 6. Section showing wall of an ampulla. × 22.
„ 7. *Hauerina complanata*, n. sp. × 48.
„ 8. *Nodosaria cylindracea*, n. sp. × 73.
„ 9. *Miliolina terquemiana*, BRADY. × 47.
„ 10. The same, oral view. × 47.
„ 11. *Sagrina raphanus*, PARKER and JONES, abnormal. × 58.
„ 12. *Polytrema miniaceum*, LINN., large specimen. × 8.
„ 13. *Amphistegina lessonii*, D'ORB. × 20.
„ 14. *Heterostegina depressa*, D'ORB. × 23.

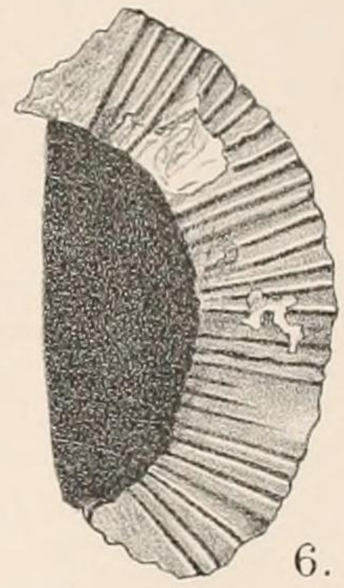


1.

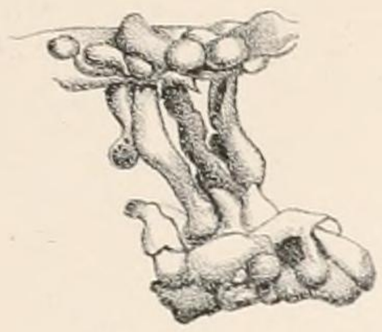
2.



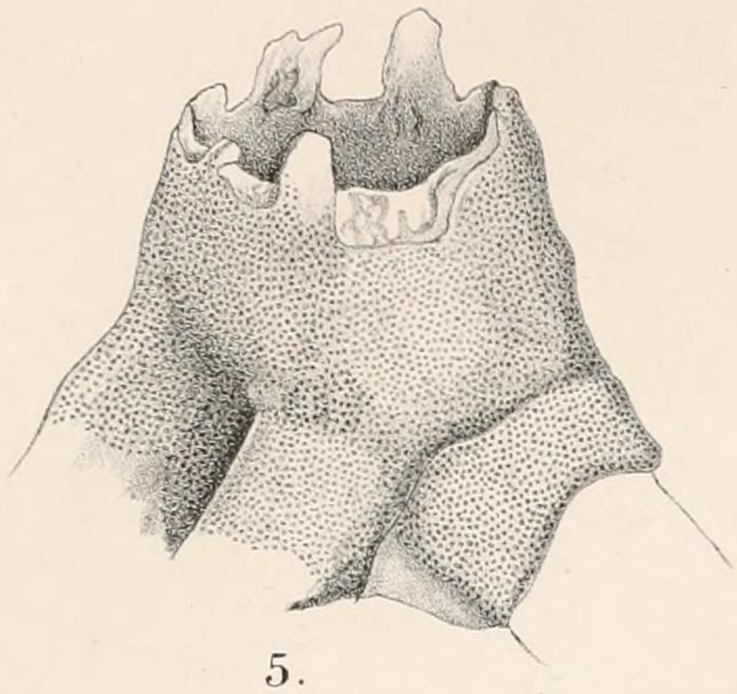
4.



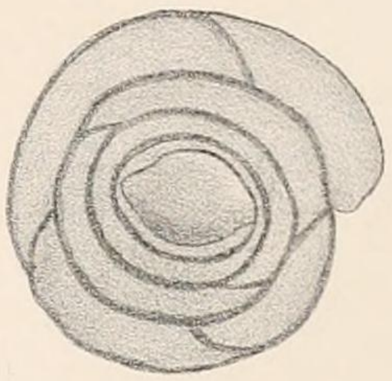
6.



3.

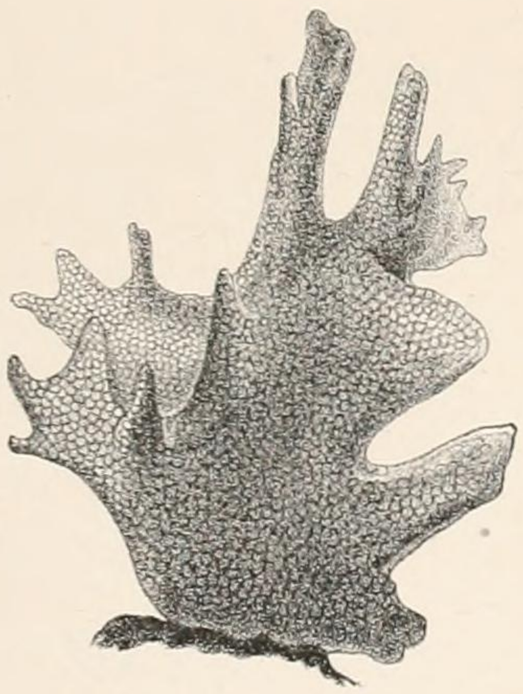


5.



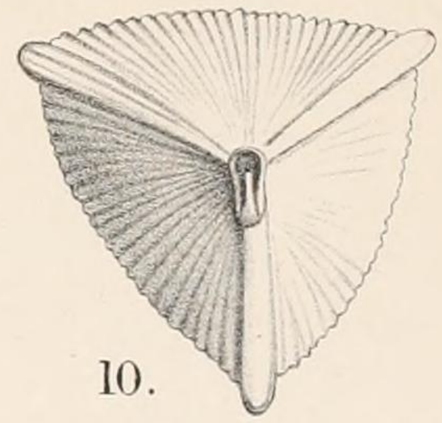
7.

9.

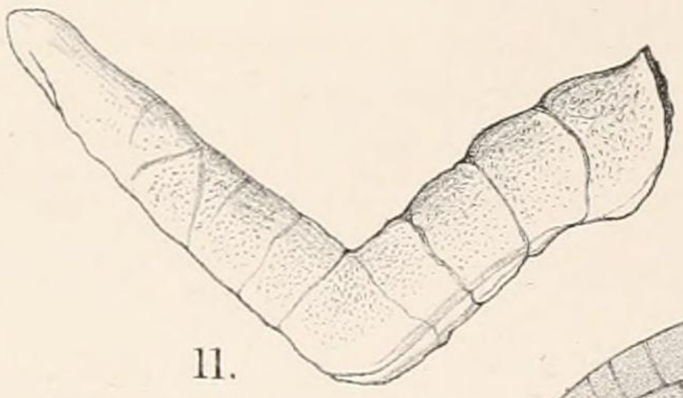


12.

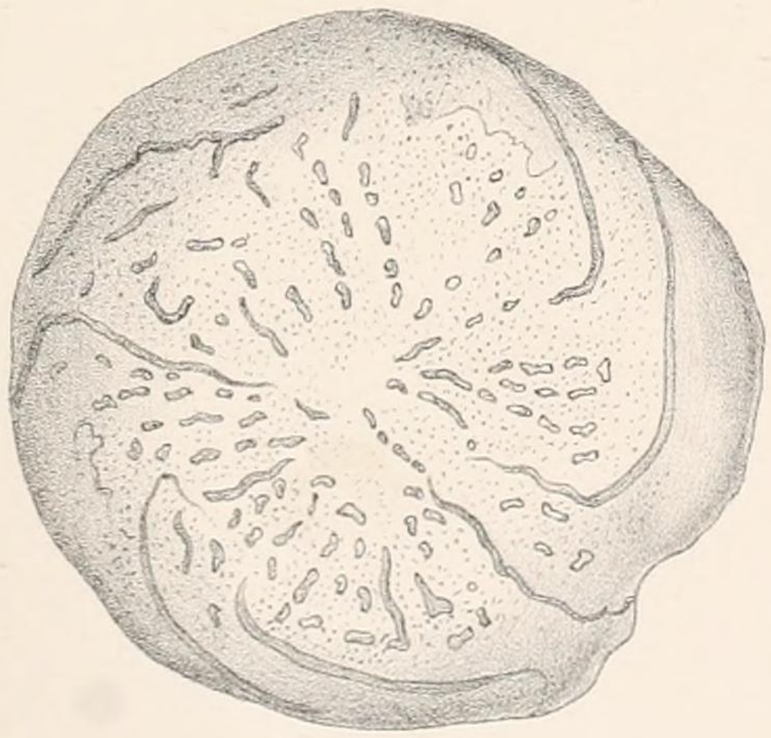
8.



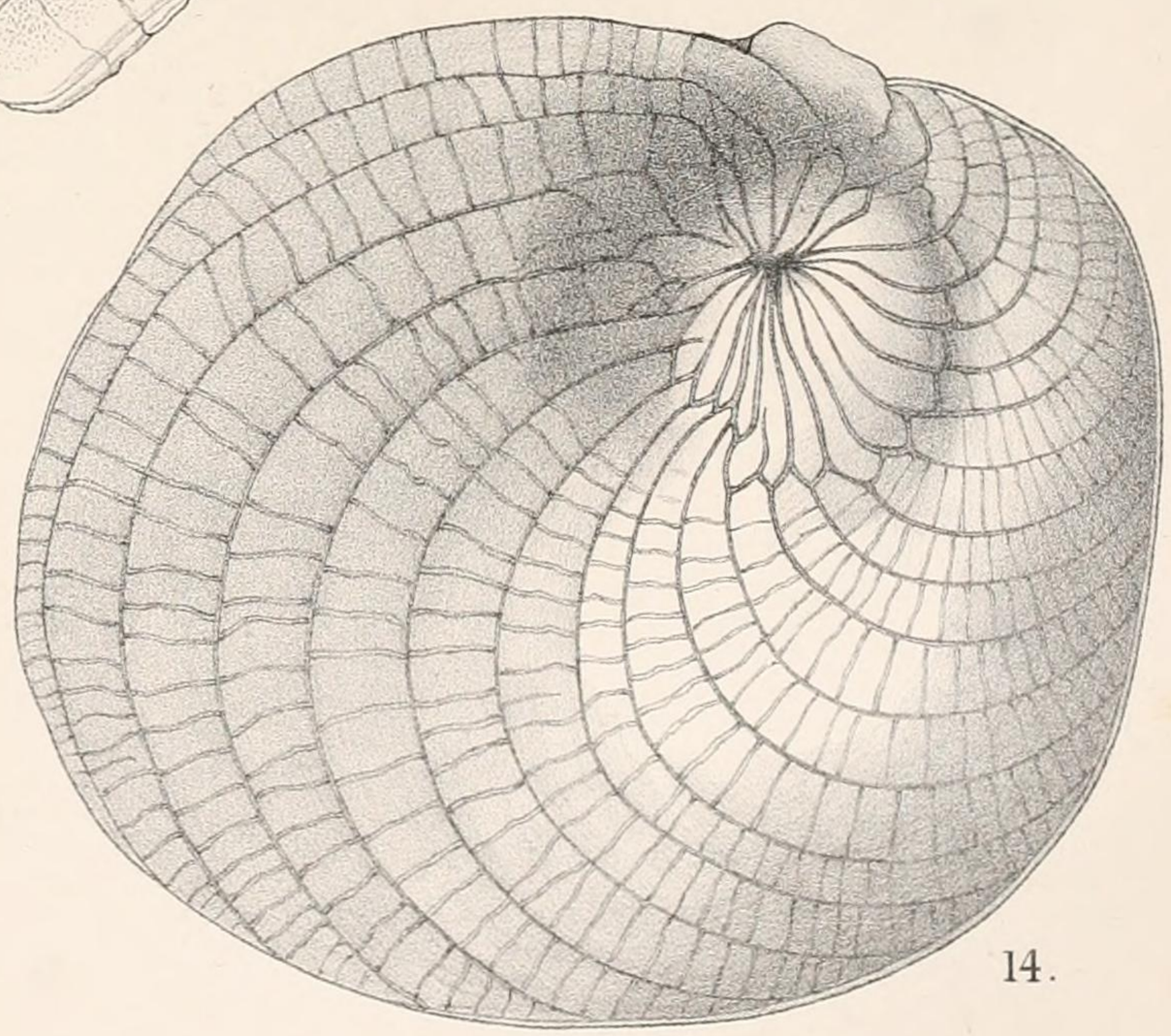
10.



11.



13.



14.

REPORT

TO THE GOVERNMENT OF CEYLON

ON THE

PEARL OYSTER FISHERIES

OF THE

GULF OF MANAAR,

BY

W. A. HERDMAN, D.Sc., F.R.S., P.L.S.,

Derby Professor of Natural History in the University of Liverpool.

WITH SUPPLEMENTARY REPORTS

UPON THE

MARINE BIOLOGY OF CEYLON,

BY OTHER NATURALISTS.

PART V.

PUBLISHED AT THE REQUEST OF THE

COLONIAL GOVERNMENT

BY

THE ROYAL SOCIETY.

LONDON:

1906.