REPORT

TO THE GOVERNMENT OF CEYLON

ON THE

PEARL OYSTER FISHERIES

OF THE

GULF OF MANAAR,

BY

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WITH SUPPLEMENTARY REPORTS

UPON THE

MARINE BIOLOGY OF CEYLON,

BY OTHER NATURALISTS.

PART III.

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CONTENTS OF PART III.

PEARL OYSTER REPORT.

SUPPLEMENTARY REPORTS.

PREFACE.

In this Part III., I have thought it best to place proportionately more of the Supplementary Reports and less of the Pearl-oyster work than was the case in Parts I. and II., for the following reasons :—

1. The Supplementary Reports here printed were ready and it might have been unfair to the authors and unfortunate for Science if there had been avoidable delay in publication by excluding any from this Part.

2. Those sections of the Pearl-oyster work which were completed, or nearly so, are of such a nature that the results can be communicated in writing to the Authorities in Ceylon, and a delay of a few months in making them known to the public seemed comparatively unimportant.

3. It seemed advisable, for obvious reasons, to have as much of the Pearl-oyster work as possible placed together in Part IV., which will, I hope, be the final volume of the series. This plan, moreover, presents the further advantage of allowing of observations and conclusions to be drawn from the coming fishery in the spring of 1905—probably the last which will be available for the purposes of this Report.

Consequently the sections on Pearl-formation and Pearl-distribution and on the different kinds of pearls and their natural classification have been postponed, and I have inserted in this Part only (1) a discussion of the recent fishery (1904) based on a report sent to me by Mr. Hornell, (2) a statement as to the present condition and future prospects of the beds of oysters on the Banks, based on Mr. Hornell's letters and other documents, and (3) a further account of the internal Parasites of the Pearl Oyster, by Mr. Shipley and Mr. Hornell, in which several new species of Cestode, Trematode and Nematode worms are described and figured.

The Supplementary Reports now issued deal with the Sponges, the Alcyoniidæ and the other Alcyonarians, the Opisthobranchiate Mollusca and the Ostracoda.

The very considerable collection of Sponges (146 species, of which 77 were new to science) has enabled Professor Dendy to make an extensive report, which is a notable contribution to the taxonomy of the group. At least two of the Ceylon sponges are of economic importance. The sponge of commerce, found in abundance at Trincomalee, is of good form and consistence and might prove worth further cultivation; and one of Professor Dendy's new species, *Cliona margaritiferæ*, is the boring sponge which ruins the shell of the pearl oyster and occasionally causes great mortality. Other sponges from the Gulf of Manaar must probably be regarded as enemies, from the damage they do in smothering the pearl oysters they encrust and surround.

Another report of a comprehensive nature, dealing with about 77 species, is that by Professor J. ARTHUR THOMSON and Mr. W. D. HENDERSON on the Alcyonaria —with the exception of the family Alcyoniidæ, reported on by Miss E. M. PRATT. Professor THOMSON has kindly provided the beautiful coloured drawings, by Mr. G. DAVIDSON, from which his plates have been produced. But I am really much indebted to *all* the authors for the careful and excellent drawings with which they have illustrated their reports. Mr. FARRAN'S report deals with a considerable number of species of a group (the Nudibranchiata) which I had hoped to have been able to examine myself. Consequently, when collecting in the Gulf of Manaar, I made some colour notes and sketches from the living animals which Mr. FARRAN has been able to make use of in his descriptions. Mr. ANDREW SCOTT records 77 species of Ostracoda, 35 of which are new to science. To all these authors I am very much obliged for their kindness in undertaking the work and for the skill they have exercised in carrying it out.

It may be well to indicate here the Supplementary Reports that remain. They are all, I think, well advanced, and ought to be ready for publication some time in the summer :—Corals, by Mr. G. C. BOURNE; Medusæ, by Mr. E. T. BROWNE; Antipatharia, by Professor J. ARTHUR THOMSON; Polyzoa, by Miss L. R. THORNELY; Polychæta, by Dr. ARTHUR WILLEY; Schizopoda and Stomatopoda, by Mr. W. TATTERSALL; Macrura, by Mr. J. PEARSON; Brachyura, by Mr. D. LAURIE; Isopoda, by Rev. T. R. R. STEBBING; Molluscan Shells, by Mr. R. STANDEN and Mr. A. LEICESTER; Marine Insects, by Professor G. CARPENTER, and the Tunicata, by myself The remaining sections of the Pearl-oyster work, and our Summary of Results and Recommendations as to the Conservation of the Banks, should then complete the Report.

The records of observations sent to me by Mr. HORNELL during the latter part of 1904, and especially his detailed reports upon the great spring fishery and the November inspection—upon which I have based the two first articles in this volume (see p. 1 and p. 37)—show that very considerable changes have taken place in regard to the condition of the beds of oysters on the paars and the prospects of fisheries during the next few years. Under the heading "CONCLUSIONS," in the article on the "History of the Principal Pearl Banks" in the last volume (Part II., p. 36) it was stated :—"Finally, there are prospects of good fisheries both next year and in 1906 on the Modragams and several divisions of the Cheval Paar—possibly also on the Muttuvaratu and the Dutch Modragam in the latter year. The results in 1907 and the immediately succeeding years will, so far as we can now see, depend upon whether large measures of transplantation are adopted without delay." In writing of the Cheval Paar (p. 20), also, I recommended that young oysters be transplanted there from the Periya Paar "at the earliest opportunity and in sufficient quantities."

Following upon that recommendation, Mr. HORNELL was authorised by the Ceylon Government to make preparations for transplanting young oysters in quantity from the Periya Paar to the Cheval Paar in November, 1904, should it still be found necessary. This was the only wise course to take. A great part of the Cheval Paar was denuded, and there was no certainty that a fresh fall of spat would occur.

It is essential that the Inspector of the Pearl Banks should have the power, and the means, of ordering transplantation to be carried out whenever it may be required. In the present instance, however, the necessity has been obviated. In the late summer, or early autumn, an abundant deposit of spat has fallen over the greater part of the Cheval Paar, clothing the barren sandy wastes and covering the patches of old oysters and the rock alike, so that they are said to be indistinguishable to the diver. These young oysters, now about 4 months old, cover an enormous area, and must be present (judging from the samples examined) in numbers that run to thousands of millions. No doubt the vast majority of them will die off from natural causes during the next few years, but a fair proportion should remain to yield fisheries in 1908 and succeeding years. In the meantime, the barren areas of the Cheval Paar denuded by the two last fisheries are once more occupied. Transplanting is, for the moment, unnecessary, but cultching of some parts of the ground is urgently required. The position of affairs and the work necessary to improve the condition of the banks are fully discussed in the articles that follow.

The other change in conditions which has to be announced is that, of the various beds of adult oysters on the Cheval and Modragam paars, some are now dying off, or will probably do so during the coming year, while others are apparently healthy and undiminished. Under these circumstances certain beds (detailed in the article on the Present Condition of the Pearl Banks, p. 44) are clearly indicated for fishing first, and fortunately there seem to be sufficient adult oysters in sight to yield at least two and possibly three successive good fisheries. But, although the prospects are so good, it is the Biologist's duty to point out that now—when there are so many beds of oysters of different ages living together on the Banks—is especially the time when vigilance and effort must on no account be relaxed, when inspections must be frequent and complete and the scientific examination of sample oysters must be thorough, when cultching of sandy ground must be extensively undertaken, when thinning out of overcrowded beds should be carried out, and when the Inspector should be authorised to dredge up and transplant young oysters whenever it may seem desirable.

Next after the healthy development of beds of oysters comes the question of infection with the parasites necessary for pearl production. In the preface to Part II. the further work that lay before us in tracing the Fish-host upon which this infection must depend was pointed out, and Mr. HORNELL has continued to take every opportunity to get information and specimens bearing on the matter. Since the November inspection he has devoted some time to work amongst the fishermen on the shores of Dutch Bay (between Colombo and the Pearl Banks) with the view of obtaining for dissection some of the larger Elasmobranch fish caught by the natives. In this he has been very successful, and recent letters inform me (1) that he has now determined the Trygon-Rays which eat the oysters as being the "Walwadi tirikkai" of the Tamils, *Rhinoptera javanica*, and the still larger "Mundakanni tirikkai," *Rhinoptera adspersa;* and (2) that amongst the Entozoa he obtained from the former species was a Tetrarhynchid agreeing in the armature of its proboscides with the larval *Tetrarhynchus unioniformis* from the Pearl oyster. As the result of this work with the fishermen, Mr. HORNELL has recently made a large and varied collection of parasites which will be the subject of a final report by Mr. SHIPLEY and himself in PART IV.

W. A. HERDMAN.

THE UNIVERSITY, LIVERPOOL,
January, 1905.

REPORT ON THE PEARL OYSTER FISHERIES OF THE GULF OF MANAAR.—PART III.

THE PEARL FISHERY OF 1904.

[*Based on a Manuscript Report and Letters from Mr.* JAMES HORNELL, *F.L.S., Marine Biologist and Inspector of Pearl Banks.*]

SINCE this present investigation was commenced in the spring of 1902, the Government of Ceylon, after an interval of eleven barren years, has held two most successful pearl fisheries—the last of which, that in the spring of 1904, yielded over forty-one millions of oysters, and established a record from having given receipts amounting to well over a million of rupees. This is, however, by no means the whole of the value of the fishery, since the divers carry off as their share one-third of the spoil, and the benefits conferred directly and indirectly upon thousands of attendants and traders may be said to affect the prosperity of a large district. But, dealing only with nett proceeds, these two last fisheries combined have brought in to the Government of Ceylon considerably over £100,000. The prospects for another good fishery in the spring of 1905 are now excellent, and the adult oysters at present known to us on various parts of the Cheval Paar ought, if no unforeseen calamity occurs, to yield fisheries in 1906 and 1907. If cultching of the barren parts of the Cheval Paar and transplantation of young oysters from the Periya Paar, as recommended in the earlier parts of this Report, be carried on with vigour there is every reason to believe that still other fisheries will follow. Spat may fall naturally upon suitable ground at any time, or it may be prevented from so falling, for a series of years, by natural causes beyond the control of man. It cannot be trusted to come when and where it is wanted and we must not depend upon it.* But if a continuity of profitable fisheries, or even a fairly constant succession, can be ensured by the

* Since the above was written, Mr. HORNELL'S report on the November inspection shows that a fall of spat has taken place on the Cheval Paar; but I leave my words unaltered, as I believe them to be generally applicable, and their truth is not affected by this unexpected, somewhat exceptional, but very welcome, occurrence.—W. A. H., January 2nd, 1905.

expenditure of a few thousand pounds annually in cultching the banks and transplanting the young oysters, it is evident that the proceeding will be economically a sound one.

Mr. HORNELL, since I left him on the pearl banks in April, 1902, has kept me supplied with frequent letters and occasional longer reports—constituting, in fact, a journal of his doings and a discussion of his observations. He has now furnished me with a very full report upon the record fishery of 1904, and from this, supplemented by the letters received from him during the progress of the fishery, I have drawn up the following account. This Report upon our pearl oyster investigation would, I feel, have been incomplete without some description of the conditions under which a great fishery is held and of the methods adopted, both administrative and scientific, on the occasion.

Mr. HORNELL'S MS. report, though giving most valuable information, was not in a form intended for publication. It was sent to me as *material to make use of.* Parts of it, such as details of the "Racial types represented among the divers," are more or less irrelevant to our present purpose; other parts, such as discussions of the value of "Beacon marks," lists of "Casualties," and record of "Services of Staff," are of purely local interest from the administrative point of view. Consequently a good deal has been omitted and much has been re-cast. I have frequently, however, as will be seen from the quotation marks, employed Mr. HORNELL'S own words. Elsewhere his account has been used as the basis of the statements, or as the text which has called forth remarks or upon which an argument has been founded. From the knowledge which I gained of the locality and of the conditions of life during my visits to the pearl banks in 1902, on the "Lady Havelock" and the "Rangasami Puravi," I find it easy to follow and to realise the changes in the oyster beds; and I have no hesitation, in the light of the fresh evidence, in pressing my former recommendations that the "paars" be cleaned, thinned and improved by dredging and cultching, and that deficiencies in spat deposit be made good on all possible occasions by the transplantation of young oysters.

THE PREPARATORY INSPECTION OF THE NORTHERN PEARL BANKS.

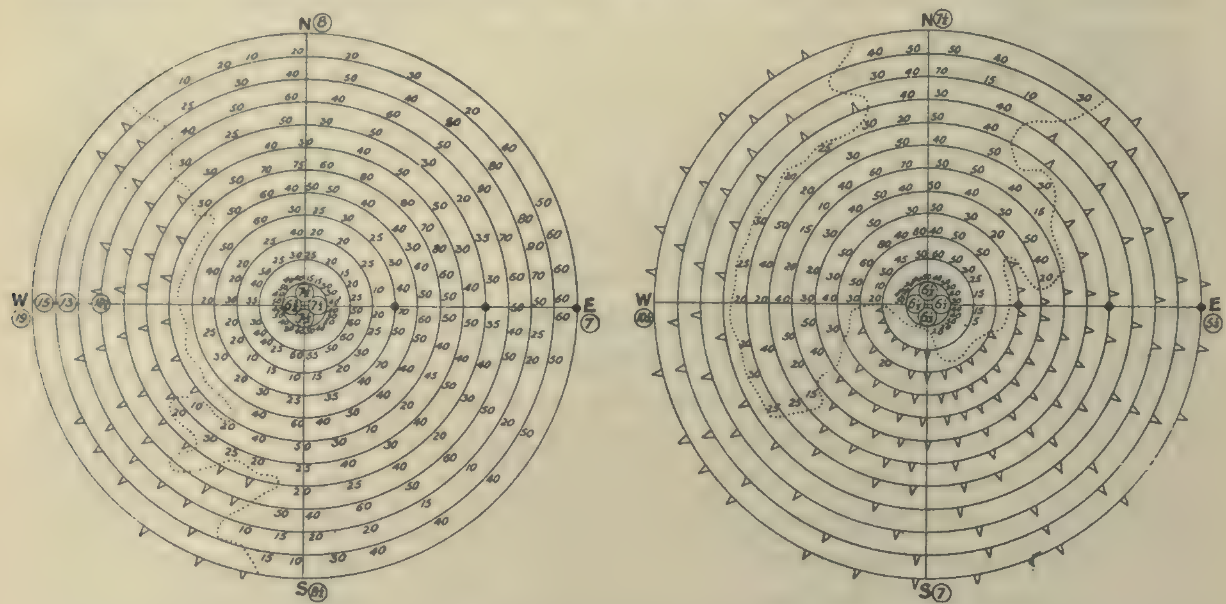
From the 26th January, 1904, on which date Mr. HORNELL was appointed Inspector of Pearl Banks in addition to his duties as Marine Biologist, until the 18th of the following month, his time was largely occupied with the multifarious preparations necessary before sailing for the pearl banks. Boats had to be repaired and painted, old stores overhauled and new ones procured, and at the same time a general supervision given to the fitting up of the steamer "Ready," which was to serve as an oyster-dredger. However, by February 18th, the last stores were on board, inclusive of over 6900 gallons of fresh water for the 70 men (divers, munducks, boatmen, &c.)

for whom provision had to be made, and the Inspector left Colombo in the native barque "Mohideen Bux" in tow of the steam dredger.

On arrival at Marichchukaddi, near the mouth of the Modragam River, the place selected as the centre of the pearl fishery and the site of the camp, on the morning of February 20th, it was found that—"no Government divers had arrived. The next day, seven Manaar men having put in an appearance, I resolved that the urgency of immediate inspection was too great to permit waiting longer for the laggards and left at 6.40 A.M. to do the best possible with these few divers—half the usual complement. The first step was to locate Captain DONNAN's sunken tanks marking the 'shoal buoy' position on the tail of Karativo shoal, and I was so fortunate as to find them within 10 minutes after anchoring on the place where I reckoned them to be according to the bearings of landmarks ashore. After laying down a large beacon buoy, as is usual at the beginning of inspections, I proceeded to take up my first inspection position at the centre of the South-west Cheval Paar."

Although the banks have been inspected on the previous November, it is always necessary to make an inspection of the beds of oysters which it is proposed to fish immediately before a fishery opens, so that the Inspector may be in a position to mark off the ground and regulate the number of boats and days allotted to particular areas. The method of inspection adopted was that introduced by Captain DONNAN (who was Inspector of the banks during our visit in 1902), modified in some details. The essential features are as follows:—Three flag-buoys are laid out by the attendant launch or tug-boat in the direction of each cardinal point of the compass, at distances apart of $\frac{1}{4}$ mile, the inmost buoys taking their distance from the inspection vessel, which is anchored to serve as a pivot mark in the centre of the circular area to be inspected (see fig. 1, p. 4).

Four inspection boats (modified whaleboats), each manned by a crew of six, together with three divers and two munducks, under the charge of an experienced coxswain, take up equidistant positions between the ship and the first flag-buoy on the north radial line, and row slowly round the ship, retaining with wonderful accuracy their relative positions the while. At regular intervals the crew rest on their oars to allow the divers opportunity to make descents and bring up oysters if any are present. The result of each dive is reported to the coxswain of the boat, who records the condition of bottom and oysters upon a diagram form with which he is provided. The oysters are retained in the boat for the Inspector to examine. The four boats, having each made a complete circuit, are next ranged in line abreast in the same manner as before, between the $\frac{1}{4}$-mile and the $\frac{1}{2}$-mile flag-buoys, and each then makes a second circuit. The day's work is completed by a third and last series of circles, in this case between the buoys distant respectively $\frac{1}{2}$ mile and $\frac{3}{4}$ mile from the ship. The four boats thus make a total of twelve concentric circuits, each boat making three. The results shown upon the coxswain's diagrams—each of which has three concentric circles drawn upon it representing the three circular paths covered are transferred by the Inspector to a final diagram or plan furnished with twelve concentric circles. When this has been done, the distribution of old and of young oysters is graphically shown for a circular area having a diameter of $1\frac{1}{2}$ miles (fig. 1 represents two such inspection areas on the Muttuvaratu Paar in 1902).



A. B.

Fig. 1. Inspection charts of (A) northern and (B) southern parts of Muttuvaratu Paar in November, 1902. There are four concentric circles made by the divers' boats between the centre and the $\frac{1}{4}$-mile buoy, four between that and the $\frac{1}{2}$-mile buoy, and four from that to the $\frac{3}{4}$-mile. Each complete area is therefore $1\frac{1}{2}$ mile in diameter. The numbers enclosed in rings indicate depths in fathoms. The numbers on the concentric circles give the quantities of oysters brought up at a dive on that spot. The cones indicate dives on a rocky bottom with no oysters. The dotted line therefore surrounds the oyster-bearing area.

After calculating in square yards the area occupied by oysters, the approximate number of oysters thereon may be estimated by taking the average number of oysters per dive (ascertained by examining the divers' results) in conjunction with the average amount of ground which a diver is credited with being able to clear at one descent. Usually this area is considered, on normal ground, to be from $2\frac{1}{2}$ square yards to 3 square yards. By assuming the area per dive to be 3 square yards, the danger of an overestimate is avoided. Inspection estimates are usually less than the total number of oysters obtained at the ensuing fishery. "Thus, at the 1904 fishery, I estimated the number of mature oysters to be 35,000,000, whereas the number actually fished from the area in question was roughly 37,000,000 (41,000,000 minus the amount of immature oysters fished on April 2nd)."

The North and South Modragam Paars were examined on March 5th, and in addition a series of diving and dredging traverses was made further north, in the region of the Vankali Paar, in fruitless search for the oysters found there during our visit in 1902. "The absence of good landmarks in the Aripu district made the inspection of this paar difficult, and I had to rely almost entirely on biological data, such as the nature of the bottom and the fauna, for the verification of my position. Without this help I could not have arrived at any certain conclusion."

How the Valuation Sample of Pearls is Procured.—Before a fishery it is also necessary to obtain samples of the oysters to be fished in order that their pearls may be officially valued for purposes of advertising the fishery. Consequently, during intervals in the inspection, three large samples of oysters of fishable age were collected from the three western blocks of the Cheval Paar, partly by means of divers and partly by the use of dredges. The results obtained showed the sample

Fig. 2. Valuation sample of pearl oysters from the Cheval Paar, being brought on board the "Rangasami Puravi," from the inspection boats—from a photograph by Mr. HORNELL.

of the South-west Cheval to be well ahead of the other two lots in the weight and the number of pearls to each 1,000 oysters; the Mid-west was extremely poor in both respects. The washing of the sample oysters and the sifting and subsequent valuation of the pearls was carried out in the usual way, the two former processes by the Government divers and munducks, the latter by three Mohammedan pearl merchants; all under the constant supervision of Mr. HORNELL, assisted by Mr. V. VRASPILLAI, the able Adigar of Musali.

"When the samples are brought into the Government Kottu, a palisaded enclosure, the sacks of oysters are emptied into dug-out canoes or 'ballams,' and covered carefully with mats. In this state they are left under guard for a period of from

7 to 10 days. Bacterial putrefaction alone is not relied upon to get rid of the flesh, the maggots of a species of blow-fly being the agency most in evidence and most desired. Under favourable conditions, at the end of 7 to 10 days, the so-called rotting period, the fly maggots should have eaten their way through everything, and have left nothing but empty shells and pearls behind. When the oysters are rotted in sacks, the time for washing is rendered evident by the pile of brown chrysalis cases—full and empty—that litter the ground immediately around the pile of sacks as well as encrust the sacks themselves.

"The time to wash having arrived, the covers are removed from the ballam, and coolies fill it to the brim with water. As the water level rises to the edge, a mad race for the points above the flood ensues among the maggots which float up in myriads from the lower recesses. The washers range themselves in line along either side, squatting on anything convenient—a canoe outrigger, an overturned tub, empty kerosine tins, and the like. They are stripped to the loin-cloth, and are not allowed to take their hands out of the water save to drop out the empty shells. The first process is to rinse the shells thoroughly, to separate the valves, and, by rubbing the outside of one valve against that of the other, to remove any detritus in which a pearl might lodge. The men scrutinize the nacreous lining for attached or shell pearls, placing any found in a special basket. The other shells, after a final rinse, are dropped outside the ballam at the washers' feet.

"After the quantity is reduced somewhat, the floating maggots are skimmed off, lifted by hand, and some of the water is baled out through a sieve, any material that remains therein being carefully returned to the ballam lest a pearl might be contained or entangled in the dirt. More water is then added, and the process of washing the shells is continued. At last all the shells have been removed and the men are then free to stand up and stretch their cramped limbs.

"A fresh supply of water is now poured in till the ballam overflows—a rough method of elutriation. Time after time this is repeated till the bulk of the lighter filth is got rid of. Then the remainder of the water is decanted, and the heavy *débris* in which the pearls are mingled is exposed on the bottom. More water is repeatedly poured in, the detritus or 'sarraku' the while being kneaded and turned over and over again.

"When this apparently interminable cleansing process comes eventually to an end, every scrap of sarraku is removed with scrupulous care to a cotton cloth and bundled up. One ballam full of oysters will usually furnish from two to three such bundles of pearl-containing dirt. The bundles of sarraku are opened later and spread to dry in the sun, undergoing a preliminary search at the beginning, and if wished at intervals during the drying. These early searchings yield usually the largest and therefore the most conspicuous of the contained pearls.

"When dry, the material is sifted out into several grades, and each is gone over time after time by the men employed (fig. 3). The final search—after it appears that even the dust-pearls, the 'masi-tul,' have been removed—is carried on by women and children, and it is amazing to see what a large quantity of small pearls their keen eyes and fine touch enable them to obtain. After the pearls are picked out it is

Fig. 3. Government divers picking out pearls from oyster washings.—Photo. by Mr. HORNELL.

the custom to offer the apparently exhausted dirt for sale, and ready buyers can always be found."

After the valuation was completed, and the results had been telegraphed to the Colonial Secretary for the purpose of advertisement, Mr. HORNELL utilized the few remaining days, prior to the advertised opening of the fishery on the 14th March, in an examination of the Karativo and Dutch Modragam Paars.

Method of Marking out the Fishing Ground.—On the 13th March Mr. HORNELL returned to the Cheval Paar and took up a position on the south-west corner of the south-west section, and marked out the ground for fishing in the following manner:—

"As the plan adopted was a novel one, the Government Agent kindly acceded to my request to notify the method by beat of tom-tom in the divers' quarters, intimating that the boundaries of the fishing ground would be marked by buoys bearing red flags, while a series of white flag buoys would be placed wherever fishable oysters were present. The divers were instructed to cluster their boats round the various white flags.

"These oyster buoys were placed according to the distribution of oysters mapped out after the inspection, but to guard against the possibility of mistake I verified the abundance of oysters at selected spots by preliminary dives before anchoring the buoys in position. The system proved a success, as by placing but a few white flags down at a time I was able to control the movements of the fleet and ensure the bank being fished in a methodical manner. At the next fishery I propose to introduce further improvements in this flag system, among others the marking of the flags individually with distinctive numbers and signs.

" **Discovery of Brood Oysters on the Periya Paar.**—The advertised date of opening the fishery found but a handful of divers assembled at the Fishery Camp at Marichchukaddi. The commencement being in consequence postponed, I took the opportunity afforded to examine the Periya Paar, and ascertained that over an area measuring at least 5 miles in length by $1\frac{1}{2}$ miles in width the bank bore its accustomed brood of young oysters.* As oysters have but once come to maturity upon any part of this paar during the past century, and that but a small patch, I hastened to recommend to Government a wholesale transplantation to the Eastern Cheval—the area cleared of oysters during the 1903 fishery—requesting the use of the dredging steamer for the purpose. This was granted, and I inspected a likely area on the East Cheval and laid down on the selected ground a set of five mark buoys for the guidance of the Master of the ' Ready ' when engaged upon the distribution of the dredged oysters. Unfortunately for these plans, the dredger, by reason of rough weather, was able to put in but $2\frac{1}{2}$ days at this work prior to April 9th, on which date I received instructions to place the ' Ready ' at Mr. DIXON'S disposal for the purpose of dredging mature oysters, and when, later on, the vessel again reverted to me, continuous bad weather had set in, rendering it impossible to work upon the exposed Periya Paar. As a consequence I had to cancel the cultching arrangements I had made to prepare the ground, and transplanting operations are in consequence postponed probably for at least a year.

" With regard to the future need of transplantation, I can but endorse Professor HERDMAN'S reiterated statement that *in this lies the true salvation of the pearl banks*. This being so, if Government approves of such recommendation, it will be absolutely necessary, in order to ensure success, to give me permission to arrange for and carry out an extensive programme of transplantation and cultching and to provide me with adequate means for the purpose, that is to say, I should have a dredging steamer at my disposal from the very date of finding young oysters fit for transplanting, and this steamer should be devoted solely to this work for the whole of the fine weather available and suitable for dredging. Only by transplantation on the greatest possible scale can success be assured. We have to remember the largeness of the object in view—nothing less than the formation of a bed of oysters of sufficient extent to allow for extensive wastage, due to a dozen different causes, and after such wastage to give a fishery of mature oysters calculable in millions.

" **Necessity for Extensive Cultching.**—Our observations show that the sections of the Cheval and Modragam paars giving the finest oysters and the most valuable pearl-yield are those possessing a well-cultched sandy surface, with somewhat restricted rocky outcrops. Unfortunately such areas are comparatively limited in extent, and

* The condition of these oysters will be discussed further on.

the major part of the Cheval, the north, north-east, mid-east and part of the south-east and south-west, with all the three central sections, consists of sandy bottom inadequately supplied with material suitable to serve as foothold to oysters.

"We now have sufficient knowledge of our local conditions to see that transplantation must go hand in hand with extensive cultching if we are to obtain a full return for the labour and money expended on the former operation—indeed we may go further and say that the transplantation of young pearl oysters will be labour wasted unless adequate cultching operations be carried out concurrently. Appreciation of the vital importance of this fact caused me to apply for authority to obtain several hundred tons of broken rubble for cultching purposes as soon as transplantation was seen to be advisable last March. The proposal was at once sanctioned, and while waiting to begin transplanting I arranged, by the kindness of the Public Works Department, for the preparation of a trial shipment of 100 tons of broken calcareous sandstone from Kalpitiya. The stone was to be roughly broken to the size of the fist—about $3\frac{1}{2} \times 3\frac{1}{2} \times 2\frac{1}{2}$ inches. The full quantity had been prepared when the transplanting scheme was arrested and now lies ready for shipment whenever it be next required.

"It may be useful to add here that whenever good prices cannot be obtained for the pearl oyster shells accumulated during a fishery, the best purpose they can be put to is to relay them upon the depleted banks, where the ground is in need of cultch.

"I calculate that at the very lowest estimate 1 ton of shells will furnish as much cultch as 3 tons of Kalpitiya stone or rubble. As this quantity of the latter costs Rs. 11.25 (three tons at Rs. 3.75 per ton) I believe that it will be more economical for Government to refuse to sell the shells at any less price than Rs. 10 per ton, and to use them as cultch unless this minimum price be obtained.

"**Clean Banks Essential to Successful Cultivation.**—In this, as in the matter of cultching, we may with great advantage profit by the experience of European oyster culturists. They find it necessary to check the growth of many other organisms upon the banks, not only those that are active enemies of the oyster—star-fishes, whelks and the like—but also such animals as curtail the area which oysters may occupy or which consume food that would otherwise fall to the oyster. Seaweeds, too, are for the most part weeded out. As a consequence much can be done in cleaning 'foul' beds by means of the dredge. If the beds are in preparation to receive spat, all harmful matter is taken ashore—both direct enemies, such as star-fish, whelks, mussels, and also the various other animals that compete for food and so may be termed the indirect enemies of the oyster.

"Fortunately the Ceylon pearl banks are comparatively 'clean.' No fact struck me so forcibly when first I began to make diving descents as the paucity of injurious life on the better quality of the oyster-bearing paars. Wherever oysters were found thriving, wherever they were seen in vigorous growth and perfect health, the bank appeared to be comparatively free from deleterious matters.

"Where 'foul' areas are found, *i.e.*, where Sponges, Corals, Alcyonarians, Echinoderms and Ascidians abound, as on many parts of the Western Cheval and Muttuvaratu paars, the oysters, while numerous enough, are stunted and poor, suffering by competition with the host of creatures living upon the same diet of microscopical organisms. The only means of cleaning such a bed is to dredge it thoroughly, separating and removing the materials brought up."

On the Ceylon pearl banks the beds are too extensive to permit of dredging being undertaken with this sole object in view, but as this cleaning can and should go on concurrently with the dredging of spat for transplantation or of mature oysters for sale, we have herein an additional argument in favour of taking up dredging on a scale of considerable magnitude. We must not lose sight of the fact that dredging has a fourfold utility, namely, (*a*) in fishing oysters, (*b*) in cleaning the ground and removing enemies, (*c*) in thinning out overcrowded beds, and (*d*) in spat transplantation. Its value is not properly assessed if account be taken of the first item alone, or even of the first and the last. Every live coral removed and replaced by a fragment of clean cultch may mean the addition of three oysters at the next fishery; every star-fish destroyed probably means scores of oysters saved from destruction; every *Cliona*-riddled block of coral bleached on the shore will tend to reduce the widespread havoc this inconspicuous sponge causes amongst the oysters. The immense advantage that accrues from keeping the banks in a state of thorough cleanliness can well be appreciated by an agriculturist, who knows how his crops fall off if weeds be left unchecked, and if fungoid and insect pests be ignored.

Beacon Marks.—Sir WILLIAM TWYNAM has pointed out the need of fixed, well-defined landmarks from which bearings may be taken at all parts of the banks; and he states his belief (p. 20 of his 1902 Report) that this want of adequate landmarks resulted in the wrong bank being fished in 1836—two beds of young oysters being fished instead of the one proposed. Again he states that the fishery of 1860 on the Modragam was all but lost for the same reason—a long continued search of 3 days being necessary before the bed was re-discovered.

A notable advance was made this year by the erection of a permanent beacon on the tail of Karativo shoal, immediately to the south of the South Cheval Paar, to serve as the point of departure at the inspection of the whole Cheval area. Many years ago (1878) Captain DONNAN sank an iron tank close to this spot and subsequently (1883) he added a second. It was his custom at the beginning of each inspection to locate these tanks by bearings taken from Kudiramalai and by means of the inspection divers, and, when found, to mark the position temporarily during the inspection by a large beacon buoy—the so-called shoal buoy.

Captain DONNAN'S successor, Captain LEGGE, appreciating both the loss of time involved in the oft recurrent hunt for sunken tanks, and the danger of taking incorrect bearings when these tanks could not be located, requested sanction to have a permanent beacon erected. This was granted, but all efforts to erect it last year were rendered futile by unfavourable weather. Before leaving for inspection this year, Mr. HORNELL pressed upon the attention of Government the importance and urgency of another effort being made to place the beacon in position. Accordingly it was sent up once more under the care of Mr. LINDSAY, the general foreman of the Harbour Works Department, who, after very great difficulties due to the heavy ground swell always present on the shoal, eventually completed the erection successfully. One great safeguard has thus been created against the loss, by oversight, of oyster patches in the Cheval region, and valuable time will also be saved at inspections. "This Karativo shoal beacon consists of four iron piles driven 6 feet into the sand, braced together securely and bearing an iron telegraph pole secured by four wire stays. The apex of the pole bears two circular metal discs set vertically at right angles, the top being 43 feet 6 inches above sea-level, and therefore visible at a distance of $11\frac{1}{2}$ miles to an observer whose eye is 12 feet above sea-level. The depth of water where and when it was erected was 25 feet 6 inches at low tide. The position of the sunken tanks is latitude 8° 39′ 15″ N., longitude 79° 45′ 0″ E.; and the new beacon is distant therefrom 233 feet N., 3° W."

Mr. HORNELL states:—"My experience during the last two years, and especially during the last inspection, makes clear to me that a beacon in the Aripu district, together with an improvement by heightening of the present Kudiramalai beacon, is essential to efficient inspections. With respect to the cost of these, I would point out that whatever it might be, the amount would be as nothing compared with the loss of revenue entailed by the loss of a bank of fishable oysters through lack of proper beacon marks—a mischance which has occurred in the past probably oftener than we imagine. At a later date the scheme of land-marks might be completed and perfected by the erection of a beacon at the Doric and by the raising of Kallar Tower another 20 feet. For the present, however, urgency centres in the raising of Kudiramalai Tower and the erection of a beacon on Aripu Reef."

PARTICULARS OF THE FISHING OPERATIONS.

The news that a pearl fishery is advertised to take place in the Gulf of Manaar is conveyed throughout India and other parts of the coast of the East with amazing rapidity, and at the appointed time a heterogeneous population of from 20,000 to perhaps 40,000 natives gathers in a few days on what is usually an uninhabited desert—a bare sandy coast with jungle extending for miles inland. A temporary town, covering a site of about one square mile, and having streets (Main Street, Old and New Moor Street, Tank Street, Divers' Street, Chetty Street, Muttu Bazaar, and the like) of houses and shops, Government buildings, such as court house, prison, hospitals, markets, and offices of various kinds, is rapidly run up. 'Camp Town' is erected under the supervision of the Adigar of Musali, largely of bamboos and palm leaves (fig. 4), and is a prosperous and very busy centre of industry and trade during the few weeks of its existence. In the neighbourhood large water-tanks are constructed, some for the drinking supply, others for washing and for the divers to

Fig. 4. Beachmaster's (Muttutamby) house, tom-tom beater and other natives. Pile of cadjans (palm-leaf mats) for building in foreground.—Photo. by Mr. HORNELL.

bathe in when they return from the day's work. At the same time the fleet of some 200 fishing boats assembles on the shore (fig. 5), and a port with the necessary officials is constituted. The whole organisation is under the Government Agent of the province.

Fig. 5. Part of the pearl-divers' fleet at Marichchukaddi.—Photo. by Mr. HORNELL.

"Four distinct racial types were represented among the divers both at last year's fishery and at this—Coast Tamils, chiefly from the Madras Presidency; Moormen, or

Lubbais, drafted largely from Kilakarai and the neighbouring villages on the Madura Coast of the same Presidency; Malayalam men, from the southern portion of the Malabar Coast (Travancore principally), and lastly a compact body of some 250 so-called Arabs from Colombo and Jaffna. The first two groups comprised the bulk of the diving community (including both divers and munducks), accounting for 1989 and 3732 respectively out of a total of 7408 who attended at last year's fishery (*vide* 'Report on Fishery of 1903,' by Mr. R. W. Ievers, C.M.G.)."

Most extravagant statements are current in regard to the time a diver can remain under water. The Arabs are far ahead of all the others in endurance, their time under water being generally from 70 to 85 seconds. The Tamil and other divers have a lower average, varying from 35 to 50 seconds. The maximum for the best divers, in our experience, is not over 90 seconds. The diving goes on from daybreak (about 6 A.M.) to noon, and the divers' boats set sail for the banks soon after midnight, taking advantage of the land wind which then blows off shore, so as to be ready to start work with the light.

"On the 15th March, twelve Colombo and Jaffna boats, manned entirely with Arab divers, had taken up positions by daybreak around the barque. As is the habit of Arabs, these men fished quietly and methodically, and with great energy. By noon they were tired and satisfied with their catch, an average of 22,811 oysters per boat, and, hoisting sail, made for the camp. The next day a number of Tamil and Moorish divers appeared, and on the 5th day of the fishery the number of boats actually at work had increased to 148, while for several days in the height of the fishery just over 200 boats (202) were employed.

"The boats used by the divers at this fishery were of at least five distinct types – narrow single-masted canoes, with an outrigger, from Kilakarai on the Madura Coast; larger 3-masted canoes, from the Tanjore Coast; large 'Dhoneys,' from Jaffna and the north of Ceylon; large sailing lighters, from Tuticorin; and 'luggers,' with square sterns, from Paumban. Some of the large boats accommodated as many as 30 divers, and with the 'munducks' (the men who attend to the divers' ropes) and crew must have had about 65 men on board.

"Fishing on the South-west Cheval went on methodically and in a perfectly satisfactory manner for 17 days, by which time the bank proper was practically cleared of oysters. On the 18th day of the fishery the fleet, instead of settling down to glean over the fished ground, flocked to a patch of mixed oysters on the north-east corner of the south-west section, and as a heavy swell was rolling in from the south-west I did not judge it advisable to attempt to move them away. This day's catch of oysters proved phenomenal, totalling close upon 4,000,000 (3,919,712), of which the Government share, 2,609,445, sold for Rs. 39,058.79, being at an average rate of nearly Rs. 15 per 1,000. The oysters on this patch lay extremely thickly strewn in bunches upon a sandy bottom; I had not included them in my estimate of the south-west bed, considering it preferable to leave them for next year's fishery. However, the thinning out which this day's fishing entailed will have excellent results and conduce to more rapid growth during the intervening 12 months.

"Judging it time to abandon the south-west region, I moved the ship to the bed upon the North-west Cheval on the 3rd April, laying out a series of red flag buoys along the boundary and white flag buoys as fishing centres, as upon the South-west, and accordingly the fleet began work there upon the following day. A break in the hitherto excellent fishing weather unfortunately coincided, and from the 5th April more or less unfavourable weather prevailed steadily and practically without intermission, rendering fishing increasingly difficult. As a consequence the north-west bed was not exploited in the thorough manner characteristic of the fishery on the south-west section, and whereas 26,000,000 5-year-old oysters were taken from the latter bed as against an estimate of 19,500,000, upon the north only 4,500,000 were fished as against the estimate of 9,000,000. This less satisfactory result was, however, not due entirely to rough weather; many large patches were so thinly furnished with oysters that 5, 7, and 10 oysters per dive were the best possible—a condition of matters ill-suiting men who had been accustomed for over a fortnight to averages of 25 and 35 per dive.

"It became expedient therefore to open the last section—the mid-west—to fishing on April 12th, and on that date the boats lifted 1,244,070 oysters from this bed. From this date the wind increased greatly in force and, being accompanied by a heavier swell, it became impossible to set definite limits to the ground to be fished upon. The number of the boats at work began to diminish rapidly, and by April 16th the fishery terminated, so far as the fleet as a whole was concerned.

"From the 16th to the 18th April the weather was too boisterous to permit of any fishing. On the latter date, some of the Arab divers being willing, it was arranged that they should be sent out aboard the steamers 'Ready' and 'Serendib' to carry on diving from these vessels. In all 44 responded to this emergency call, and I superintended their work on April 19th, beginning fishing at 10.10 A.M. and ceasing at 3 P.M. During the whole time the weather conditions were the worst possible, a heavy sea running, accompanied by a chill, cutting wind. The men worked most pluckily and with the utmost good humour. The majority did not touch food all the time they were aboard, from 5.30 A.M. to nigh on 6 P.M. This day's work by these 44 Arabs stirred up emulation in the breasts of their co-religionists, the Kilakarai Moormen, and enabled the fishery to be carried on in spite of the boisterous character of the weather for 4 days longer and with a gain to Government of Rs. 15,580.

"By this time the great majority of the divers' boats had left Marichchukaddi, and on the 23rd April it was seen to be impossible to attempt to further prolong the fishery, which thus expired, after a nominal length of 33 fishing days; on 7 days, however less than 200,000 oysters fell to Government share, owing to the unfavourable nature of the weather on these days; so under these circumstances the grand total of just over 41,000,000 oysters was an extremely satisfactory result. Last year's fishery produced an almost identical number, 41,169,637, spread over 38 fishing days of continuously fine weather. Had similarly favourable conditions prevailed this year the divers would certainly have fished another 8,000,000 oysters, and would probably have raised the grand total to 50,000,000."

It is said that even the large amount of pearls obtained from these oysters is not the total number fished up, as during the 3 or 4 hours' sail home from the banks opportunity is given to the divers and their boats' crews to abstract some of the finest from an occasional gaping shell. These illicit pearls, concealed it may be in the eyes, or in the cavities of the nose, are often discovered by the official searchers before the men leave the Government kottus. So there is some ground for supposing that the divers really carry off a good deal more than the one-third of a fishery to which they are entitled. The kottus where the oysters are received from the boats and separated into piles are large enclosures close to the beach, surrounded by high fences of wattling (fig. 6) and having sheds thatched with palm leaves. Here the

Fig. 6. Government divers and munducks picking out pearls in the kottu.—Photo. by Mr. HORNELL.

Government officials and clerks assign a separate compartment to each boat's crew as it arrives with a load of oysters. The first proceeding is for the divers to divide their oysters into three heaps, one of which is destined to be their own, and there can be no doubt that they make these piles as nearly equal as they possibly can, since they have no means of knowing which one the official will presently point out as their share. The divers now carry off their own oysters and emerge from the kottu on the landward side after running the gauntlet of the searchers. They are at once surrounded by a crowd of natives anxious to buy oysters in small quantities, by the dozen or even singly. The diver usually disposes of his whole stock in this way in a very short time, and then spends the remaining hours of the day in bathing and resting.

Inside the kottu the clerks are now counting the millions of oysters left as the Government's share; and about sunset the Government Agent puts them up for sale by auction at the Court House. The prices bid are per thousand, and may vary from 20 to 80 rupees, and the buyer can take one or more thousands at the price he bids. The kottu with its valuable contents is closed and guarded during the night, and in the morning the buyers remove the oysters to their own enclosures, and then the lengthy and unpleasant process of washing the rotting oysters begins. Some of our figures (fig. 3 and fig. 6) show the examination of the "sarraku" or residue for pearls, while fig. 7 shows Tamils, outside the kottu, searching for attached or blister

Fig. 7. Tamils searching the washed shells.—From a photograph by Mr. HORNELL.

pearls amongst the piles of shells thrown out after washing. Fig. 8 shows two pearl merchants, who sit all day ready to buy or sell, weighing, discussing and playing with their gems. They have basket-like sieves for grading the pearls, and curious little scales with scarlet seeds for certain weights. These capitalists (many of them Moormen and Bombay merchants) are an important section of the population of "Camp Town." There are also the pearl-cutters and "fakers," who carry on their business in the street at little three-legged wooden work-tables and with simple bow-drills, by means of which they pierce the pearls for stringing. All these workers who have some definite connection with the fishery or the pearl require others to

Fig. 8. Pearl merchants.—From a photograph by Mr. HORNELL.

supply them with the necessaries and the luxuries of life, and so is brought together the large heterogeneous population. But as soon as the fishery closes the whole town appears to dissolve in a day, the people separate in all directions as rapidly as they gathered, and Marichchukaddi is again a solitary sandy waste.

THE OYSTER DREDGING EXPERIMENT.

At the 1904 fishery, amongst other new departures, some of which have already been noted, oyster dredging from a steamer was tried for the first time with a view to supplement the work of native divers.

The experiment was, however, carried on with imperfect apparatus and under difficulties which will certainly disappear as further experience is gained. The steamer "Ready," engaged for this work during the greater part of the fishery, was found to be unsuitable in several particulars, and Mr. HORNELL has made a number of recommendations in regard to the deck fittings and gear, which will lead to greater efficiency and economy of time by working a larger number of dredges simultaneously.

Mr. HORNELL has kept an exact record of the dredging results day by day, which, however, considering the imperfect nature of the experiment on this first occasion, need not be published. After a discussion of the results he concludes as follows :— "At 70,000 to 80,000 oysters per day I should consider the steamer to be giving very satisfactory results, but I wish to emphasize the fact that the best results can be hoped for only from a few of the banks, *i.e.*, the North Modragam, certain large regions of the Cheval, and some of the smaller and less important paars. The South Modragam and the remainder of the Cheval occupy a somewhat doubtful position, and further working experiments are necessary before we can pronounce a definite verdict regarding the prospects of commercial success in fishing by means of the dredge. I believe, however, the advantages of dredging to be greatest in regard to spat transplantation—as has been explained elsewhere in this Report. Dredging is also of great assistance in the preliminary or prospecting inspections—when it is necessary to ascertain the presence or the absence of oyster patches on grounds too extensive for detailed examination by means of divers."

Details of the Oysters Found.

The oysters found during the recent inspection were of two distinct generations, the older being from $4\frac{1}{4}$ to $4\frac{3}{4}$ years old, the younger from $2\frac{1}{4}$ to $2\frac{1}{2}$ years. The former were of the same brood as those fished on the Eastern Cheval in 1903, and were therefore of a very satisfactory age for fishing this year (1904). Those of the younger brood will hereafter be termed "immature," not in the sense of sexual immaturity, but in regard to pearl-yield.

The fishable oysters lay as a discontinuous north and south band along the seaward or western side of the Western Cheval. Save for a scattered remnant left over from last year's fishery (1903) on the Eastern Cheval, and for occasional individuals forming the nuclei of bunches of younger oysters on the parts covered by the immature generation, no other oysters of fishable age were found. Those present last year on the Periya Paar Kerrai and Vankali Paar were gone, and the huge bed upon the Muttuvaratu Paar, estimated by Captain Donnan, in 1902, at a total of 277,000,000 oysters, and which would have been fishable this year, had also disappeared, being partially replaced by a later brood of $2\frac{1}{2}$-year-olds. On the Karativo Paar, also, none of the 25,000,000 oysters, $1\frac{1}{2}$ to 2 years old, found there in April, 1902, remained, the bank being bare save for a few handfuls of 2-year-olds. A small bed of this fresh generation of oysters was also discovered on the Dutch Modragam Paar.

The details respecting the number and distribution of the oysters present may be summarized thus :—

Number, Distribution, and Sizes of the Fishable Oysters.

The beds of $2\frac{1}{2}$- to 3-year-old oysters on the Western Cheval (comprising the south-west, mid-west, and the north-west sections), which we saw for the first time during our visit to the banks in February, 1902, were found to have the same general disposition, but to have largely decreased in area and to be represented by several detached patches thickly covered with 4½- to 5-year-olds on the South-west Cheval, by a large area of more thinly spread oysters of the same age on the north-west section, and by a third of rather smaller extent on the mid-west, the southern end of the last named joining the north-west patch on the south-west section.

"The south-west patches covered in the aggregate an area of 2,754,021 square yards, with an average of 22 oysters per dive on 1,778,676 square yards and of 21 on the remainder. As each dive is estimated to account for an area of 3 square yards, I estimated the total number of oysters on this section to be 19,500,000, sufficient to give daily loads of 10,000 oysters per boat to a fishing fleet numbering 100 boats for a period of 19½ days, each boat being presumed to have a complement of 10 divers.

"The oysters on the north-west section amounted to 9,000,000, covering an area of 1,685,460 square yards, a number based upon an average of 20 oysters per dive on 716,100 square yards and 13 per dive on 969,360 square yards. Although apparently sufficient to give fishing for 100 boats for 9 days at an average load per boat of 10,000 oysters, the result of the fishery showed that the number of oysters per dive on certain portions of this bed was too low to give profitable results, with the consequence that the fleet had to be moved off after only five days' fishing and the removal of a little over 4,000,000 oysters—rather less than half of those present.

"The bed on the mid-west had an area of 992,250 square yards, whereon I estimated there were 6,500,000 oysters, being at the rate of 20 per dive. These oysters were smaller for their age than those of the south-west and most of those on the north-west sections.

"The total number of fishable oysters on the three sections of the Western Cheval I estimated at 35,000,000, equal to 35 days' fishing for 100 boats. By far the most important of the beds found in respect of numbers as well as condition were the patches on the south-west section, for here not only were the oysters splendidly grown for their age, but they were absolutely free from mixture with young. Everywhere else there was more or less admixture of young of 2 to 2½ years of age, especially upon the eastern margin of the ground where they adjoined the beds of the immature generation.

"Over those parts of the South, South-east, and South-central Cheval, and North Modragam occupied by oysters, the older oysters, while nearly universally present, were in a very small minority, averaging not more than 1 to 6 of those 2½ or 2 years old. Here and there on the northern edge of the South-east Cheval were small patches of little mixed 4¼- to 4¾-year-old oysters, the remnants of the bed fished last year.

"As was to be expected, the Periya Paar Kerrai, ravaged by ray-fish (Trygonidæ) in March, 1903, gave no results, and but a few oysters of no fishery value were found on the Kondatchi Paar, ground that is utterly bad for oyster growth under present circumstances (*infra*).

"The sizes of average samples from the three sections of the West Cheval are as follows :—

Name of Bank.	Height of oyster.	Length.	Breadth.
	millims.	millims.	millims.
South-west Cheval . . .	76·20	69·20	32·32
Mid-west ,, . . .	72·30	65·25	31·70
North-west ,, . . .	72·87	66·50	31·57

"Some exceptionally fine oysters from a patch at the extreme south end of the Mid-west, a patch lying upon sandy bottom, rose to the high average dimensions of 76·56 millims. by 69·16 millims. by 34·44 millims. If we exclude the last-mentioned oysters as being exceptional, we get as the general average of the 4¼ to 4¾-year-old oysters fished this year 73·79 millims. by 66·98 millims. by 31·86 millims.

"During the course of last year's fishery (1903) I found the average size characteristic of oysters on the Eastern Cheval to be 75·51 millims. by 69·18 millims. by 31·18 millims. Both lots originated from the same brood, and it is significant that, although this year's oysters are a full year older, their size, except in respect of breadth, is decidedly inferior to the average of those fished last year from the Eastern Cheval. This marked character, due to stunted growth, has long been associated with oysters from this particular region, and has frequently been referred to by Sir WILLIAM TWYNAM and by Captain DONNAN. Occasionally this stunted growth has been so extreme that the divers and merchants have referred to such oysters as being of the 'Kottapakku' variety, a form which is undoubtedly correlated with overcrowding on extensive stretches of rocky bottom."

Number, Distribution, and Sizes of the Immature Oysters.

"Immense quantities of immature oysters varying from 2¼ to 2½ years old covered practically the whole space on the eastern half of the Mid and North-west sections, extending eastwards into the North-central, Central, and South-central areas. The South and the South-east Cheval also bear very large quantities, as do also the North and South Modragams.

"A fair-sized bed, plentifully covered with oysters, is at present on the Dutch Modragam Paar, but they are too young to fish for at least a year, as the age of the majority varies from 2 to 2½ years. These oysters represent the young spat which was noted as abundant in November, 1902 ; their growth has been at the expense of the older oysters that were present that year, and which have been killed off by the more vigorous and numerous young.

"The size of those on the North and South Modragam paars and those on the South, South-east, and South-central Cheval, is greater than that of those upon the remaining sections, including also the Dutch Modragam, indicating more vigorous growth and a better food supply. Indeed, many of the oysters have a superficial appearance of being from 3 to $3\frac{1}{2}$ years old. The general superiority of these oysters is well brought out in the following tabulation of the average size of representative oysters from each of the localities named :—

Locality.	Height of oyster.	Length.	Breadth.
	millims.	millims.	millims.
South-central Cheval	$67\frac{3}{25}$	$61\frac{4}{25}$	$27\frac{6}{25}$
North-west „	56	$51\frac{4}{5}$	$23\frac{13}{15}$
North-west „ (another part)	$61\frac{1}{3}$	$57\frac{1}{2}$	$23\frac{3}{4}$
Mid-west „	$56\frac{3}{5}$	$52\frac{3}{5}$	$24\frac{3}{5}$
South Modragam	$68\frac{17}{25}$	$64\frac{4}{25}$	$27\frac{7}{25}$
Dutch „	$58\frac{19}{25}$	$53\frac{18}{25}$	$25\frac{11}{25}$
Karativo Paar	$58\frac{19}{25}$	$55\frac{8}{25}$	$24\frac{4}{5}$

"There are few oysters of an age less than 2 years mixed with these—an important favourable factor, as the fall of abundant spat upon a bed of oysters approaching maturity is one of the most serious dangers that beset the fruition of an oyster bed, and one that is most difficult to combat."

Summary of the Past History of the Oysters Found.

The oysters fished this year were first seen in March, 1900, by Captain Donnan, who reported that over the whole of the Western Cheval, an area nearly $5\frac{1}{2}$ miles long by 1000 to 4000 yards wide, young oysters 3 to 9 months old were thickly spread. The area actually covered was estimated at 5800 acres. During the 12 months following a great decrease took place in the number of oysters present and in the acreage covered, the Inspector reporting that the solid phalanx of 1900 had been broken up into three detached beds totalling only some 1685 acres bearing 80,000,000 of oysters.

A year later (February and March, 1902), during our visit to the banks in the "Lady Havelock" and with Captain Donnan in the "Rangasami Puravi," we saw these oysters and noted the marked inferiority of their size to that of oysters of similar age upon the Eastern Cheval. Captain Donnan's estimate of their numbers was 123,357,000 oysters, spread over an area of 2170 acres. At the same time it was noticed as a disquieting feature that the fresh fall of spat so generally distributed over the banks had invaded the Western Cheval—a large proportion of the older generation bearing each several young attached to the valves. These young oysters, upon which we now rely for the next immediate fisheries, appeared when first seen (February, 1902) to be from 2 to 6 months old. Besides having invaded the Western Cheval, immense quantities were found on the South and North-central, South and South-east Cheval regions, and also upon the two Modragams, as well as upon many of the southern banks extending from Negombo to Karativo.

In November, 1902, the numbers on the Western Cheval bank were given by Captain LEGGE as 57,605,000, occupying 936 acres, but, owing to bad weather, the whole of the bank was not surveyed. No other numerical estimate was made till Mr. HORNELL's inspection of this year, when a very careful estimate placed the number remaining at 35,000,000 upon 1122 acres. Tabulation of the above facts shows this history clearly.*

Date.	Number estimated.	Age in years.	Acreage.	Number per dive.
March, 1900	Too great for calculation	½ to ¾	5800	—
„ 1901	80,000,000 (?)	1¼ „ 1¾	1685	21 to 30
„ 1902	123,357,000	2¼ „ 2¾	2170	27 „ 40
November, 1902 (inspection incomplete)	Over 57,605,000	3 „ 3½	Over 936	—
February, 1904.	35,000,000	4¼ „ 4¾	1122	13 to 22

The discrepancy between the estimates for 1901 and March, 1902, appears largely explicable by the estimate of oysters per dive having been either too low for the former year or too high for the latter, estimates being liable to variation with every condition that affects a diver's powers of working. Divers have been known to bring up from one particular spot only 10 oysters per dive when the weather conditions were unfavourable, and yet the following day, the sea being calm and warm, the same men would report double the number. To arrive at accurate estimates, the weather conditions, if adverse, should be allowed for, and the total number increased accordingly.

In November, 1902, the encroachment of the younger generation had markedly increased, and with the growth of the smaller ones many portions of the Western Cheval bank—the parts where they were most abundant—had to be transferred from the category of regions bearing maturing oysters to those monopolised by the younger generation.

" In February, 1903, no regular inspection was made of these latter regions, but by means of numerous descents in a diving dress I was able to obtain a fair knowledge of the distribution of the younger oysters. On the Cheval and the North and South

* See also Part II. of this Report (1904), p. 15, and figs. 9 to 14.

Modragam the young already noted were found well grown and flourishing, and, while their actual age was only $1\frac{1}{4}$ to $1\frac{1}{2}$ years, many, especially upon the Modragams and South Cheval, had the appearance of being 2 years old. On the Muttuvaratu and Dutch Modragam the older oysters had made no increase in size, and were in an unhealthy and miserable condition. Mixed with them were considerable numbers of a younger generation, apparently over 1 year old. This year, as already stated, the older generation proved to have died off upon the Karativo, while the younger generation found last year had made fair progress and appeared moderately healthy. Similar conditions, I believe, characterise the Muttuvaratu this year, judging from the rather meagre data at my command."

Rate of Increase in Size.—So little is known with exactitude concerning the rate of growth of oysters, that the following tabulation by Mr. HORNELL of the observed increase in size of these younger oysters has considerable value.

TABLE showing Rate of Growth of Oysters aged $2\frac{1}{4}$ to $2\frac{1}{2}$ Years, March, 1904.

Date.	Age in years.	Size in millimetres.
I. SOUTH-EAST AND SOUTH-CENTRAL CHEVAL :—		
March, 1902	$\frac{3}{12}$ to $\frac{6}{12}$	$35 \cdot 00 \times 32 \cdot 00 \times$ —
November, 1902	$\frac{11}{12}$ „ $1\frac{2}{12}$	$50 \cdot 57 \times 47 \cdot 52 \times$ —
March, 1903	$1\frac{1}{4}$ „ $1\frac{1}{2}$	$54 \cdot 41 \times 49 \cdot 75 \times 20 \cdot 38$
„ 1904	$2\frac{1}{4}$ „ $2\frac{1}{2}$	$67 \cdot 12 \times 61 \cdot 16 \times 27 \cdot 24$
II. MODRAGAM PAARS :—		
March, 1902	$\frac{3}{12}$ „ $\frac{6}{12}$	$37 \cdot 15 \times 33 \cdot 20 \times$ —
„ 1903 (North) . . .	$1\frac{1}{4}$ „ $1\frac{1}{2}$	$61 \cdot 17 \times 54 \cdot 50 \times 24 \cdot 28$
„ 1904 (South) . . .	$2\frac{1}{4}$ „ $2\frac{1}{2}$	$68 \cdot 68 \times 64 \cdot 16 \times 27 \cdot 28$
III. NORTH-WEST CHEVAL :—		
March, 1902	$\frac{3}{12}$ „ $\frac{6}{12}$	$33 \cdot 50 \times 30 \cdot 75 \times$ —
November, 1902	$\frac{11}{12}$ „ $1\frac{2}{12}$	$47 \cdot 64 \times 44 \cdot 36 \times$ —
March, 1904	$2\frac{1}{4}$ „ $2\frac{1}{2}$	$56 \cdot 60 \times 52 \cdot 60 \times 24 \cdot 56$
„ 1904 (another locality)	$2\frac{1}{4}$ „ $2\frac{1}{2}$	$61 \cdot 33 \times 57 \cdot 40 \times 23 \cdot 70$

When these records are extended over the remaining life-period of these oysters we shall have, for the first time, reliable data as to the relative rate of growth from year to year upon three of the most important of our oyster banks.

The respective increases during the first two annual intervals are as follows :—

	South-east and South Cheval.	North-west Cheval.	Modragams.
	millims.	millims.	millims.
12 months from age 3 to 6 months.	$19 \cdot 41 \times 17 \cdot 75 \times$ —	—	$24 \cdot 02 \times 21 \cdot 30 \times$ —
12 months from age $1\frac{1}{4}$ to $1\frac{1}{2}$ years	$12 \cdot 71 \times 11 \cdot 41 \times 6 \cdot 86$	—	$7 \cdot 51 \times 9 \cdot 66 \times 3 \cdot 00$
Total for two years .	$32 \cdot 12 \times 29 \cdot 16$	$25 \cdot 46 \times 24 \cdot 25$ (average)	$31 \cdot 53 \times 30 \cdot 96$

It will be noted that while the growth of the Modragam and of the South-east and South Cheval oysters has been greater and more rapid than that of those upon the Western Cheval, the Modragam oysters, growing more quickly than those of the South-east and South Cheval up to the age of $1\frac{1}{4}$ to $1\frac{1}{2}$ years, and thereby attaining larger size, suffered retardation in the rate of increase thereafter, making but 7·51 millims. $\times$ 9·66 millims. $\times$ 3·00 millims. increase, whereas the South-east and South Cheval oysters made 12·71 millims. $\times$ 11·41 millims. $\times$ 6·86 millims. in the same period, and so reduced the disparity in size caused by the more rapid growth of the Modragam individuals at the earlier age—so much so that the difference between them at the age of $2\frac{1}{4}$ to $2\frac{1}{2}$ years is but 1·56 millims. $\times$ 3·00 millims. $\times$ 0·04 millim.

This lends support to our previous statement (this Report, Part I., 1903, p. 136) that shell growth is most vigorous during the first two years of life, or, as we may now put it, up to the size of about 60 millims. $\times$ 54 millims. $\times$ 24 millims., and that thereafter it slackens to a very slow rate, actually coming to a stand, or even retrograding as regards height and length in the case of the stunted oysters of the Muttuvaratu and the Mid-west Cheval.

As examples of this slowness of growth in older oysters we may take those fished this year from the South-west Cheval. These were the most vigorous and freely grown as regards the general average, and yet the increase made from November, 1902, to March, 1904, was but 5·31 millims. in depth by 3·77 millims. in length, *i.e.*, between the ages of say $3\frac{1}{2}$ to $3\frac{3}{4}$ and $4\frac{1}{2}$ to $4\frac{3}{4}$ years (size in November, 1902, was 71·25 millims. $\times$ 65·39 millims.). Contrast with this the increase *within the same period* (16 months) when the oyster is younger, say between the ages of $\frac{11}{12}$ to $1\frac{2}{12}$ and $2\frac{1}{4}$ to $2\frac{1}{2}$ years. In the case of oysters of this age from the South Cheval, the increase has been, as shown above, as much as 16·55 millims. $\times$ 13·64 millims., and in the case of the North-west Cheval 13·69 millims. $\times$ 13·04 millims.—a remarkable difference indeed.

Again we see that the disparity of growth is most marked during early life—up to the age of 2 years—so that oysters situated in exceptionally favourable conditions attain such dimensions that they are liable to be credited with greater age than knowledge of their origin will warrant. This circumstance may account for some of the differences of opinion as to the ages of young oysters in the past (see, for example, the oysters attached to the Karativo buoy in 1866, described by Mr. HOLDSWORTH and discussed by Sir W. C. TWYNAM—Report, &c., Colombo, 1900).

CAUSES OF DECREASE AMONG THE FISHABLE OYSTERS SINCE MARCH, 1902.

The factors which tend to reduce the number of oysters, both old and young, have been treated of at some length in former parts of this Report, and it is only necessary here to discuss the causes which have led to great decrease since 1902 in the old oysters that were fished this year on the Western Cheval and the disappearance of the same generation from the Muttuvaratu, the Dutch Modragam and the Karativo paars. The decrease appears to have arisen from two chief causes, overcrowding and sand disturbance, the ill-effects of which have been intensified by several other influences of subsidiary importance. The former affected the beds in the North-west and Mid-west of the Cheval sections, with the Muttuvaratu and Karativo paars; the latter those of the South-west Cheval.

Sand Disturbance did the greatest harm upon the South-west Cheval, as this area has but few stretches of exposed rock surface, while "cultch" is not sufficiently abundant. When first seen by Captain DONNAN in 1900, the whole area was thickly spread with oysters on the sand as well as on the rock and on the cultch-strewn areas. With every recurrent period of stormy weather since that time these oysters have suffered thinning by encroachment and overwash of sand, till eventually they were cleared from off the sandy uncultched areas and only those were left that lay on rocky ground and on sufficiently cultch-covered bottom.

A subsidiary cause of destruction was the ravages of the boring sponge, *Cliona margaritiferæ*, which appeared specially active on this section, riddling the valves and apparently sapping the vitality of the oyster by the drain it caused upon nacre-secretion. Out of 400 individuals examined 310 were affected by *Cliona*—less than 23 per cent. were free from the infection.

Apart from this the oysters of the South-west Cheval were the healthiest, the bodies being plump and well developed, whereas a considerable proportion of those from the Mid-west and North-west sections were thin and of poor appearance.

The Effects of Overcrowding.—Sand disturbance produced comparatively little numerical reduction upon the North-west and Mid-west sections, these regions possessing more extensive stretches of rocky bottom than any others in this neighbourhood. The reduction here was due primarily to the effects of overcrowding, not, perhaps, so much because of their own numbers, great as these were originally, but rather because of deposits of spat which fell in July and December of 1901 upon the older oysters along the eastern part of these sections. For the first year the effects were little marked, but as the myriads of new-comers flourished and increased in size the well-being of the older generation was affected, a result that showed itself first by arrest of the growth of the shell and then, later, by starvation, lowered powers of vitality and reproduction, and wide-spread mortality.

Regarding the arrest of growth, we noted that the older oysters on the Mid-west Cheval measured 69·42 millims. × 64·54 millims. in March, 1902, when they were $2\frac{1}{2}$ to $2\frac{3}{4}$ years old, while survivors on less thickly populated parts of the bank were only 72·30 millims. × 65·25 millims. in March, 1904, an increase in size of but 2·88 millims. in height by 0·71 millim. in length in 2 years, a growth so slight as to justify the conclusion that oysters from the Western Cheval practically attain their maximum height and length upon reaching the age of 3 years, increasing thereafter in no appreciable extent save in thickness, which is due to deposits of nacre upon the inner surface of the valves.

In the case of the Muttuvaratu, the Karativo and the Dutch Modragam paars, the disappearance of the oysters has been total, caused not so much by the competition introduced by the presence of myriads of vigorous young—though this also existed and no doubt had some effect—as by the overcrowding and diseased condition set up by the immense number of adults. This has had such baneful effect that when Mr. Hornell saw them in March of last year they showed marked deterioration upon their condition 4 months previously, while their average size showed actually a decrease in height and length (58·84 millims. × 54·32 millims. in November, 1902, as against 57·54 millims. × 54·00 millims, in March, 1903). These oysters are in a shrunken, poorly nourished condition, and out of 227 examined, 25, or over 11 per cent., were affected with the "yellow" disease—a malady marking the imminence of wide-spread mortality, and characterised by the invasion of most of the tissues by immense numbers of leucocytes crowded with yellow granules.

That the Muttuvaratu oysters should have been entirely cleared away, while a relatively large number of the same generation is left upon the Western Cheval, is undoubtedly due to the overcrowding having been less acute and less wide-spread in the latter case.

Subsidiary Causes.—The general enemies of the pearl oyster were present as usual, such as star-fish, boring molluscs and the smaller oyster-eating fishes (*Balistes*, &c.). The two former, the star-fishes especially, do much harm, and their reduction in number is one of the benefits to be derived from dredging on a large scale. The smaller oyster-eating fishes have not been excessively numerous upon the Cheval and are not at present a destructive agency, seeing that the oysters are now too large and too strong to be crushed by the small jaws of these fishes. Their ravages are only to be feared when a bank is covered with spat; then these fishes gather from all quarters and, if the deposit is limited and the nature of the bottom sufficiently smooth, the attack may involve partial or even entire annihilation of the bed. The boring-annelid, *Polydora* sp., was markedly abundant on the South-west Cheval, but comparatively few bad cases could be traced to its tunnelling. Far otherwise was it with the inroads of the boring sponge, *Cliona margaritiferæ*, already alluded to. Hundreds of valves were examined where not only was the substance of the shell riddled by its honeycomb-like tunnels (see fig. 9), but, a more serious matter, the

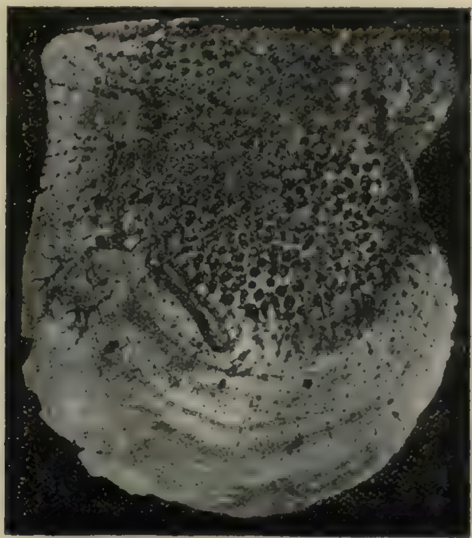


Fig. 9. Pearl-oyster shell honeycombed by *Cliona margaritiferæ*, DENDY.

insertion scar of the adductor muscle was tuberculated and diseased, a condition due to the inferior powers of nacre-production of the epidermal layer in this region. "So great indeed was the nacreous tuberculation in some cases, that I have seen the natives save these shells with a view to cutting the tubercles off to use in the manufacture of native pearl jewellery." Whenever the inroads of *Cliona* were extensive, the sub-epidermal tissue in particular, and the other tissues in general, were thin and diseased-looking. A fairly large proportion of the dead shells found during the fishery on the South-west Cheval was badly affected; *Cliona* must undoubtedly be included among the more destructive agencies with which we have to contend.

"There was no evidence of any depredations on the part of Ray fishes this year, like the destruction of the Periya Paar Kerrai oysters last year. Rays were, however, several times seen; on the 27th February a large shoal, heading south, passed the ship at anchor on the North-west Cheval. The sight was a remarkable one, the sea for over 20 yards square being one patchwork of yellow disk-like bodies. Fair-sized examples of *Trygon walga* were caught from time to time. None of them furnished direct incriminating evidence, the stomachs being filled with crustacean *débris* and fragments of lamellibranch shells other than those of the pearl oyster. Like the trigger fishes, these smaller rays would appear to find the present size and strength of the oysters too great for the power of their teeth and jaws."

No sharks were seen on the fishing grounds. Mr. HORNELL says: "During all the months I have spent upon the pearl banks during the last $2\frac{1}{2}$ years, I have never had a glimpse of a shark dangerous to man. Several times the boatmen have caught 'basking-sharks'* of considerable size, but all were of a species that lives almost entirely upon small fishes and mollusca."

CONDITION OF SPAT ON THE PERIYA PAAR IN 1904.

"March 14th was devoted to an inspection of the Periya Paar, with the result that an immense bed of oyster spat† was there discovered. The young oysters were incredibly abundant, spread densely over an area fully 5 miles in length by from 1 mile to $1\frac{1}{2}$ miles in width. The age was under 3 months, so that they must have been spawned not earlier than December of 1903, more probably towards the end of the month. Alike on sandy and on rocky ground was this profusion seen, but on the rock the numbers were notably greater. On the sandy stretches the oysters formed bunches often of large size, the individuals attached in most cases to one another, but generally having a nuclear fragment of small cultch which most frequently was a cockle shell, a nullipore ball (*Lithothamnion*) or a small fragment of 'paar.' The spinning mussel (*Modiola barbata*), 'Suran' as it is called by the Tamil divers, was in places abundant, especially upon the sandy ground, but not sufficiently so to constitute a grave danger to the bed. This discovery of spat paralleled in extent and nature that made by Professor HERDMAN in February, 1902, when he estimated approximately the numbers of the young oysters at 100,000,000,000, and which, it will be remembered, had all disappeared when I next examined the bank in November of the same year.

"A very remarkable fact was that some of the largest of these young oysters when last seen, 3rd April, had already developed gonads filled with reproductive products fully formed and ready to be shed. The average size of these sexually mature individuals was $25\frac{1}{2}$ millims. $\times$ $26\frac{1}{2}$ millims. $\times$ 9 millims. The smallest was $24\frac{3}{4}$ millims. $\times$ 25 millims. $\times$ $8\frac{3}{4}$ millims. The extreme age of these cannot be more than $3\frac{1}{2}$ months, and we are fully warranted in considering that sexual maturity is reached by the pearl oyster soon after the age of 3 months. Previous to this record, the age of 6 months was the earliest at which reproduction had been observed."

Sexual maturity at such a small size and early age, in itself remarkable, has a practical bearing upon the replenishing of the banks from time to time—a subject to be treated of again.

Principal Spawning Seasons.—The gonads of this year's fishable oysters were nearly all in a spent condition during February and March, and this taken in conjunction with the presence of enormous multitudes of very young oysters—so young indeed that they could not have been set free earlier than the middle of the December

* The sketch of one of these which Mr. HORNELL has sent home has been identified by Mr. G. A. BOULENGER as *Stegostoma tigrinum* (GMEL.).

† The term "spat" is used in these pages in a wide sense to comprise all sizes of attached oysters under the age of 4 months.

preceding—points to December and January as being the period of one of the maxima of reproductive activity in the pearl oyster of Ceylon.

In April the gonads began to show signs of increase, and a small quantity of spat was seen. It now seems that the two maxima do not coincide, as we at first supposed, with the intervals of fine weather and variable winds between the monsoons, *i.e.*, November in the one case, March and April in the other. This year's observations point distinctly to the chief spatting seasons having December and January, and June, July or August, as the central periods respectively—times when the monsoon winds are blowing steadily and strongly. It may be noted that a wide dispersal of the embryos can be more effectually attained during these boisterous periods of strong currents than if they were expelled during the inter-monsoon lulls, characterised by light winds and erratic surface drift.

Prospects of Future Fisheries.*

"The prospects of a large fishery, both next year and in 1906, upon the Cheval and Modragam paars are excellent; the immense quantities of young, 2 to $2\frac{1}{2}$ years old, occupying the Modragams, the South-east, South, Mid-west, North-west, and the greater part of the three central blocks of the Cheval Paar being ample for 2 years' fisheries. Those on the Modragams, and on the South, South-east, and South-central Cheval will, I hope, be fit to fish next March, being more advanced in growth than those on the Mid-west and North-west Cheval. Apart from this reason it will be advisable to fish the former at as early a date as the valuation of samples may show to be profitable, because, as many of the oysters on the beds named lie loose in bunches on a sandy bottom, they are thereby exposed to the danger of destruction by currents of exceptional force—a contingency infrequent but not unknown (*e.g.*, fishery of 1888). By March of 1905 these oysters will be about $3\frac{1}{2}$ years old, and, judging from the rapidity of their growth and their present large size, by that date they should be sufficiently matured to give a profitable fishery. They will then be practically of the same age as those of the 1903 fishery, which realised just under Rs. 30 per 1000, average price.

"If the fishery be postponed till 1906, the pearl yield would be greater, but if this were done, even supposing the oysters remained in safety till March, 1906, upon the banks, there would then be too great a quantity to fish in one year, and a portion would be left for the succeeding year, 1907. But in 1907 the remainder would be $5\frac{1}{2}$ years old, and under the conditions prevailing on the Western and Median Cheval, where these oysters are, it is most improbable that they would be still alive. A definite decision cannot be arrived at till the next valuation has been made† in November of the present year.

* I give this as Mr. Hornell's opinion in the Summer of 1904. It must be read in conjunction with the next article (p. 37) based upon the inspection of last November.

† See below, p. 43.

"The oysters at present on the Muttuvaratu and the Dutch Modragam paars should also be ready to fish in 1906, but I do not build confidently upon this; even now these oysters are extremely stunted and sickly looking, and are certain to decrease very much before they are ripe for fishing.

"Beyond 1906, or at latest 1907, there is likely to be a break in the fishery sequence, a more or less prolonged blank* whereof the duration will be to some extent dependent upon whether or not large measures of transplantation are resorted to, seeing that there has been no fall of spat upon the Cheval, Modragam, or Muttuvaratu paars within the last two years, that is to say, since June, 1902. The only other hope lies in the possibility that a younger generation may be growing up on some of the paars that have not been inspected of recent years. I therefore trust that I may be given the opportunity to make exhaustive inspections during the next 2 years. The more I learn at first hand about the banks and the more I read of the old records, the more convinced I am that limited and narrow-compassed inspections have been the cause of the loss of many valuable fisheries. To give a concrete instance of the essential need for thorough periodical examinations of the whole pearl-bank area, the following extract from Captain DONNAN's Report of the 1878 inspection furnishes significant reading:—

" 'While inspecting the Cheval I discovered oysters on a new bank, $2\frac{1}{4}$ miles to the 'westward of the Cheval, where it has generally been considered that there was 'nothing but an extensive sandy flat. I saw it recorded in the diary of inspection 'by Captain LAUGHTON, in March, 1802, that he found oysters of 4 or 5 years in 'abundance in 9 fathoms, rocky bottom, Kudiramalai bearing S.E. $\frac{1}{4}$ E.; and being 'anxious to test if rocky bottom really existed in that neighbourhood, I took all the 'inspection boats in tow of the launch out to the verge of the bank of soundings, 'and directed them to dive all the way back to the inspection vessel, so as to cross 'the position noted by Captain LAUGHTON, and they came upon rocky ground and 'oysters, where they placed a buoy. On subsequent examination this bed of oysters 'proved to be about $1\frac{1}{2}$ miles in its longest direction N.N.W. and S.S.E., and about '$\frac{3}{4}$ mile broad at its broadest part, having a depth of water over it of from $8\frac{1}{4}$ to '$9\frac{1}{4}$ fathoms, and a sandy flat of 9 fathoms between it and the Cheval. I believe it 'to be an extension of the Periya Paar in a S.E. direction. I have duly recorded 'its position in my diary. The superficial area of the bed is 3,845,935 yards, and 'the oysters on it average 22 to a dive. I estimate the total number of oysters on 'it at 3,500,000, sufficient to give 10 days' fishing for 50 boats with loads of '7000 oysters each. I found, however, 13 per cent. of dead shells, which is an 'unfavourable sign, and a large quantity of seaweed growing on the oysters. I have 'been much puzzled about the age of these oysters, as they appear to be old, although 'of small size. I believe them to be of the description known to the natives as

* The position of affairs is now altered by a great fall of spat on the Cheval Paar (see below, p. 37).

' "kottapakku," which are said to be a small class of oyster but rich in pearls. They ' resemble the oysters of the Chilaw banks, which I know to be 4 years old now, and ' therefore they ought to be fit for fishing in March next. I can find no record of ' this bed having ever been inspected since 1802, and it is a curious coincidence that ' what was then recorded of its condition might be recorded now on its most probably ' first examination since that time.' "

The oysters referred to in the above extract were fished the following year, 1879, and the question is at once suggested, "How many times between 1802 and 1878, the interval during which this paar received no attention, did oysters mature unknown upon this ground; and, further, how many other oyster-bearing patches have been left unnoticed for want of more extended inspections?"

Parasites of the Pearl Oyster.

"Entozoa were plentiful in the oysters fished this year, both nematode worms and encysted cestode larvæ being found; the former especially were more numerous than I had before seen, and many oysters contained two individuals. A solitary example of the trematode *Aspidogaster margaritiferæ* was found, located as usual in the pericardium. Cestode larvæ were particularly abundant in the oysters from the North-west Cheval, and this fact will be referred to when we come to treat of the relative pearl yield of the three sections.

"More specimens are still needed to enable us to complete our knowledge of the life-history of the pearl-inducing parasite, and till I have an opportunity to dissect a number of individuals of the large oyster-eating sting-rays, the Walwadi tirikkai of the Tamils, there can be no hope of filling up this important gap in our investigation. No opportunity offered to obtain one of these rays at the late fishery, my position 12 miles from land precluding access to the fishermen of Pukkulam and Marichchukaddi, the only possible places where I could hope to procure specimens. Several small individuals of *Trygon walga* were caught by the inspection boatmen. This species does not, however, possess teeth sufficiently powerful to destroy oysters more than a few months old and no parasites belonging to the species found in the pearl oyster were discovered when these fish were dissected. Besides pearl oysters a large number of fishes were dissected in search for the adult stage of the pearl-parasite, and a continuation of such work will form the subject of a detailed report in the future."

The Yield and Character of Pearls from Different Regions.

During the inspection of the Cheval Paar representative samples of mature oysters were collected from the South-west, Mid-west and North-west beds respectively, and from the 7th to the 9th of March Mr. Hornell was engaged superintending the washing of these samples and the valuation of the pearls picked out. The results showed that the South-west oysters were the richest in pearls, the North-west following closely, with the Mid-west unmistakably much poorer in yield.

The following table will make clear the relative returns :—

Bed.	Quantity.	Total weight of pearls.		Weight per 1000.		Valuation per 1000.	Size of oysters in millimetres.
		Kalanchu.	Manchadi.	Kalanchu.	Manchadi.	Rs. cts.	
South-west Cheval	12,000	7	13·25	—	12·76	36.01	76·20 × 69·20 × 32·34
North-west Cheval	7,200	2	17·00	—	7·91	33.75	72·67 × 66·50 × 31·50
Mid-west Cheval	6,000	2	0·88	—	6·81	20.25	72·30 × 66·50 × 31·57

"The weight of pearls per 1000 oysters was very high in the case of those from the South-west, which fact may be correlated with the size of these oysters being considerably greater than that of the other two lots. In regard to the quality of the pearls, the North-west oysters, while yielding a less weight, contained a much greater proportion of 'cyst pearls' of excellent quality than those from the South-west, which owed their greater proportionate weight of pearls to a noteworthy abundance of 'muscle pearls.'

"External characteristics give the most meagre indication of what the pearl yield may be—in regard to 'cyst pearls' the abundance, or otherwise, is connected with the factors which control the relative abundance of the pearl-inducing cestode and those which conduce to its death during encystment in suitable localities within the tissues—problems as yet obscure. The fact, however, is to be noted that dissection showed the oysters from the North-west Cheval to be more extensively infested with cestode cysts than those from the other districts, while the valuation sample showed that cyst-pearls were much more abundant in these oysters than in those from either the Mid-west or South-west Cheval sections. With regard to muscle pearls the general fact stands out, deduced from my experience of two fisheries, that the more vigorous and well grown are the oysters the more abundant are the muscle pearls."

Shell-pearls.

"At the close of the inspection, when the valuation samples of oysters had been washed, I seized the unique opportunity thus afforded to examine over 30,000 pairs of separated valves of the pearl oyster. I did this chiefly to see if any considerable proportion of shell-pearls were induced by the irritation caused by perforation of the shell by boring parasites—sponges, lamellibranch molluscs and annelids. The result negatived this idea and showed that these animals have little or no influence upon pearl production; the sponge, *Cliona margaritiferæ*, causes occasional roughening, or even rugged tuberculation (fig. 10), at the insertion scar of the adductor muscle, and the annelid, *Polydora*, may produce an occasional discoloured internal excrescence, usually sharp-pointed: more rarely a parasitic nematode, free or encysted, is cemented to the nacre and sealed up in a pearly sarcophagus.

Fig. 10. Inside of pearl oyster shell, showing adductor impression affected by *Cliona* borings on the outside. × ½.

" By far the larger number of shell-pearls, fully 90 per cent. of the whole number, are due to the attachment of cyst- and muscle-pearls to the nacreous lining of the shell, consequent upon fusion of the pearl-forming sac with the epidermal layer outside, and rupture of these tissues caused by the pressure of the growing pearl, thus placing the pearl in actual contact with the nacre and converting its closed pearl-secreting sac into a pouch or ampulla, the open neck directed outwards and in continuity with the general epidermal layer upon the exterior of the mantle.

" Shell-pearls originating in this manner are at first pedunculated, and at this stage may be detached readily. The peduncle tends, however, to become obliterated, and eventually the pearl may be entirely lost in the substance of the shell nacre. Such shell-pearls are in most cases affixed singly, without definite arrangement. Examples may be located anywhere, the largest, however, being usually either in the peripheral region of the nacre, or in the central region, corresponding with the lateral surfaces of the visceral mass.

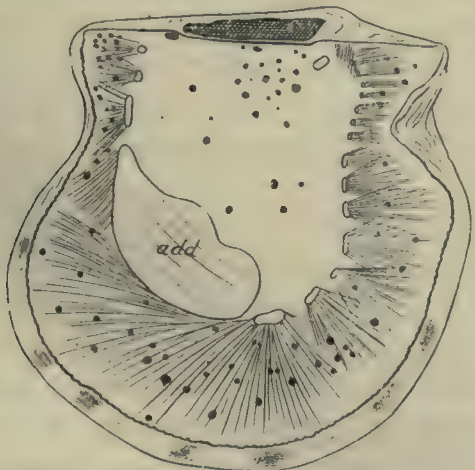


Fig. 11. Diagram showing comparative frequency of cyst pearls in the various parts of the mantle.

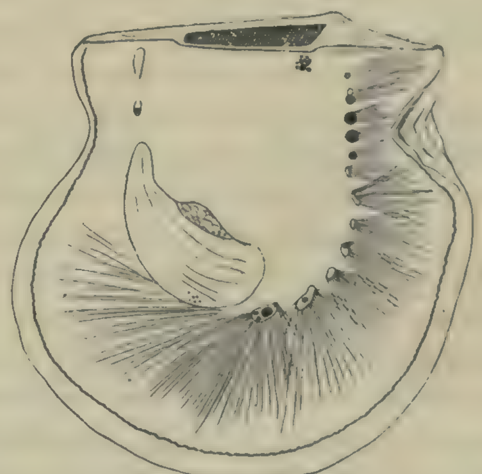


Fig. 12. Diagram showing the positions most frequently occupied by muscle pearls.

" Smaller attached pearls are not infrequently either singly or in a serial line of from two to five along the pallial line, each pearl coinciding in position with a muscle scar. Very rarely small ones may be seen along the edge of the adductor. Most frequent of all are pearl masses of irregular or even botryoidal form attached at or adjacent to the levator insertions. Decalcification of these pearls reveals no organic nuclei, whereas the pearls irregularly disposed have cestode embryos as nuclei, exactly as 'fine' pearls have.

"Examination of these 30,000 shells gives, therefore, strong confirmatory evidence in support of the theory set forth by Professor HERDMAN and myself* associating such pearls as have no organic nuclei (cestode or other platyhelminthian embryos) with the attachment surfaces of those muscles which are inserted on the shell, especially the small and comparatively weak levator and pallial muscles. Figs. 11 and 12 show the distribution in the body of cyst pearls and muscle pearls respectively, and fig. 12 is very instructive in showing the perfect way in which the positions of the shell pearls there depicted coincide with the series of pallial muscle scars.

"PHOSPHORESCENT AND OTHER PHENOMENA.

"On the evenings of April 9th, 10th, 11th, and 12th, when at anchor on the Western Cheval, we beheld a repetition of the strange phosphorescent phenomenon witnessed by Professor HERDMAN on March 13th, 1902 (see this Report, Part I., 1903, p. 81). The display began at about the same hour each evening, varying from 8.45 to 9.30 P.M., the sea being dotted with large isolated flashing lights that pulsated and vanished ghost-like at regular and frequent intervals.

"The rhythmic and progressive blotting out and rekindling of these phosphorescent fires was as if the sea were swept by regularly recurring search-light rays. The beginning of each successive light-wave appeared to lie to the south; the intervals were approximately of two seconds' duration. All the four nights were dark, but the weather was variable, one night tempestuous, another fairly calm, a moderately strong swell prevailing the whole time. The displays lasted approximately for an hour each evening. The cause remains undetermined.

"**Trichodesmian calm.**—During several days in March vast quantities of the red-brown scum of *Trichodesmium erythræum* lay profuse and filthy upon the surface of the sea. So abundant was this scum that twice did it extend the period of noontide calm, acting precisely as a film of oil does. At midday when the first puffs of the sea-breeze came out of the north-west, while the breeze was evident enough otherwise, yet it failed for sometime to disturb the surface where lay this scum. Where it was absent, or where the progress of the launch broke a lane through the film, the wind raised ripples and wavelets which little by little spread and encroached upon the Trichodesmian calm. This with the gradual freshening of the wind finally scattered the particles, driving them downwards.

* 'Brit. Assoc. Report,' Southport, 1903, p. 695.

" **Surface drift.**—Nothing can be done towards the solution of this question without the employment of bottle-drifters, except to note the direction of the current from day to day, when at anchor on the banks. This was attended to from 19th February to 19th April, the result being to show that during February the current set in the main to the south and to the south-west in dependence upon the general direction of the wind which at this period was mostly north-east. The following month, March, distinguished for its alternate land and sea breezes, showed a to-and-fro motion of the water upon the banks, the current altering with every change of wind and never attaining any strength. In April, consequent upon the continuous south-west wind and swell, the current ran strongly northwards, frequently at a rate of from 2 to 3 knots per hour."

Finally, Mr. HORNELL has sent me a series of " Recommendations " in regard to the further exploitation and conservation of the pearl banks. Some of his paragraphs deal with matters treated of above, while others are better left over for discussion in the Final Part of the Report. I give here the following headings of the chief points in his recommendations :—

SYNOPSIS OF RECOMMENDATIONS.

(*a.*) Improved and extended inspection.

(*b.*) The provision of a beacon on Aripu reef and the improvement of Kudiramalai Tower.

(*c.*) Transplantation on an extensive scale by means of steamer dredging whenever blank spaces occur upon the Cheval, coincident with the presence of young oysters in the neighbourhood, within a radius of 20 miles.

(*d.*) Cultching to go on concurrently with transplantation. If these operations can be carried out within the next twelve months, 500 tons of oyster shells and 300 tons of Kalpitiya stone to be provided for this purpose.

(*e.*) The thinning out of overcrowded beds by means of the dredge.

(*f.*) The cleaning of the oyster banks by means of the dredge.

(*g.*) Further investigation of the life-history of the pearl-inducing Cestode.

(*h.*) A series of drift-bottle experiments in conjunction with the Madras Presidency officials.

(*i.*) The establishment of a chank fishery on Government account and under Government management in the neighbourhood of the Aripu pearl banks.

TABLE SHOWING THE PRINCIPAL FACTS RELATING TO THE OYSTER-POPULATION ON THE PEARL BANKS IN NOVEMBER, 1904—TO ILLUSTRATE "THE PRESENT CONDITION OF THE PEARL BANKS" (p. 37).

Name of Paar.	Estimated number of oysters on the bank.	Valuation per 1000 oysters.	Age (November, 1904).	Condition.	Prospects.
South Cheval . . . South-east Cheval .	40,000,000 23,600,000	Rs. 24.65 10.76½	years $2\frac{2}{3}$ to $3\frac{1}{6}$ $2\frac{2}{3}$ „ $3\frac{1}{6}$	Healthy and vigorous	Should live through two more seasons without excessive diminution in numbers.
Mid-east and South-central Cheval	13,750,000	13.21	years $2\frac{2}{3}$ to $3\frac{1}{6}$	Healthy, but smothered in young oysters	The majority will die off within the next year owing to the smothering effects of the myriads of young oysters present.
South-west Cheval .	3,500,000	—	years $5\frac{1}{2}$	Healthy for their age	Too old to live beyond 1905.
The remainder of the Cheval	Thousands of millions	—	months $1\frac{1}{2}$ to $2\frac{1}{2}$	Healthy	Good. Should furnish fisheries in future years.
North Modragam . South Modragam .	4,700,000 21,000,000	— 17.86½	years $2\frac{2}{3}$ to $3\frac{1}{6}$ $2\frac{2}{3}$ „ $3\frac{1}{6}$	Unhealthy, shells and bodies diseased; those on the south smothered in young oysters	Dying off rapidly.
Periya Paar . . .	Thousands of millions	—	months $1\frac{1}{2}$ to $2\frac{1}{2}$	Healthy	Will probably disappear during the next South-west Monsoon.
Muttuvaratu . . .	20,000,000	3.16½	years $2\frac{2}{3}$ to $5\frac{1}{2}$	Stunted and diseased	Dying off gradually.

THE PRESENT CONDITION OF THE PEARL BANKS.

[*Based on Mr.* HORNELL'S *Inspection in November, 1904.*]

MR. HORNELL left Colombo for the Pearl Banks on October 25th, 1904, with the inspection barque "Rangasami Puravi" and the dredging steamer "Violet"—a trawler recently acquired by the Government for pearl-fishery purposes. I have received a detailed MS. report from him which has furnished the quotations and facts that form the basis of the present section.

"The actual examination of the banks was begun on the morning of October 29th and lasted with but one day's partial interruption, caused by heavy rain squalls, until November 17th, when I brought the inspection to a close and went ashore [at Marichchukaddi] to superintend the washing of the samples obtained."

This last inspection of the Cheval, Modragam, Periya and Muttuvaratu paars was evidently unusually extensive and thorough for a November inspection, and examination of the valuation records since the year 1854 shows that the number of oysters (87,500) lifted by the divers was by far the largest ever collected.

The size of these samples affords a better opportunity than usual of ascertaining the true average value of the oysters upon the different banks.

The result of the inspection is briefly as follows (see also Table opposite, p. 36) :—

1. Mature oysters, aged from $2\frac{2}{3}$ to $5\frac{1}{2}$ years, were found in quantity upon the North and South Modragam and Muttuvaratu paars, and upon the South, South-east, South-central and Mid-east sections of the Cheval Paar, together with a small and thinly covered patch remaining from last year's fishery (1904) upon the South-west Cheval.

2. Very young oysters, aged from $1\frac{1}{2}$ to $2\frac{1}{2}$ months at the beginning of November, cover the whole area of the Cheval excepting the South-west, South and South-east sections, and are also found equally abundant on the Periya Paar and the South Modragam Paar. If we estimate their age from the average size it is evident that a fall of spat covering an immense extent of ground and quite unusual in numbers must have occurred between the middle of August and the middle of September. This is a most important occurrence which, though hoped for, was not expected and could not have been foreseen. It greatly improves the fishery prospects for some years to come and diminishes the need for any immediate transplantation from the Periya to the Cheval Paar.

Details of the Condition of Each Bank.

On the South and South-east sections of the Cheval Paar (see fig. 13) is a large and continuous bed of excellently grown oysters from $2\frac{2}{3}$ to $3\frac{1}{6}$ years old. The area covered with oysters Mr. Hornell computes at 6,705,000 square yards, but as the bed extends in one direction beyond the limit surveyed we may safely calculate upon a fishable area in this one locality alone of fully 7,000,000 square yards. But even taking the former figure and reckoning the population at an average of from 16 to 26 per dive, it is estimated that this bed has a total of 63,820,000 oysters. Mr. Hornell reports that "these oysters are extremely well grown for their age and while they contain but a small proportion of cyst-pearls and therefore yield, at present, but few pearls of high individual value, they give a remarkably heavy weight of muscle-pearls, so much so that the valuation of the sample pearls ranges from Rs. 10.76 per 1000 oysters in the case of the South-east to as much as Rs. 24.65 per 1000 in the case of those from the South section —a fact accounted for by the ready sale which comparatively low-class pearls meet with locally and in India."

Fig. 13. Proposed culture areas recommended for the Cheval Paar and Periya Paar Kerrai.

Scarcely any young oysters are mixed with the mature individuals in this bed—a fact of some importance when considering the rotation of fishing operations. This point will be considered later on.

On the eastern part of the South-central and over the South-west quarter of the Mid-east Cheval another extensive bed of oysters occurs, continuous along the southern margin with the South Cheval bed. In area it contains about 2,300,000 square yards, bearing oysters averaging 15 to a dive, from which we estimate the number of oysters present to be fully 13,750,000. The bulk of this ground was fished, but imperfectly, in 1903, and, as a consequence, there are occasional patches of oysters nearly $5\frac{1}{2}$ years old, intermingled here and there with the younger generation, $2\frac{2}{3}$ to $3\frac{1}{6}$ years old, which forms the greater part of the bed (fig. 14). The presence of a proportion of older oysters might be thought to make the quality and value of the pearls from this locality higher than that of those from the South Cheval, but actually the valuation is only Rs. 13.21 per 1000 as against Rs. 24.65 per 1000 in the case of the latter bed. The difference seems due to a less vigorous growth upon the Mid-east Cheval, a character correlated with inferior power of nacre-secretion and consequent inferiority in the yield of pearls.

Over the whole of this bed of oysters, and extending west and north upon those portions of both sections (South-central and Mid-east) which are bare of mature oysters, myriads of the very young oysters before mentioned (now a few months old) occupy every available point of hard ground. Where older oysters are present the young ones crowd thickly upon the valves, ranging from 20 and 30 up to actually (and frequently) counted totals of 96 to 99 upon each individual. Where cultch and unoccupied outcropping rock occur every inch is crowded, the little oysters seeming to shoulder each other in their fight for vantage ground. Mr. HORNELL goes on to state: "Towards the west, upon the sandy cultch-barren stretches of the South-central Cheval, the struggle for existence among the young oysters is already intense; clusters of individuals are grouped round nuclei of absurdly small and inadequate dimensions, and often I have counted from 30 to 50 oysters in a bunch having for its centre a fragment of stone or shell no larger than a pea in size. In other cases even this may be wanting, the oysters adhering to one another."

The danger to these unstable clusters is obvious; a strong current or under-tow will sweep them hither and thither, and while this may have a certain value in possibly bringing about the stocking of bare stretches of the bank elsewhere, the dangers that these young oysters run of being swept into unsuitable localities far outweigh the advantage to be gained by wider dispersion.

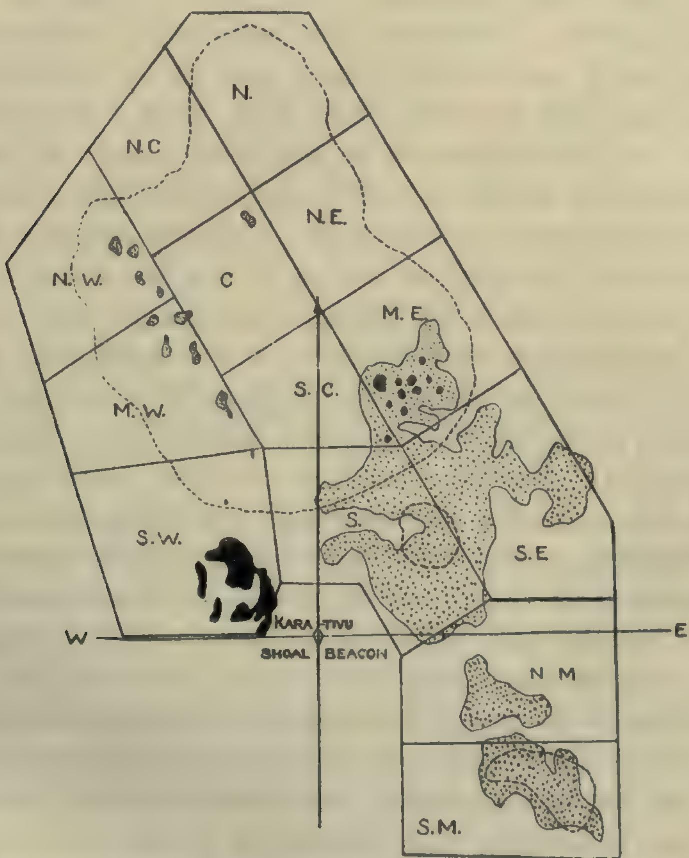


Fig. 14. Sketch-plan of the Cheval and Modragam paars, showing the distribution of pearl oysters in November, 1904. Scale: Half an inch to one nautical mile. The broken line surrounds the areas covered with spat a few months old, the dotted areas are those with oysters about 3 years old, the solid black indicates those beds of oysters over 5 years old.

No other fishable oysters in any quantity are to be found on the Cheval Paar, with the exception of an irregular and sparsely populated patch on the south-west corner of the South-west Cheval—a remnant left from the last fishery. The quantity is just under 3,500,000, reckoning the area at 1,150,000 square yards and the number of oysters per dive as 9. No spat is here present, and as there is no admixture of a younger generation, these oysters, which will be nearly 6 years old in March next, should give a high valuation in pearls. They are too unevenly distributed to permit of being dredged to any advantage. The native divers should, however, find the patch remunerative, and it will probably be found advisable to begin next year's fishery on this ground. The rest of this area (south-west) is blank, without even a trace of the very young oysters found elsewhere (see fig. 14).

The whole of the remaining sections without exception—the Mid-west, the North-west, the North-central, the Central, the North and the North-east—were everywhere packed densely in the beginning of November with very young oysters of from $1\frac{1}{2}$ to $2\frac{1}{2}$ months of age, healthy in condition, vigorous in growth, and too abundant to estimate in numbers. Indeed, so great is the profusion that Mr. HORNELL reports that "the remainder of the $2\frac{1}{4}$- to 3-year-old oysters that abundantly stocked much of this region in the early part of the present year are so masked by the covering of spat as to be unrecognisable by sight. The divers cannot distinguish between rock and old oysters; both are submerged in this young brood of oysters, and till the masses are brought to the surface the differences are not seen. Even if the quantity of old oysters were considerable, fishing under such circumstances would be well nigh impossible; but, as it is, we are saved having to face this difficulty by the fact that the North-west, Mid-west, and North-east sections have been ravaged by ray-fish (Trygonidæ) during the last few months, and the numbers of mature oysters so thinned that these regions, for all practical purposes, may be considered blank so far as concerns a fishery during the next 2 years. The prospects for an extensive fishery 4 years hence are on the other hand excellent; by that time the present spat will be old enough to be fished on those regions where growth progresses most rapidly."

On the North Modragam there is a small bed of 700,000 square yards in extent, covered with oysters of $2\frac{2}{3}$ to $3\frac{1}{6}$ years old, ranging in density from 16 to 24 per dive. This bed should yield at least 4,700,000 oysters if fished in March next. Spat is absent from the whole of this section.

The South Modragam bears a much larger bed, fully 2,200,000 square yards in area. At 24 oysters per dive the present population is estimated to be about 21,000,000. Unfortunately for fishing operations, very young oysters (spat) are extremely abundant, and may prove somewhat troublesome to the divers, as practically every old oyster will have to be, at the least partially, stripped of its load of young. Mr. HORNELL recommends that "fishing operations should be hastened as much as possible so far as this bank is concerned, as the health of the fishable generation is far from satisfactory. The oysters are thin and the shells of a large proportion are so diseased that if not fished within the next 4 months I shall expect to find the bank cleared of this generation in March, 1906. The age is the same as of those on the North Modragam."

The only other bank where, from our previous observations, there was the remotest possibility of finding fishable oysters is the Muttuvaratu Paar, lying off Dutch Bay (see Map, Mu., fig. 15). Three days were devoted to the inspection of this, with the

Fig. 15. Sketch-map showing the principal pearl-oyster banks in the Gulf of Manaar. C., Chilaw Paar; Ch., Cheval Paar; K., Dutch Modragam and Karativo paars; M., Modragam Paars; Mu., Muttuvaratu Paar; P., Periya Paar; P.K., Periya Paar Kerrai.

result that Mr. Hornell estimates the number of oysters thereon, aged from $2\frac{2}{3}$ to $5\frac{1}{2}$ years, to be about 20,000,000. "All are stunted in outward appearance, the shells both small and unhealthy, covered and distorted in many cases with a parasitic growth of coral, while the substance is riddled and tunnelled by boring sponges, molluscs, and worms. The soft parts are in like condition, miserably thin and sickly, and many are obviously diseased." It is therefore not surprising to find that the sample of 10,000 average individuals which was collected by the divers on November 11th yielded only a very small quantity of pearls, valued at Rs. $3.16\frac{1}{2}$ per 1000 oysters.

The valuation of the same bank of oysters in the previous November (1903) gave Rs. 1.50 per 1000, so, as the value has more than doubled in the twelve months, there is the possibility that a remnant might provide a small fishery in 1906 if oysters be then scarce elsewhere. The only remaining bank inspected was the

Periya Paar. An examination of this remarkable region during the progress of the fishery of 1904* showed the entire extent to be densely packed with untold millions of young oysters from $1\frac{1}{2}$ to 3 months old. At the present time but a few handfuls of these survive; the others have, as usual, disappeared, having been no doubt swept from the bank into deep water or buried in sand during the turmoil of the south-west monsoon. Their place is, however, now taken by a new generation of young oysters of the same age as those so plentiful upon the Cheval Paar. They will be of excellent size for transplantation in March next, if there be then need of such an operation. If not utilised they must inevitably share the usual fate of oysters on this bank, and will without doubt disappear during the next south-west monsoon.

Enemies of the Pearl Oyster.

Mr. Hornell reports that "Oyster-eating fishes are at present abundant on the banks. Numbers of 'Kilati' (*Balistes mitis*, chiefly) and of 'Vellamīn' (*Lethrinus nebulosus* and other species) were caught by the crew whenever we anchored upon spat-covered ground, and unmistakable evidence of their diet was given by the stomach contents. In the stomach of one *Balistes* which I examined there was found a minute pearl."

The quantity of young oysters is, however, sufficient to afford ample margin of safety from such dangers, and with another 6 months' growth the shell will be sufficiently strong to give protection against these particular enemies. "Greater danger threatens from the huge ray called 'Walwadi tirikkai' by the Tamil fishermen (*Rhinoptera javanica*). This fish can destroy the strongest-shelled oyster, and so great is its appetite and the capacity of its mouth and stomach that a shoal is capable of destroying an entire bed of oysters within a few weeks or even days, as witness the destruction of the fine bed of oysters on the Periya Paar Kerrai, which was found to be in progress at the time of the fishery of 1903.† During the recent inspection traces of widespread havoc from this cause were much in evidence over the northern sections of the Cheval Paar, and this enemy is responsible for the greater part of the reduction in numbers of the younger generation of oysters so abundant on this area in March last."

The region of the bank in question is notably deficient in natural cultch, and till this defect is remedied this and other similar parts of the Cheval and Modragam paars must always be more or less subject to ravages and losses, even to the extent of occasional total destruction of a bed and the consequent failure of expected fisheries.

The boring sponge, *Cliona margaritiferæ*, Dendy, is doing great harm to the oysters of the Modragam paars. On these banks there is also an excessive abundance of

* See this volume, p. 28.

† See this Report, Part II., p. 25.

shell-tunnelling annelid worms (*Polydora*), of boring molluscs (*Lithodomus*), and of encrusting and enveloping sponges. This combination of parasites has induced in the oysters a weakly condition which doubtless predisposes to disease. "As a consequence the oysters here are sickly, the rate of mortality is increasing, and comparatively few are likely to survive to 1906. Star-fishes are also abundant on this bank and are aiding in the destruction of this bed of oysters."

On the Periya Paar, where very young oysters are plentiful, small carnivorous gastropod molluscs (*Sistrum* and other genera) are unusually abundant, and are causing, by boring through the shell, the death of considerable numbers of the young oysters. On the Cheval Paar they are less numerous, and, speaking generally, there is, saving for the great rays, no special or dangerous abundance of oyster enemies upon this the most important bank.

Valuation Results.

The exceptionally great number of oysters collected at this inspection was made up as follows :—

40,000	from the	South Cheval Paar.
15,000	,,	Mid-east Cheval Paar.
6,000	,,	South-east Cheval Paar.
1,500	,,	North-west Cheval Paar.
15,000	,,	South Modragam Paar.
10,000	,,	Muttuvaratu Paar.
87,500		

Mr. Hornell reports that "One-half (20,000) of the South Cheval sample was given to Mr. G. G. Dixon to be treated by his oyster-washing machine for comparison with the other half, which was to be hand-washed and hand-picked in the ordinary manner.* In addition, one bag containing 750 of the South-east Cheval oysters was handed by mistake of the landing boatmen to Mr. Dixon, who will account for it. All the rest of the samples which I collected were washed in the ordinary way by the divers and munducks."

The result shows that the two highest valuations were yielded respectively by the South Cheval and the South Modragam, the former being worth Rs. 24.65 per 1000 oysters, the latter Rs. 17.86½ per 1000. In the case of the former (higher) valuation the result is due to the great *weight* of pearls present, in the latter to the comparatively high value of the individual pearls. The one gives quantity, due to an unusual abundance of muscle-pearls, the other quality, owing to fine cyst-pearls being present in a higher ratio than in the former case.

* See this volume, p. 6.

Regarding the 40,000 oysters from the South Cheval Paar washed for comparison, half by hand and half by Mr. DIXON in his machine, Mr. HORNELL reports that "the half washed by hand gave a valuation of Rs. 24.65 per 1000 oysters as against Rs. 16.79 in the case of the machine-washed. The weight of pearls from the machine-washed oysters was also markedly inferior, being but 7 manchadi per 1000 as against a weight of a little over $11\frac{11}{20}$ manchadi in the case of the hand-washed."

Mr. HORNELL adds: "Lest it should be thought that the two lots might have been taken from different localities, I wish to state that the whole 40,000 oysters were lifted on the same days and from the same parts of the bank. They were originally all piled on the deck of the inspection vessel, bagged under my supervision, and sent ashore in one lot. The final division after being landed was carried out by Mr. SAUNDERS, Assistant Government Agent, Manaar, and by Mr. G. G. DIXON conjointly, I not being present."

FISHERY PROSPECTS AND RECOMMENDATIONS.

As the result of this inspection in November, 1904, Mr. HORNELL reports that at the present time there are available for fishing the following oysters, all yielding a pearl valuation above Rs. 10 per 1000, the minimum at which it is considered profitable to fish a bank, viz.:—

Paar.	Estimated number of oysters.	Value per 1000.	Age next March.
		Rs.	years.
South Cheval	40,220,000	24.65	3 to 3½
South-east Cheval	23,600,000	10.76¼	3 „ 3½
Mid-east and South-central Cheval	13,750,000	13.21	3 „ 6
South-west Cheval	3,500,000	—	5½ „ 6
North Modragam	4,700,000	—	3 „ 3½
South Modragam	21,000,000	17.86½	3 „ 3½
Total	106,770,000		

The highest recorded number of oysters landed at any one fishery has been 44,311,441 in 1891. At the utmost we could not hope to lift above 50,000,000 at the next fishery and this would therefore leave rather more than half the number to fish in 1906. Thus the number of fishable oysters appears amply sufficient to give two large fisheries in 1905 and 1906 respectively and possibly a small one in 1907. This can probably be brought about, if a careful watch be kept upon the banks and if we take note of the various biological contingencies likely to menace the different beds of oysters during the next 18 months. Mr. HORNELL recommends that the order in which the banks should be fished be as follows, provided the inspection of

February next shows the position of matters to be much the same as at present, viz. :—

In 1905—	(*a.*)	3,500,000	oysters	on the	South-west Cheval,
	(*b.*)	21,000,000	,,	,,	South Modragam,
	(*c.*)	4,700,000	,,	,,	North Modragam,
	(*d.*)	13,750,000	,,	,,	Mid-east and South-central Cheval.
Total . .		42,950,000	oysters,		

leaving for 1906 and 1907 the unmixed oysters now aged between $2\frac{2}{3}$ and $3\frac{1}{6}$ years upon the South and South-east Cheval.

The 40,000,000 oysters on the South Cheval are, with the exception ot the small patch of $5\frac{1}{2}$-year-olds on the South-west Cheval, the richest in pearls at the present moment, and it might be thought that Mr. HORNELL was assuming a grave responsibility in advising the postponement for a whole year of a fishery upon this bank. It must be remembered, however, that the section of the Cheval in question is very reliable, and has scarcely ever disappointed the hopes of the authorities. There are also the following special reasons for the course recommended :—

(*a.*) The Modragam oysters are unhealthy and liable to die off in great numbers within the next 12 months.

(*b.*) The South-west Cheval oysters, being nearly 6 years old, have all but reached the span of oyster existence, and, though as yet fairly healthy, cannot be expected to survive to 1906, when they would be nearly 7 years of age.

(*c.*) The oysters on the Mid-east and South-central Cheval are so densely covered with very young oysters, a few months old, that, judging from the results of similar competition seen repeatedly elsewhere during the last 3 years, the inevitable consequence will be that in a year's time, or even less, the growth of such enormous numbers of young will smother and kill off so large a proportion of the old that the bed will cease to be one of mature or fishable oysters. Fishing on this bed will, therefore, only be possible if carried out within the next 3 or 4 months. If fished within this time the bulk of the young oysters could be returned to the sea, and the bank will then be one of young oysters holding out good prospects of a fishery in 1908 or 1909.

The above are arguments in favour of fishing certain banks first. Those against immediate fishing on the South Cheval and the South-east Cheval are :—

The oysters on these two beds are at present in a healthier condition than those on any of the others; their growth is vigorous and they are not overcrowded with young oysters. The oysters are clean and wholesome in appearance, food is plentiful, and, so far as we know, no harmful agencies are present in a marked degree. These oysters offer every prospect of being able to survive till 1906—which cannot be said of any other bed of mature individuals now known.

In the case of the South-east Cheval there is also the obvious additional argument against fishing in 1905, derived from the small pearl yield given by the present valuation sample; a year's growth would, no doubt, result in an enhanced pearl value.

On the other hand, there is, of course, always a certain risk in leaving a fishable bed of oysters unfished, and, once the biological facts given above have been stated, it lies with the Government to decide what risk can be run and what course should be taken. If the 40,000,000 oysters on the South Cheval Paar, or a considerable number of them, can be fished in addition to the 43,000,000 which certainly ought to be secured first, there will, no doubt, be a large additional profit now—a present certainty in place of the prospect of a possibly much greater result next year.

Summary of the Prospects of Fisheries from 1905–1909.

The following forecast assumes (*a*) the adoption of the suggestion made above as to the order in which the banks be fished; (*b*) that extensive cultching operations be undertaken next year to improve the purely sandy areas; and (*c*) that no exceptional catastrophe happens, such as an inroad of rays or abnormal weather conditions.

1905.—A fishery numerically as extensive as that of 1904, to be held on the North and South Modragam paars, South-west Cheval Paar, Mid-east Cheval Paar, South-central Cheval Paar. [Possibly also the South Cheval Paar.]

1906.—A fishery of large extent upon the South and South-east sections of the Cheval Paar. [Unless the South be fished in 1905.]

1907.—A small fishery on the same grounds and possibly upon some small patches elsewhere.

1908.—A portion of the Northern and Central thirds of the Cheval Paar now covered with young oysters, if the pearl yield be then found sufficiently high to give a remunerative return.

1909.—A fishery upon the remainder left from the preceding year's fishery.

That accounts for all the beds of oysters, old and young, now in sight. During these five years other deposits of spat may fall upon reliable paars such as the Cheval. If not, young oysters for future fisheries must be transplanted from the Periya Paar, where they will no doubt be present in abundance from time to time.

Culture of the Banks.

In various parts of this Report Mr. Hornell and I have urged the necessity of transplanting large quantities of young oysters by means of a dredging steamer, in the event of no fall of spat occurring in the immediate future upon the unoccupied sections of the Cheval Paar. Accordingly, on setting out upon the past inspection, Mr. Hornell was authorised to employ the dredging steamer "Violet" for this purpose if, upon examination of the banks, he still considered this procedure necessary, and provided the conditions on the Periya and Cheval paars respectively were found suitable. Nature, however, proved unexpectedly generous; the last spatting season (August to September, 1904) must have been unusually bountiful, and the currents favourable, as the result has been that all the great blanks on the Cheval Paar and elsewhere have been filled up with young oysters in profusion.

The need for transplantation in consequence of this quite exceptional spat-fall has ceased to be urgent for the present season. The Government has been saved the considerable outlay which transplantation on the scale contemplated would have entailed. The dredging steamer consequently became available at the inspection for fishing mature oysters, and means were thus provided to supply Mr. G. G. Dixon with large numbers of oysters for experimental washing in the machine devised by him for this purpose. It must not be thought, however, that the necessity for transplanting has disappeared altogether. It is only postponed for a season, and might become urgent again at the next inspection if, for example, it were found that any catastrophe had occurred to the young oysters over any large section of the Cheval Paar. The Inspector of the Pearl Banks should be authorised to transplant from the Periya Paar whenever he may find it necessary.

The spat-fall has taken place equally upon sandy and upon rocky ground. That upon the latter may for the present be safely left without special attention, but the deposit upon the sandy areas requires careful nursing if it is to be brought to maturity and yield a fishery. The prime necessity is extensive cultching operations, the enriching of the surface of the sandy wastes of the South-central and North-east Cheval especially with large quantities of fragmentary hard material in order to furnish foothold to a few, at least, of the many millions of young oysters now existing there in a very precarious condition. These young oysters have upon such sections of the bank but few opportunities to make attachment to any fragments of a size and weight sufficient to resist the strength of the bottom currents during even moderately severe monsoon weather. They are liable at such times to be swept from the banks, more especially during the first two years of existence, when the shells are still light in comparison with their bulk, and when the small bunches into which they are aggregated are of just the right form to permit of their being readily rolled along the level stretches of the sandy areas till they finally perish.

Time and opportunity did not permit of the adoption during this last inspection of active measures for the protection of these young oysters upon anything approaching an adequate scale. All that Mr. Hornell could do was to take from the beach at Marichchukaddi a quantity of nullipore balls (*Lithothamnion*, see fig. 16), dead coral and broken calcrete ("paar-rock") and spread that hard material over a small portion of the South Cheval area. He also directed the Master of the dredging steamer to instruct his crew to break up all large masses of rock and coral that came up in the dredge and to return the fragments to the sea. This is being done at present, and if carried out consistently will go some little way towards effecting what is desired. Much more active measures must, however, be taken to ensure an immediate improvement of the ground, and to save the spat now on the sand a great deal of cultching work must be done during the next three months.

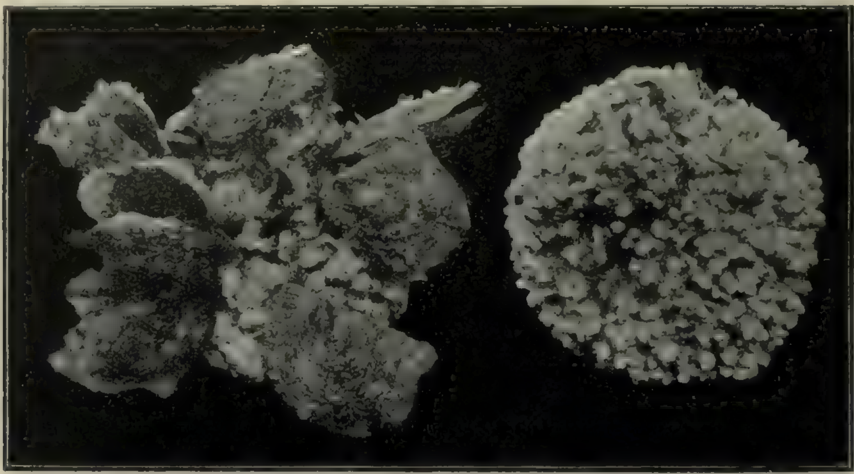


Fig. 16. Natural cultch (*Lithothamnion*) and, to the left, a similar Nullipore ball with a dozen young pearl oysters attached.

The cultching operation which Mr. HORNELL has recommended to the Ceylon Government, and which I entirely approve of, is the disposal annually, for the next few years, of a quantity amounting to not less than 500 tons of rubble, carefully broken to a standard size of $3\frac{1}{2}$. inches $\times$ $3\frac{1}{2}$ inches $\times$ $2\frac{1}{2}$ inches, upon the South-central and North-east sections of the Cheval Paar. If it be possible to get any broken or waste tiles and bricks, such material is preferable to stone rubble and should be utilised so far as obtainable. The cost delivered on the banks of the above quantity should not exceed Rs. 1500, an insignificant sum compared with the enormous return in the form of oysters saved from destruction which we should reasonably expect to receive from this outlay. This quantity should, however, be regarded as the minimum annual amount; a much larger deposit of cultch would probably well repay the increased expenditure.* The ravages of ray-fish have been great during recent months upon some parts of the Cheval Paar, and it should be mentioned that the efficient strewing of rubble over the ground is probably one of the most feasible methods of stopping their depredations.

This section may appropriately end with a reference to the tabular statement on p. 36, drawn up by Mr. HORNELL to show the present condition of the beds of oysters on the principal pearl banks.

* As this goes to the printer, I have received the information that the Ceylon Government has very wisely decided upon the larger measure of cultivation. Rs. 5000 in place of Rs. 1500 has, I understand, been placed upon the estimates to meet the expense of this year's cultching operations.

FURTHER REPORT ON PARASITES

FOUND IN CONNECTION WITH THE

PEARL OYSTER FISHERY AT CEYLON.

BY

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[WITH ONE PLATE.]

THE following short Paper is based on material collected by Mr. HORNELL largely from Elasmobranchs which frequent the Pearl Beds of Ceylon. The specimens unfortunately arrived too late for our account of them to be incorporated in the article on the "Parasites of the Pearl Oyster," published in the second volume of this Report, but as some of the forms are new and the Cestodes may possibly, though perhaps not probably, be the parent form of the pearl-producing larvæ, it has seemed advisable to publish this further instalment. Unfortunately our further researches throw no direct light on the problem of the *provenance* of the pearl-producing parasite.

I. CESTODA.

Staurobothrium ætiobatidis, n. gen. et sp.—Plate, figs. 1 and 2.

A considerable number of tapeworms, with large cruciform heads, were taken from the intestine of the Bird or Cockle-eating Ray, *Ætiobatis narinari*, MARCG., at Marichchukaddi, the centre of the recent pearl fishery.

The head has the form of a cross with very short broad arms (Plate, fig. 1). Each arm ends in a sucker which, however, does not penetrate far into the arm, and whose lumen is rather shallow. From the centre of the cross posteriorly arises the trunk, whilst anteriorly the centre bears usually a slight papilla with rings round it; the distinctness and size of this latter varies, however, greatly with the state of contraction of the specimen (Plate, fig. 2). In some specimens the head was swollen, and then its longitudinal diameter equalled its greatest transverse diameter, but, as a rule, the transverse axis is three times the length of the antero-posterior. There is no armature. Also there is no neck, the strobilization commencing immediately behind the head. The proglottides are at first many times as broad as long, but these proportions alter as we pass backward, and at the posterior end of the body they are perhaps one and a half times as long as they are broad. Each proglottis has a very well marked salient posterior border, and their shape and relative size at different regions of the body are well shown in fig. 1. Altogether there are about 100 proglottides, and the whole tapeworm measures on an average 1·5 centims. in length, and about 0·5 millim. to 0·7 millim. in breadth where it is broadest. These tapeworms were, when preserved in formalin, stout and stiff, with well cut outlines.

In transverse sections the proglottides are circular, and the genital pore opens for, at any rate, some consecutive proglottides on the same side, if one may speak of the side of a cylindrical body. It was not possible to make out details of the sexual organs beyond this fact, and that the uterus in the posterior proglottides is follicular.

As it has been impossible to find any figures or descriptions which correspond at all closely with this animal, we have ventured to establish a new genus which we propose to call *Staurobothrium*, and since it is found in the Bird Ray, I suggest the specific name of *ætiobatidis*. The name *Staurocephalus* would better have fitted the facts, but unfortunately it has been used before.

The formal definition is as follows:—

Staurobothrium, n. gen.

Cestode with large cruciform head, without hooks, genital pore lateral, no neck.

Staurobothrium ætiobatidis, n. sp.—Head without hooks or any armature, it consists of four well marked arms projecting from a centre, like the arms of a Maltese cross; each arm ends in a shallow sucker; anteriorly where the arms meet is a low annulated papilla representing the rostrum, but, as said above, there are no hooks. There is no neck. Each proglottis overhangs the one which succeeds it by salient angles forming a funnel-shaped skirt. The genital opening is on one side. The uterus, when full of ova, is follicular. The average length of the worm, with about 100 proglottides, is 15 millims., the average width from 0·5 millim. to 0·7 millim.

The systematic position of this Cestode is obscure. In structure the head superficially resembles that of *Cylindrophorus*, Dies., but it bears no hooks. Very little change would be required in the architecture of the head to turn *Staurobothrium* into the *Calyptobothrium* of Monticelli, but the terminal sucker of the latter is absent in the new genus. In this respect it differs also from Linton's genus *Crossobothrium*. On the whole I think we are justified in placing *Staurobothrium* in the family PHYLLOBOTHRIIDÆ, and not very far from the genus *Phyllobothrium*, VAN BEN.

Tetragonocephalum trygonis, n. gen. et sp.—Plate, figs. 3, 4, 5, 6, 7 and 8.

A number of very minute Cestodes were found in the alimentary canal of *Trygon walga*. It frequently happens that most delicate tapeworms are found in the most powerful and voracious Elasmobranchs, and nothing could be more delicate and fragile than the Cestodes in question. The worms are fragile, and very limp when preserved in formalin. They do not lie stiff and distinct as do those described above from *Ætiobatis narinari*, but they are entangled together and form a mass like a knot of chewed fine white cotton thread (Plate, fig. 3).

The head forms a distinct knob, hardly more than visible to the naked eye, borne on the slender neck. Its diameter is some 0·03 millim. and its antero-posterior axis is usually rather less than its diameter from side to side. In some specimens, as in the one shown in fig. 3, the head is swollen, and its longitudinal axis is longer than its transverse. It is a curious cushiony-looking head, consisting of two distinct parts. Anteriorly there is a circular and rounded knob, about twice as broad as it is long and resembling in shape the stones which are used in the Scottish sport of curling. This probably corresponds with the rostellum of other forms. It is quite unarmed (Plate, fig. 4). This rounded rostellum rests on a second region like a crown upon a cushion. This second region is square in outline, and at each of its corners it carries a small but distinct sucker, the orifice of which is minute. From these suckers small papillæ protrude, passing through their orifice. The rostellum is separated from the square sucker-bearing portion by a thick basement membrane, and it is traversed by many muscle bundles. Similar bundles are attached to the hinder surface of this basement membrane and run down into the neck, where they soon fade away.

The neck is short, and the narrow strictures separating the nascent proglottides commence close behind the head. The constrictions between the proglottides always remain slight; the older proglottides somewhat resemble those of *Dipylidium cucumerinum*, but are less distinct and, except for the slightest possible thinning between adjacent proglottides, the posterior part of the Cestode, after it has attained a certain dimension, remains the same width throughout. At the same time, every here and there there are constrictions which do not seem to correspond with the divisions between proglottides. These are well shown in Plate, fig. 3.

The reproductive apertures are lateral, and the penis lies concealed in a spacious recess (Plate, fig. 6). The pores irregularly alternate, some four being in the left followed by one or two on the right, then a few on the left and again perhaps four on the right. At its first appearance the uterus seems double, an anterior and a posterior part lying one in front and one behind the genital pore; the two are, however, in communication by a narrow channel (Plate, figs. 5, 6 and 7). The whole uterus in the ripe proglottides is thus somewhat dumb-bell-shaped, the narrow part being pinched in by the cirrus bulb. The ova are slightly oval.

At first it might be thought that we had to do with a tapeworm of the same genus as LINTON'S *Lecanicephalus*, but on referring to his description* and figures it is evident that this can hardly be the case. LINTON describes the head as "consisting of two disciform plates," but he figures a round anterior part lying in the foremost plate. The figure is very poor and we may be wrong in this interpretation, which, however, is strengthened by his comparison of *Lecanicephalum* with the *Discobothrium* of VAN BENEDEN, for in this genus the head is divided into three distinct parts. The disks of *Lecanicephalum* are nearly circular, and the posterior bears four suckers, but there is no mention of any papillæ projecting from them. VAN BENEDEN'S genus *Discobothrium* found in *Trygon pastinaca* is figured, but not described by him.† It has two distinct circular disks, corresponding with the rounded anterior part and the first disk of *Lecanicephalum*, and then a thicker somewhat cruciform disc with very salient angles which terminate in suckers. Our specimen has the anterior round part—the curling stone as we have described it—resting on a quadrangular cushion with suckers at the angles. On the whole it seems that we must describe it as a new genus, and this we do under the name *Tetragonocephalum*, from the square cushion which forms the larger part of the head.

Tetragonocephalum ætiobatidis, n. sp.—Plate, figs. 9 and 10.

A single specimen of another Cestode of apparently the same genus was found with those described above in *Ætiobatis narinari*. Its length was 1·3 centims., and its breath, which was remarkably uniform behind the head, was 0·5 millim. (Plate, fig. 9). The head was three times this breadth and consisted of a rostellum, long and conspicuous and unarmed, and of a swollen base, squarish in cross-section, with four small suckers at the anterior angles (Plate, fig. 10). Posteriorly the basal portion overlapped the anterior proglottides. There is no neck, but the proglottides appear immediately after the head, at first very narrow but with marked constrictions; as they increase in size the posterior angle becomes salient, less so, perhaps, than in *Staurobothrium ætiobatidis*, but more so than in *Tetragonocephalum trygonis*. The last three proglottides are twice the length of those which immediately precede them and this growth is somewhat sudden.

The head, though it differs greatly in its proportions, resembles in essentials the head of *T. trygonis*. The marked saliency of the posterior edge of the proglottides separates off the species in question from the species which inhabits *Trygon walga*. As there was but a single specimen, it did not seem advisable to cut it, and as it was preserved in osmic it was not possible to make out anything of the internal anatomy.

The definition of this genus is as follows:—

* 'U.S.A. Commission of Fish and Fisheries,' 1891, p. 802.

† 'Mem. Ac. Belgique,' xxxviii., 1871.

Tetragonocephalum, n. gen.

Head unarmed, consisting of an anterior knob-like portion arising from a cubical base; the four posterior corners of the cubical base have minute suckers, each with a papilla.

This genus would be a member of the family Lecanicephalidæ, and would probably come not very far from the genus *Lecanicephalum*, LINT., in BRAUN'S classification given in BRONN'S "Thierreich."

The species above described may be formally defined as follows:—

Tetragonocephalum trygonis, n. sp.—Fragile, minute, head hardly visible to the naked eye; length of body 2–4 centimetres: in section the head is circular and the proglottides almost so, their greater diameter being 0·03 millim.; head consisting of a curling-stone-shaped anterior portion resting on a square cushion with suckers at each corner from which a papilla protrudes; neck short; furrows between contiguous segments very slight and in some places invisible; reproductive pores lateral and irregularly alternate; genital recess large, and the remains of this constrict the ripe uterus into a dumb-bell-shaped structure.

Tetragonocephalum ætiobatidis, n. sp.—Minute head not much more than visible to the naked eye; length of body and head 1·5 centims.; head consists of an elongated rostellum, unarmed, which projects freely from an almost cubical base, this base is as long or longer than it is broad; at its anterior angles it bears four small suckers; there seems to be no, or at most a very short, neck; the proglottides overlap.

II. TREMATODA.

In the following account of two Trematodes, one from *Balistes* sp. and the other from either a species of *Carcharias* or *Rhinodon typicus*, the "basking shark"* of tropical waters, we are much indebted to Mr. NORMAN MACLAREN both for notes on the structure of the animals and for the drawing of fig. 11 on our Plate.

Distoma palleniscum, n. sp.—Plate, fig. 11.

This Trematode comes very near *D. pallens*,† but differs from it in having certain peculiarities which seem of specific rank. *D. pallens* was found in *Chrysophrys aurata*, CUV., by the authors mentioned in the footnote, and by LINTON in *Alutera*

* There is some doubt as to the host represented by the "basking-shark." The "basking-shark" of the Indian Ocean, according to the books, is the rather rare *Rhinodon typicus*, but Professor HERDMAN'S recollection is that the term was applied by the sea-going men to a *Carcharias*. A drawing of one of these sharks caught on the pearl banks has, however, been identified by Mr. BOULENGER as *Stegostoma tigrinum*.

† RUDOLPHI, 'Entozoorum Synopsis,' 1819, pp. 111 and 410; DUJARDIN, 'Hist. Nat. d. Helminthes,' pp. 457 and 458; DIESING, 'Syst. Helm.,' vol. 1, p. 348; STOSSICH, 'Saggio di una Fauna Elmint. di Trieste,' p. 47; 'LINTON, 'Proc. Nat. Museum,' vol. 20, pp. 526 and 527, plate xlvii., figs. 8 and 9.

schœpfii. The present species is from the intestine of *Balistes* sp., the File- or Trigger-fish found on the Ceylon pearl banks (Plate, fig. 11). The distoma is characterised as follows:—Length 5 millims.; perfectly smooth skin; anterior sucker almost globular, with a relatively small mouth; the pharynx does not directly abut on the anterior sucker; œsophagus wide; digestive cæca reach to posterior end; yolk-glands extraordinarily prominent, arranged in 2 rows, one on each side and behind the testes; the shell glands and receptaculum seminis not easy to distinguish, but they lie anterior to the ovary; the termination of the vas deferens is apparently eversible and is probably used as a penis; a definite penis is absent; numerous glands surround the terminal parts of both the male and the female ducts.

This species seems to differ from the *Distoma pallens* of RUDOLPHI in the facts (i.) that the ventral sucker is not twice the size of the oral, (ii.) the aperture of the ventral sucker is rounded and is not a transverse slit, (iii.) the ovary is not globular, (iv.) the yolk-glands are prominent and arranged in two rows.

Distomum richiardii, LOPEZ.

Many specimens of this elegant little Trematode were taken from the perivisceral cavity of *Rhinodon typicus.* The species has recently been described by MONTICELLI,* who has found it in the body-cavity of *Acanthias vulgaris* and more rarely in *Mustelus vulgaris* and *Myliobatis aquila*, in the Bay of Naples.

III. NEMATODA.

Cheiracanthus spinosissimus, n. sp.—Plate, figs. 12 and 13.

Length 13·7 millims., breadth 0·45 millim.; œsophagus $\frac{1}{45}$, and the conical tail, which is round quite at the end, is $\frac{1}{31}$ of the whole body-length; cuticle 0·022 millim. thick, tough, transversely wrinkled; head end rounded like the mouth of a Turkish pipe (Plate, fig. 12); four tongue-like projections pointing backwards in the inter-mediate areas; 30 to 33 transverse rings, each consisting of some hundreds of spines; six lips around the mouth; four neck glands of $\frac{2}{3}$ to $\frac{3}{4}$ the length of the œsophagus, in front these are thin, with two swellings, but they thicken behind and contain spiral muscles; intestine dark brown; the tail has on each side two præ-anal and four post-anal papillæ, arranged as shown in fig. 13; the papillæ in outline resemble a skittle; cirri equal and 0·7 millim. long.

This Nematode was obtained from *Myliobatis aquila*, in the Gulf of Manaar.

This above definition has been furnished by Dr. VON LINSTOW, who kindly undertook to investigate the *Cheiracanthus.* He adds that this new species differs from *C. unicinctus* both in its head and in its neck glands.

* 'Zool. Jahrb. Syst.,' vi., Supplement, 1893.

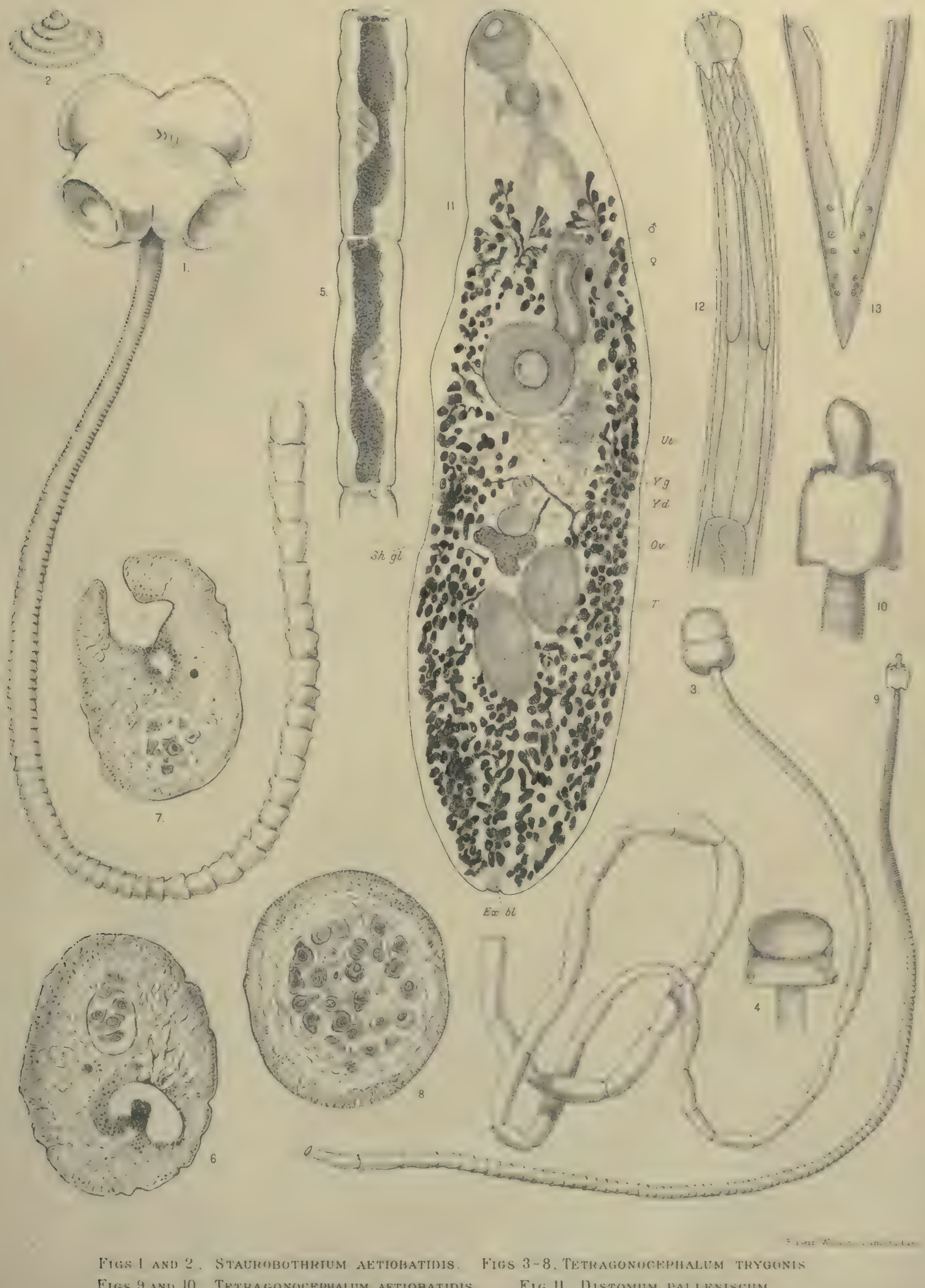
LIST OF PARASITES WITH THEIR HOSTS.

The species described in this and the previous Paper are as follows :—

PARASITE.		HOST.
CESTODA :—		
Small Cestode larvæ	from	*Margaritifera vulgaris.*
Tetrarhynchus unionifactor	,,	,, ,,
,, *balistidis*	,,	*Balistes mitis, B. undulatus,* and *B. stellatus.*
,, *pinnæ*	,,	,, ,, ,,
,, *minimus,* v. LINS	,,	*Tæniura melanospilos.*
Staurobothrium ætiobatidis	,,	*Ætiobatis narinari.*
Tetragonocephalum trygonis	,,	*Trygon walga.*
,, *ætiobatidis*	,,	*Ætiobatis narinari.*
TREMATODA :—		
Muttua margaritiferæ	,,	*Margaritifera vulgaris.*
Musalia herdmani	,,	,, ,,
Aspidogaster margaritiferæ	,,	,, ,,
Distomum palleniscum	,,	*Balistes* sp.
,, *richiardii*	,,	*Rhinodon typicus.*
NEMATODA :—		
Ascaris meleagrinæ	,,	*Margaritifera vulgaris.*
Cheiracanthus uncinatus	,,	,, ,, larva, and *Balistes mitis* and *B. stellatus.*
,, *spinosissimus*	,,	*Myliobatis aquila.*

EXPLANATION OF PLATE.

Fig. 1. *Staurobothrium ætiobatidis.* × 12.
,, 2. Anterior end of the same more highly magnified.
,, 3. *Tetragonocephalum trygonis.* × 24.
,, 4. Another head of the same, showing different dimensions. × about 75.
,, 5. Some mature proglottides of the same more highly magnified, showing the dumb-bell-shaped uterus.
,, 6. Transverse section through the same, showing the penis, the genital recess, and the narrow part of the uterus.
,, 7. Another transverse section, showing the opening of the genital recess to the exterior.
,, 8. A third transverse section nearer the end of a proglottis, showing the uterus taking up almost all the space.
,, 9. *Tetragonocephalum ætiobatidis.* × about 20.
,, 10. The head of the same. × 75.
,, 11. *Distomum palleniscum.* *Ex.bl.*, excretory vesicle; *Ov.*, ovary; *Sh.gl.*, shell glands; *T.*, testis; *Ut.*, uterus; *Y.g.*, yolk glands; *Y.d.*, yolk ducts; ♂, male, and ♀, female, reproductive pores.
,, 12. *Cheiracanthus spinosissimus*, head end.
,, 13. The same, tail end.



FIGS 1 AND 2, STAUROBOTHRIUM AETIOBATIDIS. FIGS 3-8, TETRAGONOCEPHALUM TRYGONIS
FIGS 9 AND 10, TETRAGONOCEPHALUM AETIOBATIDIS FIG. 11, DISTOMUM PALLENISCUM
FIGS. 12 AND 13, CHEIRACANTHUS SPINOSISSIMUS.

REPORT

ON THE

SPONGES

COLLECTED BY

PROFESSOR HERDMAN, AT CEYLON, IN 1902.

BY

ARTHUR DENDY, D.Sc., F.L.S.,

PROFESSOR OF ZOOLOGY IN THE SOUTH AFRICAN COLLEGE, CAPE TOWN.

[WITH PLATES I. TO XVI.]

INTRODUCTION.

CONSIDERING the frequent opportunities for collecting which have been afforded by the Pearl Fisheries of Ceylon, it is remarkable that our knowledge of the Sponge-Fauna of this locality, rich and varied as it is, should so long have remained in so backward a condition. In 1887, Mr. RIDLEY and I (**1**)* called attention to this fact in our Report on the Monaxonida collected by H.M.S. "Challenger," but as the "Challenger" unfortunately did not visit Ceylon, the results of that memorable voyage did nothing towards improving matters in this respect. In the same year, however, as that in which our "Challenger" Report was published, I was able to report (**2**) also upon a collection of sponges from Madras, made by Mr. EDGAR THURSTON, the Superintendent of the Government Central Museum, and again in 1889 I reported (**3**) on a second collection of sponges made by the same Zoologist in the Gulf of Manaar. In this way considerable additions were made to our knowledge of the Sponge-Fauna of Ceylon and Southern India, but Mr. CARTER'S papers (**4, 5**) on the sponges collected in the Gulf of Manaar by Captain W. H. CAWNE WARREN still remained the principal works on the subject; a very remarkable fact, when we remember the extraordinarily

* The numbers in brackets refer to the List of Literature at the end of the Report.

small bulk of the material which he investigated and amongst which he found altogether something like 70 species—a notable addition indeed to the 13 or so previously described from the same neighbourhood by Esper (**6**), Haeckel (**7**), Bowerbank (**8**), and Holdsworth (**9**).

The collection of sponges (146 species) made by Professor Herdman is, however, far more extensive than any previously obtained in Ceylon waters, and includes not only a large proportion of the species already described by the authors mentioned, but also a considerable number (77 species) of new ones, some of which are of very great interest. With the exception of the Calcarea, which are singularly few in number, and of the Hexactinellida, which are, of course, a deep-water group and not likely to be met with in the neighbourhood of the pearl banks, the collection contains representatives of practically all the important sub-divisions of the Phylum. In dealing with so large a mass of material, the question of classification has assumed a very formidable aspect, and I have found it desirable to make certain modifications in this respect which I hope may be regarded as improvements. These modifications will be duly explained, and I hope justified, in the proper place.

Since, in spite of the enormous advances which have been made during the last twenty years in our knowledge of the sponges, our ideas as to taxonomy are not yet by any means in a settled condition, I have considered it desirable to give brief diagnoses of the various sub-divisions with which I have to deal, in order that there may be no mistake as to the sense in which I employ them. We are, undoubtedly, progressing rapidly towards a satisfactory and natural classification of the group, but the problem is an extremely difficult one, and every new collection of any considerable extent, such as the present, must for a long time to come necessitate more or less modification of existing views. The classification which I have adopted may at present be regarded as the latest of these modifications, based principally upon the writings of Sollas, Ridley, Lendenfeld, Topsent, and myself. Topsent, in particular, has done much in the last few years both in arranging and classifying the chaotic mass of information left by earlier writers, and in making notable additions to our systematic knowledge of this difficult but interesting group.

In order to facilitate reference to the type specimens by future workers and to make the systematic portion of this report as precise as possible, I have adopted the system, already employed in my Catalogue of Non-Calcareous Sponges collected by J. Bracebridge Wilson, &c. (**10**), of giving at the end of the description of each species the Register Number (R.N.), which I have attached to each specimen. This method also has the great advantage of enabling one to refer readily to individual specimens in the text.

At the conclusion of the Report I propose to give as complete a list as possible of the Sponge-Fauna of Ceylon and to discuss the problem of Geographical Distribution. In the meantime I append a list of the principal memoirs dealing with the subject arranged in chronological order.

Special Bibliography of the Ceylon Sponge-Fauna.*

1798–1806. Esper.—"Fortsetzung der Pflanzenthiere," Part 2.

1870. Ehlers.—"Die Esper'schen Spongien." (In this memoir the author re-describes two Ceylon species.)

1872. Haeckel.—"Die Kalkschwämme." (This work includes descriptions of half a dozen species of Calcareous Sponges collected by Wright in Ceylon waters.)

1873. Bowerbank.—"Report on a Collection of Sponges found at Ceylon by E. W. H. Holdsworth, Esq.," 'Proc. Zool. Soc. Lond.,' 1873, p. 25. (This paper contains descriptions of only four species. It was criticized by Gray in 'Ann. and Mag. Nat. Hist.,' Ser. 4, vol. XII., p. 266.)

1873. Holdsworth.—"Note on the Occurrence of *Xenospongia patelliformis*, Gray, on the Coast of Ceylon," 'Proc. Zool. Soc. Lond.,' 1873, p. 32.

1880. Carter.—"Report on Specimens dredged up from the Gulf of Manaar and presented to the Liverpool Free Museum by Captain W. H. Cawne Warren," 'Ann. and Mag. Nat. Hist.,' Ser. 5, vol. V., p. 437; vol. VI., p. 35 and p. 129. (In this paper the author describes fifty-four species, the great majority new, from material which he tells us would hardly fill a quart measure, the largest of the specimens being not more than three inches in its longest diameter.)

1881. Carter.—"Supplementary Report on Specimens dredged up from the Gulf of Manaar, &c.," 'Ann. and Mag. Nat. Hist.,' Ser. 5, vol. VII., p. 361. (A considerable number of species are added to the previous list.)

1884. Ridley.—"Zoological Collections of H.M.S. 'Alert,'" British Museum. (The author refers incidentally to the Sponge-Fauna of Ceylon.)

1887. Dendy.—"The Sponge-Fauna of Madras. A Report on a Collection of Sponges obtained in the neighbourhood of Madras by Edgar Thurston, Esq.," 'Ann. and Mag. Nat. Hist.,' Ser. 5, vol. XX., p. 153.

1888. Sollas.—"Report on the Tetractinellida collected by H.M.S. 'Challenger.'" (In this work the author deals critically with the Tetractinellida described by Carter from the Gulf of Manaar.)

1889. Dendy.—"Report on a Second Collection of Sponges from the Gulf of Manaar," 'Ann. and Mag. Nat. Hist.,' Ser. 6, vol. III., p. 73. (The list of the Ceylon Sponge-Fauna is herein considerably extended, and the report contains records made by Mr. Thurston of the colours of many of the species when alive.)

1889. Lendenfeld.—"Monograph of the Horny Sponges," 'Royal Society.'

* This list includes only works which deal directly with Ceylon species, and was inserted here on account of its historical interest. In the course of the Report I shall have occasion to refer to many other memoirs, and, in order to conform with the system adopted in the other Reports of this series and to save space, I have decided to give a full list of the literature cited at the end of the work and to refer to it by means of numbers.

SYSTEMATIC DESCRIPTION OF THE GENERA AND SPECIES OF SPONGES IN PROFESSOR HERDMAN'S COLLECTION.

Phylum PORIFERA.

Class: NON-CALCAREA.

PORIFERA without calcareous spicules.

The non-calcareous sponges are divisible into four natural groups, for which I propose to use the names MYXOSPONGIDA, TRIAXONIDA, TETRAXONIDA, and EUCERATOSA respectively, and which may be conveniently regarded as of ordinal rank.

Order: MYXOSPONGIDA.

Non-calcarea which are primitively destitute of spicules and horny fibre; with simple canal system and usually large flagellate chambers.

In this order I include the genera *Halisarca*, *Bajalus*, *Hexadella*, and *Oscarella*, all of which appear to me to be nearly related to one another, so that it is hardly necessary to divide them, as is usually done, into two families, Halisarcidæ and Oscarellidæ. All of them are, I believe, primitive forms, and should therefore stand at the bottom of the series of non-calcareous sponges.

It is quite possible that LENDENFELD's "Hexaceratina" may be closely related to the "Halisarcidæ," as supposed by that author; but, if so, it appears to me that the Halisarcidæ are the more primitive forms, from which both Hexactinellida and Hexaceratina have been derived. LENDENFELD, on the other hand, appears to regard the Halisarcidæ as being derived from the Hexaceratina by loss of horny fibres, and in this opinion he is followed by TOPSENT (11), who observes "Dépourvu à la fois de spicules et de fibres cornés, le genre *Hexadella* est vraiment le dernier chaînon de la chaîne des Hexaceratina et doit occuper la place qu'on a parfois assignée, sans raison valable, aux *Halisarca*."

The Myxospongida may therefore be regarded as representing a common starting point, from which have originated the Triaxonida, the Tetraxonida, and the Euceratosa, and I cannot agree with Professor MINCHIN (12) in placing this order at the end of the siliceous series instead of at the beginning. The primitive character of the canal system argues strongly against the belief that they are forms in which the skeleton has been lost by gradual reduction, and the case is obviously quite different from that of *Chondrosia*, whose highly specialized canal-system, strongly developed cortex, and evident relationship to *Chondrilla*, afford good grounds for regarding it as a reduced siliceous sponge in which the absence of skeleton is a secondary and not a primary character.

Hexadella, Topsent.

Myxospongida with large, sac-shaped flagellate chambers and a distinctly differentiated, tough ectosome.

The description given by Topsent (*loc. cit.*, p. 119) of this genus and of the two species which he includes in it is evidently of a preliminary character and is unfortunately without illustrations. His own diagnosis of the genus runs, " Hexaceratina revêtantes, molles, sans spicules ni fibres cornés; un peu plus épais que dans les genres voisins, l'ectosome jouit seul de quelque consistance et sert, dans une certaine mesure, de squelette externe à la masse."

As the genus is as yet so little known, I shall postpone the discussion of its relationship until I have described in some detail the anatomy of the Ceylon species.

Hexadella indica, n. sp.—Plate I., figs. 1–3.

Sponge thin, encrusting; spreading extensively over masses of calcareous Polyzoa and other organisms, but usually only about 1 millim. in thickness. Colour in spirit, grey (in life, red ?). Surface smooth, glabrous, minutely reticulate. Vents few, minute, scattered. Consistence (in spirit) rather tough and membranous (owing chiefly to the ectosome), so that the sponge can be stripped off from the substratum like a skin.

The ectosome (Plate I., fig. 1, *Ect.*) forms a tough pellicle about 0·08 millim. thick, which can be stripped off from the underlying choanosome. The choanosome evidently consists of a thin lamella (fig. 1, *Ch.L.*, fig. 2), very much folded upon itself. The lamella itself is little, if any, thicker than the ectosome, and contains a single layer of large, sac-shaped flagellate chambers (figs. 1, 2, *F.C.*), whose arrangement, of course, follows the curvature of the lamella. The structure of the choanosome thus reminds one very strongly of what occurs in *Oscarella*, but there is no extensive internal portion free from flagellate chambers as in that genus.

Between the folds of the choanosomal lamella lie the primary inhalant (*P.I.C.*) and exhalant (*P.E.C.*) canals. The former expand at their outer ends into large, irregular crypts (fig. 1, *Cr.*), roofed over by the ectosome, which merges insensibly into the choanosome at the points of contact. These crypts, resembling subdermal cavities, may sometimes be seen from the surface, ramifying horizontally beneath the ectosome. The primary exhalant canals open at their inner ends into larger exhalant channels (fig. 1, *L.E.C.*).

Owing to the development of the ectosome, the water does not enter the primary inhalant canals directly, as in *Oscarella*, but by means of numerous well-developed "chones" (fig. 1, *Ch.*), which penetrate the ectosome at right angles to the surface. Each chone expands somewhat at its outer end in a trumpet-like manner, and is covered over by a membrane (fig. 3, *Mem.*) which doubtless contains the inhalant pores, but the pores are now all closed and cannot be recognised. I have, however, seen indications, in the form of fine, slit-like canals in the closing membrane, of the existence of several minute pores in the roof of each chone.

From the primary inhalant canals the water reaches the flagellate chambers by fine, sometimes branching canaliculi of considerable length (fig. 2, *I.Ca.*). The chambers themselves (figs. 1, 2, *F.C.*) are sac-shaped, unbranched (at any rate usually) and up to about 0·098 millim. long, though usually less (say about 0·065 millim.). They open into the primary exhalant canals either directly (eurypylous) or through short exhalant canaliculi.

The mesoglœa, both of the ectosome and choanosome, is abundantly developed and chiefly collenchymatous, with a profusion of small connective-tissue cells (fig. 2, *C.T.C.*) with much-branched processes. The mesoglœa of the ectosome passes insensibly into that of the choanosome at the points of contact; the former, however, stains rather more darkly than the latter, and is often distinctly, though very finely, fibrillated.

In the mesoglœa we also find embedded a large number of small, darkly staining, spherical cells (figs. 1, 2, 3, *Sy.A.*), about 0·006 millim. in diameter, sometimes apparently with small central nuclei. These cells are most abundant around the various parts of the inhalant canal-system, and are congregated in immense numbers in the inner portion of the ectosome. They sometimes appear to be broken up into groups of smaller cells. They are in all probability symbiotic algæ, such as are known to occur frequently in sponges, a conclusion which is rendered almost certain by the fact that, when treated with iodine and sulphuric acid, they give a distinct purple coloration (although it must be admitted that when tested for starch with SCHULTZE's solution, only negative results were obtained). These bodies are probably closely comparable to the "cellules sphéruleuses" to which TOPSENT (*loc. cit.*, p. 120) attributes the red colour of his *Hexadella racovitzai*, and which are also (in my opinion) probably symbiotic algæ. Unfortunately, I have no information as to the colour of *Hexadella indica* in life, but if, as seems just possible, it is identical with CARTER's *Halisarca rubitingens*, it is also red, and the colour may likewise be attributable to the symbiotic algæ.

This very interesting sponge appears to form a connecting link between the three genera *Oscarella*, *Halisarca*, and *Hexadella*, to which latter genus I have referred it only after long hesitation. It resembles the first in the distinctly folded character of the choanosomal lamella and the arrangement of the flagellate chambers, which are, however, much larger and usually (though not always) eurypylous, while a more important distinction is introduced by the strong development of the ectosome. The structure of the ectosome, the absence of the curious connective-tissue fibres, and the unbranched character of the flagellate chambers, together with the less extensive development of the mesoglœa, separate it from *Halisarca*. The mesoglœa appears, however (as far as one can judge from TOPSENT's description), to be a good deal more extensively developed than in his species of *Hexadella*. TOPSENT says nothing about the existence of a distinctly folded choanosome lamella, or of inhalant chones, in his species, and it is quite possible that a new genus may be necessary for the reception of the Ceylon sponge, but this is a point which cannot be decided until we have more information as to the European species.

Hexadella indica may, as I have already suggested, possibly be identical with CARTER's *Halisarca rubitingens* (5), which was described from *dry* material from the Gulf of Manaar and referred to the genus *Halisarca* provisionally by its author. Having examined one of Mr. CARTER's original preparations of *Halisarca rubitingens*, now in my possession, I have come to the conclusion that we cannot say for certain what that organism was, and that it will be best to abandon the name altogether.

R.N. 26, 46 (Gulf of Manaar), 254 (south of Adams Bridge, 5 fathoms).

ORDER: TRIAXONIDA (HEXACTINELLIDA).

Non-calcarea in which the skeleton is composed of siliceous spicules whose fundamental form is triaxonid and hexactinellid.

Owing, doubtless, to the collecting operations having been confined to comparatively shallow water, there are no representatives of the Hexactinellida in the collection. There are, however, a few specimens of the so-called Hexaceratina which may be found ultimately to belong here. As, however, I do not consider that their systematic position is yet definitely settled, I have decided to deal with them later on, in connection with the other horny sponges (see below, p. 200).

ORDER: TETRAXONIDA.

Non-calcarea in which the fundamental form of the spicule is tetraxonid and tetractinellid. The spicules may, however, be more or less reduced, and also to a greater or less extent replaced by spongin or even sand.

It will be seen that I use the term Tetraxonida in a wider sense than that in which it is employed, for example, by MINCHIN, in his admirable article in LANKESTER's 'Zoology.' It appears to me necessary to do this in order to bring out the most fundamental character of the group, viz., the primitively tetraxonid and tetractinellid character of the spicule, in contrast with the triaxonid and hexactinellid character of the spicule in the Triaxonida.* The term Tetractinellida may be reserved for those non-Lithistid Tetraxonida which retain to a greater or less extent the primitive spicule-form, a form which doubtless characterised the ancestors of all the Tetraxonida, but has been lost by reduction in many of the existing members of the group.

The Lithistida have evidently developed along special lines of their own, and

* The occurrence of triods in the most primitive family of the Tetraxonida (viz., Plakinidæ) suggests a triaxonid (and triradiate) precursor of the tetraxonid and tetractinellid spicule. The triaxonid spicule of the Plakinidæ is, however, a fundamentally different form from that of the Triaxonida (Hexactinellida).

include both tetractinellid and monaxonellid forms, they may therefore be most conveniently regarded as constituting a separate "grade." By this exclusion of the Lithistida, the term Tetractinellida is confined to SOLLAS's group "Choristida," a sense in which it has already been employed by LENDENFELD in his work on the Tetractinellida of the Adriatic (**13**).

Recent researches, however, have shown that the Tetractinellida, Lithistida, Monaxonellida, and certain horny sponges which I propose to call Pseudoceratosa, are so closely related to one another that they must certainly be included in one and the same order. Indeed, it is difficult to draw a hard and fast line between these sub-divisions, which merge very gradually into one another. It is certain that the Monaxonellida have been derived (probably polyphyletically) from ancestral Tetractinellida, and the Pseudoceratosa (or, at any rate, the great majority of them) from ancestral Monaxonellida (probably polyphyletically), while the Lithistida may also be of polyphyletic origin and are closely related to the Tetractinellida on the one hand and to the Monaxonellida on the other.

The sharp separation of these four groups is, therefore, to a large extent artificial, but must be retained as a matter of convenience till we know a good deal more about their phylogeny. It must, however, be clearly recognised that the groups Tetractinellida, Lithistida, Monaxonellida, and Pseudoceratosa simply represent stages in a complex evolutionary series, commencing with the first-named group, and that each of the later stages may possibly have been reached along more than one line of descent.

GRADE: TETRACTINELLIDA.

Tetraxonida in which the primitive tetraxonid and tetractinellid condition (or a possibly still more primitive triaxonid and triradiate condition) is retained by some at least of the spicules, while no desmas are developed.

SUB-ORDER: HOMOSCLEROPHORA.

Tetractinellida in which microscleres and megascleres are not yet sharply differentiated from one another and no triænes are developed.

I venture to propose the name Homosclerophora to replace the old name Microsclerophora of SOLLAS. The latter is very misleading in that it does not indicate the primitive undifferentiated character of the spicules as regards size, and leaves it to be inferred that microscleres, as distinct from megascleres, are present.

TOPSENT (**14**), followed by MINCHIN (**12**), associates the Homosclerophora (Microsclerophora) with the "Microtriænosa" and the "Oligosilicina" in one group, to which he gives the old name "Carnosa." This appears to me a most undesirable proceeding, for while the Homosclerophora (especially the Plakinidæ) are evidently primitive forms, as SOLLAS (**15**) long since pointed out and as is clearly shown by their anatomical characters, the "Microtriænosa" are what Minchin terms "a heterogeneous collection of sponges of divers affinities," and the "Oligosilicina" ("Chondrosidæ," of Schulze) are simple only by the reduction of the skeleton and not primitively. I therefore consider that Topsent's revived "Carnosa" should be again abandoned, the "Microtriænosa" placed amongst the other triæne-bearing Tetractinellida, and the "Oligosilicina" placed near the Tethyidæ, to which they are evidently allied by their corticate character, the general arrangement of their canal-system, and the astrose microscleres of Chondrilla.

The Homosclerophora are thus left as the natural starting point of the Tetraxonid series, a position already clearly indicated for them by Lendenfeld in his work on the Tetractinellida of the Adriatic. Topsent, it is true, fully recognises the artificial character of his "Carnosa" and places them after his "Tetractinellida." Minchin, on the other hand, places them first, a diversity of opinion which clearly indicates the impracticability of associating together such widely different forms as are included in the group.

Owing to their primitive character, the Homosclerophora form a very important and interesting sub-order, and it is here that we must seek for the origin, not only of the various types of canal-system, but also of the almost innumerable types of both micro- and megascleres met with amongst the Tetraxonida.

Family: PLAKINIDÆ.

Homosclerophora in which no distinct cortex is developed.

This appears to be the most primitive family of the Tetraxonida. The genus *Plakinastrella*, formerly included herein, but possessing more or less well-developed triænes, finds a more natural position amongst the Pachastrellidæ.

Dercitopsis, n. gen.

Plakinidæ with calthrops, triods and smooth oxea, but no candelabra. The oxea vary greatly in size, and some of the smaller ones form a special dermal layer, in which they are commonly arranged at right angles to the surface.

It is, perhaps, doubtful whether this genus ought to be separated from *Plakortis*, but the species for which it is founded differs from the type species of *Plakortis* (*P. simplex*) in three respects :—(1) Calthrops are present as well as triods; (2) some of the oxea are so large as to deserve the name of megascleres, although they pass gradually into the smaller forms (microxea); (3) some of the microxea form a special dermal layer, in which they are commonly arranged at right angles to the surface.

In this genus we have a refutation of Sollas's statement that "megascleres are absent" from the so-called "Microsclerophora" (including the Plakinidæ), and we see very clearly how oxeote megascleres may be derived directly from primitive triaxon or tetraxon spicules by suppression of one or two actines (see Plate II., fig. 1). From the same source are derived microxea, and these, being frequently curved, have probably given rise to the sigmata and toxa and, perhaps, other curvilinear microscleres of higher groups. Increase in the number of actines of the primitive spicule, on the other hand, accompanied by other modifications, has probably given rise to the astrose series of microscleres. Thus *Dercitopsis* and its allies may be regarded as representing at the present day the common ancestors of both Astrophora and Sigmatophora.

Dercitopsis ceylonica, n. sp.—Plate II., fig. 1.

This species is represented in the collection by two small, flat pieces which have probably been encrusting and may have formed parts of the same specimen. One is about 22 millims. in length, 13 millims. in greatest breadth, and 7 millims. in greatest thickness. The other is about 26 millims. in length, 16 millims. in greatest breadth, and 7 millims. in greatest thickness. The surface is smooth but rather uneven. Colour in spirit, dark slate grey on the outside, dull yellow internally. Vents minute, scattered singly, with a tendency towards marginal arrangement or grouping on prominent parts. Inhalant pores dispersed abundantly over the surface, not in sieves.

Skeleton very dense, for the most part quite confused and irregular, but with the smallest microxea forming a thin dermal crust, in which they are commonly arranged at right angles to the surface.

Spicules.—(1.) Calthrops and triods (Plate II., fig. 1, *a–h*); rays smooth, sharply and gradually pointed, commonly about 0·033 millim. long by 0·005 millim. in maximum diameter, but subject to considerable variation, and occasionally exhibiting monstrous forms such as twins.

(2.) Oxea (fig. 1, *i–o*); varying enormously in size, but in such a perfectly graduated series between the smallest and the largest that they cannot be divided into mega- and microscleres. The dermal microxea measure only about 0·025 millim. by 0·002 millim., while the oxea in the deeper parts of the sponge frequently measure as much as 0·42 millim. by 0·012 millim. Both large and small oxea are smooth, gradually and finely pointed at each end, and frequently centrotylote. They often exhibit a curvature, which may be sigmoid or toxoid, and thus strongly support the conclusion arrived at by Sollas (*loc. cit.*, p. 109) to the effect that the toxa of *Dercitus* are probably microxea which have acquired a curvilinear growth. The same author has also pointed out that the spinose microrhabds of *Dercitus* originate as smooth centrotylote microxea, which he regards as diactinal asters. From a similar origin we get, in the case of *Dercitopsis ceylonica*, comparatively large oxeote megascleres, which seems to indicate that this common type of spicule may also have been derived from an aster. It also seems probable that the well-known sigmata, so widely distributed in certain tetractinellid and monaxonid groups, may have originated from such microxea as we find here, in other words, from diactinal asters.

The distinction between ectosome and choanosome is not well-marked, and there is no properly defined cortex. The ectosome is, however, fairly thick (about 0·27 millim.), and much more densely spicular than the choanosome; it contains numerous small brown pigment cells (which are also met with in the outer part of the choanosome). There is no fibrous tissue in the ectosome, and what little mesoglœa there is between the densely packed spicules is probably collenchymatous. The mesoglœa of the choanosome is very finely and uniformly granular.

The dermal pores lead into short inhalant canals which penetrate the ectosome more or less vertically and, after uniting together to a greater or less extent, open beneath the ectosome into spacious "crypts," from which the inhalant canals of the choanosome take their origin. The flagellate chambers are rather large, pouch-shaped, about 0·04 millim. in longer diameter; eurypylous, or with short, wide exhalant canals.

R.N. 139, 235 (? Parts of the same specimen. From Station XLI., 12 miles off Galle, 100 fathoms).

Sub-order: ASTROPHORA.

Tetractinellida with triænes and with astrose microscleres; without sigmata.

Family: PACHASTRELLIDÆ.

Astrophora without long-shafted triænes and without sterrasters. Calthrops, in addition to short-shafted triænes resembling calthrops, may be present.

Plakinastrella, Schulze.

Pachastrellidæ with calthrops and (or) short-shafted triænes and oxea for megascleres; and oxyasters and microxea for microscleres; the microxea forming a special dermal skeleton.

This genus occupies an intermediate position between the Plakinidæ and the Stellettidæ, and probably indicates the first stage in the evolution of the long-shafted triæne from the calthrops. The relationship to the Plakinidæ is clearly shown by the form of the oxea, and the differentiation between megascleres and microscleres is not yet by any means complete.

Plakinastrella intermedia, n. sp.—Plate I., fig. 4; Plate II., fig. 2.

Specimen (Plate I., fig. 4) irregularly branched and shortly stalked; branches short, thick, irregularly nodose, spreading more or less horizontally, rounded at the extremities. Surface smooth but uneven, minutely porous in parts. Texture firm and incompressible, with many relatively large foreign bodies embedded in the substance of the sponge and sometimes projecting beyond the surface. Vents small and few, on rounded ends of branches. Pores scattered in irregular groups; many in each group, easily visible under a pocket lens. Colour in spirit, greyish brown. Total height, 20 millims.; greatest breadth, 26 millims.

The skeleton is for the most part very confused. The choanosome is densely strewn with large oxea lying in every direction and occasionally aggregated in loose bundles; with these are mingled oxea of smaller size and a few tetract spicules, while the interspaces are filled in with immense numbers of oxyasters, uniformly and thickly scattered through the soft tissues. On the surface of the sponge is a dense layer of small oxea, tangentially disposed, and for the most part lying so close together as to touch one another and form a continuous crust, perforated by the numerous circular inhalant pores where these occur. Beneath this dermal crust are extended horizontally a number of the large oxea and the heads of the dichotriænes.

Spicules.—(1.) Dichotriænes (Plate II., fig. 2, *a–d*), with cladi extended beneath the dermal crust and shaft projecting inwards at right angles to the surface. The shaft is short, stout, and fairly gradually sharp-pointed, only about as long as the radius of the cladome (or even shorter), measuring, say, about 0·37 millim. by 0·055 millim. The protocladi are short and stout, about 0·092 millim. by 0·055 millim. The deuterocladi are about two and a half times as long as the protocladi, but variable; fairly gradually and sharply pointed, commonly slightly curved and often unequal. Boiled-out preparations show various monstrous forms of this spicule, *e.g.*, one with one cladus unbranched, another with one deuterocladus itself branched, another with the shaft branched, and also a number of very much slenderer forms of the same spicule which are probably not fully developed. Although these dichotriænes are essentially characteristic of the sub-dermal skeleton, yet we find a good many branching spicules scattered through the deeper parts of the sponge, which evidently belong to the same type.

(2.) Oxea (Plate II., fig. 2, *e–p*). *a*, large; more or less curved or even angulated in the middle; fusiform; usually gradually and fairly sharply pointed; size about 1·2 millims. by 0·037 millim. Occasionally a slightly curved stylote spicule may be observed, with one end broadly rounded; apparently derived from an oxeote by suppression of one ray. *b*, small; found chiefly in the dermal crust; fusiform, gradually and sharply pointed, slightly curved; varying very much in size; averaging, say, about 0·18 millim. by 0·01 millim., but ranging from about a third of these dimensions through intermediate sizes to the large forms.

(3.) Rather large oxyasters (Plate II., fig. 2, *q–v*), abundantly strewn through the choanosome; with usually about five long, slender and gradually sharp-pointed rays, which are smooth and up to about 0·025 millim. in length; there is no centrum.

Stained sections show that the ectosome is rather thin, apparently consisting only of the dense spicular crust and with no fibrous tissue except a little around the oscular tubes. The choanosome is gelatinous (collenchymatous). Both ectosome and choanosome contain numerous pigment cells full of brown granules, especially in the walls of the canals. The material is not sufficiently well preserved to show the characters of the flagellate chambers. The inhalant pores, about 0·13 millim. in diameter, are the single openings of short cylindrical chones which penetrate the spicular dermal crust and are provided with well-developed sphincters near its inner limit; but there are no extensive subcortical crypts.

(A fragment of a large, massive anatriæne was found in a boiled-out preparation of the spicules of this sponge, but I could find no others, either in boiled-out preparations or in sections. Should this form of spicule prove to be proper to the species, it would necessitate its removal from the genus *Plakinastrella*).

R.N. 224 (from Station XLI., 12 miles off Galle, 100 fathoms).

Plakinastrella schulzei,* n. sp.—Plate II., fig. 3.

This well-characterised species is represented in the collection by an irregular massive specimen (or fragment) which has been cut off at the base from its attachment. The upper surface is strongly convex and is produced into irregular elevations. The specimen contains many foreign organisms, both internally and encrusting the surface (it is penetrated by the spiral shells of a species of *Tenagodes* (*Siliquaria*), a gastropod which habitually lives in sponges). The colour is purplish grey externally (owing to the presence of numerous granular pigment cells), yellowish within. The vents are irregularly scattered, well-defined circular openings, which may be crateriform; up to about 3 millims. in diameter, but usually a good deal smaller. Inhalant pores (?) are rather conspicuous on some parts of the surface, but irregularly scattered and varying much in size. The specimen measures about 50 millims. in length, 30 millims. in breadth, and 18 millims. in thickness.

The main skeleton is a very irregular interlacement of numerous large oxea and a few short-shafted triænes; the spicules occasionally forming loose wisps. The dermal skeleton is a dense feltwork of small oxea.

Spicules.—(1.) Short-shafted triænes (Plate II., fig. 3, *a–d*), resembling calthrops and subject to much variation in form; commonly with three rays long and bifid and the fourth short and simple, all fairly sharp-pointed; or all the rays may be simple; or one only may be bifid; or one may be trifid, and doubtless other variations could be found. Total diameter measured up to about 0·68 millim. from apex to apex of rays, with primary rays about 0·046 millim. thick.

(2.) Oxea (Plate II., fig. 3, *e–t*). The large oxea of the main skeleton (*e*) are stout, fusiform and gradually sharp-pointed at each end; more or less curved and occasionally slightly angulated at two points, but not centrotylote. They measure, when fully developed, about 1·3 millims. by 0·055 millim. The small dermal oxea (*r*, *s*, *t*) are commonly centrotylote, more or less sharply pointed at each end, and with the two terminal thirds bent upon the middle third at slight angles in the same direction;

* Named in honour of the most eminent of Spongologists, Professor F. E. Schulze.

they are quite smooth and measure about 0·35 millim. by 0·018 millim., but with considerable variation in size. Between the large and small oxea thus described we find so many intermediate in shape and size (*f–q*) that it is impossible to distinguish them as megascleres and microscleres respectively.

(3.) Oxyasters (Plate II., fig. 3, *v*-*x*) with smooth, slender, sharp-pointed rays and little or no centrum, are very abundant in the deeper parts of the sponge; they measure about 0·02 millim. in total diameter.

The irregular arrangement of the short-shafted triænes (which presumably originated phylogenetically at the surface of the sponge and acquired their characteristic form in direct relation to that position), and the absence or scarcity of typical calthrops, seem to indicate that this species is less primitive than the type of the genus (*P. copiosa*, SCHULZE), and, in fact, somewhat degenerate.

R.N. 149 (from Station XLI., 12 miles off Galle, 100 fathoms).

Stœba, SOLLAS.

Thin, encrusting Pachastrellidæ, with short-shafted triænes, resembling calthrops, for megascleres, and only spined microxea for microscleres.

In 1888 SOLLAS (*loc. cit.*, p. 102) proposed the genus *Stœba* for CARTER'S *Samus simplex* from the Gulf of Manaar, but LENDENFELD (**13**), followed by TOPSENT (**14**), has merged the genus in *Dercitus*. Inasmuch, however, as the type species of *Dercitus* (*D. bucklandi*, Bk. sp.) possesses toxa amongst its microscleres, while *Stœba* does not, it seems to me desirable to retain the distinction between the two, especially as we now know three more or less distinct species without toxa, viz., *Stœba simplex* (= *Samus simplex*, CARTER; *Dercitus simplex*, TOPSENT); *Stœba plicata* (= *Corticium plicatum*, SCHMIDT; *Calcabrina plicata*, SOLLAS; *Dercitus plicatus*, LENDENFELD and TOPSENT), and *Stœba extensa*, n. sp.

SOLLAS'S genus *Calcabrina*, founded for SCHMIDT'S *Corticium plicatum*, must be regarded merely as a synonym of *Stœba*.

Stœba extensa, n. sp.—Plate V., fig. 1.

Sponge thin, encrusting, spreading extensively over the surface of and into the cavities of a mass of calcareous *débris* (Melobesia, Polyzoa, Coral, Worm-tubes, &c., mixed together). Surface for the most part smooth and sub-glabrous, slightly rugose in parts; consistence tough and rather fleshy; colour in spirit, pale grey. Vents and pores not seen. The exposed part of the sponge forms an almost uninterrupted sheet about 45 millims. by 33 millims. in extent, but of irregular outline.

The main skeleton consists of short-shafted triænes scattered abundantly, but quite irregularly through the choanosome, but very sparsely in the ectosome, and there is a thin dermal crust of microxea.

Spicules.—(1.) Triænes (Plate V., fig. 1); with short, stout, sharp-pointed shaft, measuring about 0·136 millim. by 0·02 millim. when fully developed, with cladome about 0·2 millim. across; the cladi are usually extended nearly at right angles to the shaft; they are short and each usually divides into two short, sharp-pointed branches; occasionally, however, the cladi are unbranched and sometimes they are very irregular.

(2.) Spined microxea (Plate V., fig. 1); very slender, straight or very slightly curved, with spination minute but sharp and abundant and fairly uniform throughout the length, excepting that there is frequently a constriction in the middle of the spicule, in which the spination may be more or less wanting; size about 0·02 millim. by 0·00133 millim. (excluding spines). These spicules occur very abundantly in the dermal crust already mentioned and also scattered throughout the sponge.

The ectosome forms a cortex about 0·27 millim. thick, composed of large oval cystenchymatous cells with fibrous tissue between them, the fibres, for the most part at any rate, lying parallel with the surface. The cystenchyme cells measure about 0·06 millim. in longer diameter and are also abundant in the choanosome.

This species is obviously very closely related to the European *Stœba plicata*, on the one hand, and to *S. simplex*, from the Gulf of Manaar, on the other. From the former, which has been fully re-described by Topsent (**14**), it differs in its longer and slenderer and more sharply-pointed microxea, and in the fact that the triænes are nearly all dichotriænes. From the latter it differs in the smaller size of the triænes and the larger size of the microxea, and in the fact that the spines of the microxea are not "most prominent towards the ends," though, as I have pointed out above, they may be more or less absent from the middle of the spicule. It appears to be a good deal more robust in growth than either species. It is quite possible, however, that subsequent researches may make it possible to consider all three as mere varieties of one species, but for the present it seems desirable that they should be kept separate.

Topsent describes the ectosome of *Stœba plicata* as being collenchymatous, but he mentions and figures large "cellules sphéruleuses," which are evidently closely similar to the large cystenchyme cells of *S. extensa*. The partly fibrous cortex of the latter, almost devoid of megascleres, may possibly afford another means of specific distinction.

In external appearance (in spirit at any rate) *Stœba extensa* bears such a close resemblance to the thin encrusting form of *Chondrilla australiensis* that it is difficult, if not impossible, to distinguish the two without microscopical examination.

R.N. 167 (Station LXVI., off Mutwal Island, March 19, 1902, 10 to 35 fathoms).

Family: STELLETTIDÆ.

Astrophora with long-shafted triænes, without calthrops and without sterrasters.

Myriastra, Sollas.

Microsclere a euaster of one form only. Ectosome not a cortex.

Myriastra clavosa (RIDLEY).

1884, **Stelletta clavosa,** RIDLEY (**16**); 1888, **Myriastra clavosa,** SOLLAS (**15**).

I have no hesitation in referring to this species four small specimens from deep water off Galle. The specimens are approximately spherical in form and up to about 9 millims. in diameter. There is a single slightly depressed vent, which, in three of the specimens at any rate, has a membranous margin. The colour is grey-yellow. As this is an entirely new locality for the species, which has hitherto been obtained from waters north of Australia, I propose to give the details of spiculation of one specimen in justification of the identification.

Spicules.—(1.) Dichotriænes; shaft, 1·4 millim. by 0·025 millim., gradually and finely pointed; chord, 0·6 millim.; protocladi, 0·08 millim.; deuterocladi, 0·2 millim.

(2.) Anatriænes; shaft, 2·3 millims. by 0·02 millim., very finely and gradually pointed; chord, 0·1 millim.; cladi, 0·06 millim., rather stout; of the shape figured by RIDLEY.

(3.) Large oxea; fusiform, gradually and sharply pointed, 2·2 millims. by 0·025 millim.

(4.) Cloacal oxea; commonly 0·2 millim. by 0·004 millim., may be rather larger.

(5.) Chiasters; extremely minute, with no distinct centrum, and long, slender, tylote rays varying in number; total diameter, 0·01 millim.

It will be seen from the above that the shaft of the dichotriæne is a good deal shorter than in previously described specimens, but, considering the variation in this respect, we cannot regard this difference as being of specific importance.

R.N. 131, 132, 227, 228 (all from off Galle and onwards up the West Coast of Ceylon, depths up to 100 fathoms).

Myriastra tethyopsis (CARTER).

1880, **Stelletta tethyopsis,** CARTER (**4**); 1888, **Myriastra** (?) or **Anthastra** (?) **tethyopsis,** SOLLAS (**15**).

There are four specimens of this very remarkable sponge in the collection. SOLLAS regards the species as insufficiently characterised, but, as a matter of fact, CARTER'S description is very good, and leaves no doubt as to the identification. The fact that SOLLAS was unable to assign it definitely to any of his genera tends rather to show the unsatisfactory nature of his system of classification than the insufficiency of the original description.

The specimens (in spirit) are light grey in colour. The smallest is about 10 millims. and the largest about 42 millims. in diameter. The shape is very characteristically turbinate, more or less flattened below, and conical above. The surface is harsh to the touch and finely granular, very minutely and rather sparsely hispid. In the larger specimens a dense mass of long, hair-like spicules projects from more or less of the lower surface. The larger specimens were evidently attached below. The apparent total absence of vents is a remarkable feature. Only in the smallest specimen have I seen what looks like a small natural vent, and that is on the flattened (presumably lower) surface. Doubtless the exhalant apertures are completely concealed by contraction in preserved specimens. Owing to the enormously strong development of the dense radiating skeleton, and the manner in which the cladi of the triænes come close up to the surface (giving it its granular character), I have found it impossible to cut a tangential or surface section in the ordinary way in order to look for pores in the dermal membrane. On attempting to cut such a section the sponge splits up radially along the lines of the gigantic spicules.

The skeleton is remarkably strongly developed, the shafts of the huge oxea and triænes being arranged in dense bundles, which radiate from a central "nucleus" and leave only narrow interspaces between them; while the expanded cladi of the dichotriænes form a thin but dense dermal crust, in which innumerable very minute asters also occur.

Spicules.—(1.) Dichotriænes; shaft about 8·0 millims. long by 0·074 millim. thick a short way below the cladome, tapering very gradually to a narrow, long-drawn-out but rounded point; cladi short, stout, once-forked, expanded almost at right angles to the shaft; chord about 0·46 millim.

(2.) Protriænes; with long and very slender shafts and slender cladi about 0·05 millim. long, commonly projecting from the general surface. Much larger protriænes, with comparatively stout shafts and short stout cladi, occur in the anchoring tufts on the lower surface of the adult sponge.

(3.) Anatriænes; with long slender shafts, and rather stout cladi up to about 0·1 millim. long.

(4.) Oxea; associated in bundles with the shafts of the dichotriænes; fusiform, gradually and fairly sharply pointed at each end; size about 8·0 millims. by 0·073 millim.

(5.) Asters; very numerous at and near the surface of the sponge, with small centrum and numerous slender conical rays of equal length; total diameter about 0·01 millim. Such spicules are very rare in the deeper parts of the sponge, and those which I have seen do not differ in any important respect from the asters of the surface.

The smallest specimen possesses in one part, beneath the surface, in addition to the asters, numerous minute refractive globules, which look as if they might be siliceous.

Stained sections show that there is a very thick gelatinous (collenchymatous) ectosome, excavated by numerous large, irregular cavities, from which occasionally wide canals, provided with numerous transverse diaphragms, lead vertically inwards through the choanosome. Small dermal pores are scattered between the cladi of the dichotriænes. The choanosome is not sharply differentiated from the ectosome, but is finely granular. The flagellate chambers are oval and measure up to about

0·04 millim. in longer diameter; they are densely crowded together, and either eurypylous or with very short, wide exhalant canaliculi.

This species is so peculiar that it might almost form the type of a new genus, but I cannot fix upon characters which would separate it absolutely from SOLLAS's *Myriastra.* The sponge, however, is not exactly small, nor are the oscules distinct, nor are the pores in sieves, nor yet is the ectosome thin; all of which features are mentioned by SOLLAS as characters of *Myriastra*, though I should hardly consider them as being of generic value myself.

R.N. 128, 128A, 128B, 130 (Station XLI., 12 miles off Galle, 100 fathoms).

Pilochrota, SOLLAS.

Microsclere a eüaster of one form only. Ectosome differentiated to form a cortex.

Pilochrota haeckeli, SOLLAS.—Plate II., fig. 4.

1888, **Pilochrota haeckeli,** SOLLAS (**15**).

There are eight specimens in the collection which agree so closely with SOLLAS's description as to leave no doubt of their specific identity with the "Challenger" species, represented in the "Challenger" collection by a single specimen from the Philippine Islands. The Ceylon specimens are irregularly spherical or oval in shape, and the largest is about 16 millims. in maximum diameter. The colour in spirit is grey. The vent (when visible) is single, small, and surrounded by a membranous lip, minutely hispid owing to projecting oxea. The inhalant pores are arranged in small sieves, which are irregularly scattered or situated in shallow meandering grooves. The sponge has a strong tendency to attach itself to foreign objects by means of short, root-like processes.

I subjoin the spicular measurements taken from one specimen (R.N. 127), in support of the identification:—

(1.) Orthotriænes (Plate II., fig. 4, *a*); shaft, 2·3 millims. by 0·074 millim., gradually and sharply pointed; cladi, 0·3 millim. long, stout, conical, sharp-pointed, expanded almost at right angles to the shaft, slightly recurved.

(2.) Anatriænes (Plate II., fig. 4, *c*); shaft, 2·8 millims. by 0·037 millim., long and slender, finely pointed; cladi, strongly recurved, fairly stout, sharp-pointed, 0·13 millim. long.

(3.) Somal oxea; fusiform, gradually and sharply pointed at each end, symmetrical, often slightly curved; measuring about 2·3 millims. by 0·04 millim.

(4.) Cloacal oxea; small and slender, about 0·2 millim. by 0·005 millim.

(5.) Chiasters, with very slender, tylote rays; total diameter about 0·012 millim., not very abundant.

(There are also a few curiously abnormal triænes with very short and stout shafts, as shown in fig. 4, *b*, *d*, *e*, but I think that these must be regarded as monstrous forms of the orthotriænes and anatriænes, and not as having any taxonomic value.)

R.N. 127, 127*a*, 127*b*, 127*c*, 127*d* (all from deep water off Galle and onwards up the West Coast); 197 (no special locality); 215 (deep water outside the pearl banks, Gulf of Manaar); 225 (Station XLI., 12 miles off Galle, 100 fathoms).

Pilochrota hornelli, n. sp.—Plate II., fig. 5.

The single specimen is shaped like a somewhat elongated potato, with a fairly smooth but rather uneven and finely granular surface, to which a number of foreign bodies, such as shell-fragments, Foraminifera, &c., are attached. In its present condition it measures about 45 millims. by 33 millims. by 33 millims., but a small piece has been cut off from one end. The texture is somewhat spongy internally, but with a firm, dense outer crust nearly 1 millim. thick in places. The colour is light brown throughout. The inhalant pores are arranged in small groups (pore-sieves) thickly and generally scattered over what was probably the lower half of the sponge; they are also scattered singly on the upper part. There is a single large vent near one end of the upper surface, elongated transversely to the long axis of the sponge and with a narrow, thickened, smooth, fleshy margin. The vent measures about 6 millims. by 2 millims., and is the opening of a short, wide oscular tube formed by the union of a number of large exhalant canals.

The skeleton in the interior of the sponge is loose and irregular, composed principally of large, scattered oxea, not arranged in definite fibres. Towards the surface the spicules tend to collect together into fibres which end in dense brushes composed almost entirely of ortho- and anatriænes. These brushes separate the wide subcortical crypts from one another, but their expanded outer ends form a continuous spicular crust at the surface. The cladi of the orthotriænes are for the most part extended at the surface of the sponge, but do not project beyond it, those of the anatriænes lie somewhat deeper down in the cortex. There are also a large number of orthotriænes whose cladi lie beneath the subcortical crypts while their shafts project inwards into the choanosome.

Spicules.—(1.) Orthotriænes (Plate II., fig. 5, *a–d*); with stout shaft tapering very gradually to a narrow, bluntly rounded or sharp apex, and with short, stout, conical cladi extended almost at right angles to the shaft; two typical examples from a boiled-out preparation gave the following measurements:—(*a.*) Shaft, 1·5 millims. by 0·032 millim.; cladi, 0·123 millim. by 0·03 millim. (*b.*) Shaft, 1·017 millim. by 0·04 millim.; cladi, 0·115 millim. by 0·033 millim. In the dermal crust one or two of the cladi not infrequently become bifurcate, but this takes place very irregularly, and a good many monstrous forms occur.

(2.) Anatriænes (Plate II., fig. 5, *e*); shaft long and fairly stout, not tapering to hair-like dimensions, though, of course, much narrower at the proximal than at the distal extremity; bluntly or sharply pointed; cladi stout, strongly recurved, sharply pointed; front of cladome flattened. A specimen from a boiled-out preparation, somewhat longer than usual, gave the following measurements:—Shaft, 1·96 millim. by 0·019 millim.; cladi, 0·0656 millim. by 0·0164 millim.

(3.) Oxea (Plate II., fig. 5, *f*); fairly stout, fusiform, gradually and usually fairly sharply pointed, gently curved, approximately iso-actinate, measuring about 1·3 millims. by 0·032 millim.

(4.) Chiasters (Plate II., fig. 5, *g*, *h*, *i*); with no centrum and very slender, slightly roughened and distinctly tylote rays; total diameter of spicule up to about 0·02 millim.; abundant, especially in the deeper parts of the sponge.

The histological structure of the strongly developed cortex agrees very closely in some respects with that described and figured by Sollas (*loc. cit.*, p. 122) for his *Pilochrota pachydermata.* The cortex itself, about 0·8 millim. in thickness, consists chiefly of very dense fibrous tissue, in which the fibres interlace in various directions. Imbedded in this tissue we find histological elements of two other kinds:—(1.) Large, rounded, deeply staining bodies up to about 0·2 millim. in diameter, each made up of an aggregation of much smaller bodies (cells?), and the whole very finely and uniformly granular. These remarkable bodies have a rather deep yellowish brown colour in unstained preparations, and they form a single layer beneath the surface in the outer part of the cortex. They are evidently homologous with what Sollas terms "oval or round clusters of granule-cells" in *P. pachydermata.* Sometimes the finely granular "cells" occur separately as well as aggregated in clusters, especially in the margin of the vent. (2.) Numerous irregularly scattered, small groups of faintly staining, homogeneous, spherical globules, varying in size in each group up to about 0·005 millim. in diameter; abundant in the deeper parts of the cortex and also in the choanosome. These bodies do not seem to have been observed in *P. pachydermata.*

Beneath the fibrous cortex lie extensive sub-cortical crypts, separated from one another by the radiating spicule bundles and a sparse development of ectosomal collenchyma.

The inhalant pore-sieves overlie well-developed chones which penetrate the fibrous cortex to reach the sub-cortical crypts, being provided with sphincters or diaphragms where they join the latter; the sphincters, however, do not lie quite so deeply as the lower limit of the fibrous cortex. From the sub-cortical crypts originate numerous fairly wide incurrent canals which penetrate the choanosome and sub-divide therein.

The choanosome is finely granular, and the flagellate chambers are approximately spherical, about 0·02 millim. in diameter, and apparently eurypylous.

It is not impossible that this species may be identical with Sollas's *Pilochrota cingalensis*, also from Galle, but the description of the latter (**15**), apparently based upon a mere fragment, for the author says "*Sponge* (?)," is too imperfect for safe recognition. Sollas, moreover, states that the cortex is thin, about 0·35 millim. in thickness, and all the megascleres seem to have their shafts characteristically bluntly pointed or even strongylote, a condition to which there is only a tendency in our specimen. Our species is also very closely related to *Pilochrota pachydermata*, SOLLAS, from Tahiti, but differs in certain respects, such as the form of the chiaster, which is not tylote in *P. pachydermata*.

R.N. 176 (collected in the lagoon inside the reef, Galle, shallow water, by Mr. HORNELL, after whom, on Professor HERDMAN'S suggestion, I have much pleasure in naming the species).

Stelletta, SCHMIDT.

Microscleres euasters of two forms.

It might be advisable to sub-divide this genus according to whether or not a fibrous cortex is present, as SOLLAS has done in similar cases. *Stelletta herdmani* would then come under the first sub-division and *S. vestigium* under the second. I do not, however, think it would be desirable to take such a step until we know more about the value of this character in classification.

Stelletta herdmani, n. sp.—Plate II., fig, 6.

Sponge quite irregular in shape; sometimes vallate; sometimes with occasional digitiform or mammiform projections; often very much mixed up with coarse calcareous débris. Surface uneven, very harsh to the touch and striate owing to the presence of the huge megascleres immediately beneath the thin dermal membrane; not hispid except where apparently worn. Vents few, scattered on prominent parts, up to about 3 millims. in maximum diameter; leading out of deep cloacal tubes, which are of about the same diameter and lined by a sieve-membrane. Inhalant pores scattered in the dermal membrane. Colour (external) ranging from pale yellowish to slate-grey in the same specimen. The largest specimen is about 55 millims. in greatest diameter, but is a good deal damaged and much mixed up with foreign matter.

Skeleton very dense and more or less confused; consisting of irregular bundles of huge oxea and triænes, for the most part radiating towards the surface, but lying tangentially beneath the dermal membrane and thus forming an ill-defined but dense spicular cortex about 0·36 millim. thick.

Spicules.—(1.) Plagio- or protriænes (Plate II., fig. 6, *a*, *b*, *c*.); with short, stumpy, conical cladi projecting more or less forwards, and stout shaft, usually somewhat curved, more or less swollen at some distance below the cladi and tapering gradually to a sharp point at the other end. Size somewhat variable, shaft up to about 1·2 millims. by 0·074 millim., with cladi 0·18 millim. long.

(2.) Oxea (Plate II., fig. 6, *d*.); fusiform, straight or slightly curved, tapering gradually to a sharp point at each end; size about 2·8 millims. by 0·09 millim.

(3.) Chiasters (Plate II., fig. 6, *e*–*h*); very abundant in the dermal membrane, scarcer within; with numerous rather short, truncate conical rays, and often with a distinct but small centrum; total diameter about 0·012 millim. or less.

(4.) Oxyasters (Plate II., fig. 6, *i–k*); fairly numerous in the deeper parts, but may be difficult to find; with little or no centrum, and long, slender, conical, sharp-pointed, smooth rays, varying in number; total diameter about 0·029 millim.

Owing to the great size and abundance of the megascleres it is impossible to cut satisfactory sections by the ordinary paraffin method, but such as I have been able to obtain have yielded some interesting results. The ectosome is remarkably developed as a very thick gelatinous layer containing numerous stellate cells (collenchyma), and a thin layer of fibrous tissue (about 0·08 millim. thick), situated about 2·5 millims. beneath the surface and separating the gelatinous layer from the choanosome. The arrangement of the main skeleton appears to be in no way correlated with the differentiation between ectosome and choanosome, the large megascleres passing through the fibrous layer from one to the other without distinction. The mesoglœa of the choanosome ranges from collenchymatous to finely granular, and the flagellate chambers are more or less spherical and about 0·024 millim. in diameter.

There are six specimens of this sponge in the collection. The arrangement of the skeleton reminds one very strongly of SOLLAS's genus *Stryphnus*, but the absence of amphiasters or sanidasters prevents us from placing the species in that genus (according to SOLLAS's classification). The species also resembles to a considerable extent KIRKPATRICK's *Stelletta* (*Astrella*) *horrens*, from South Africa (**17**), but is distinguished by its external form, by the arrangement of the pores and vents, and by the details of spiculation.

R.N. 66 (Gulf of Manaar); 89, 137, 137A, 157, 203 (all from off Galle and onwards up the West Coast, depths up to 100 fathoms).

Stelletta vestigium, n. sp.—Plate II., fig. 7.

Specimen irregular in shape, massive, encrusting, and containing many calcareous foreign bodies. (In the same mass as the two specimens of *Tethya lyncurium* var. *a.*) Maximum diameter about 23 millims. Colour in spirit, nearly black. Vents and pores not seen. No cortex.

The skeleton is a confused reticulation of megascleres, mingled with foreign bodies and sometimes collected into loose fibres; with a thin dermal crust of asters, also much mixed with foreign bodies.

Spicules.—(1.) Triænes (Plate II., fig. 7, *a–d*); with cladi reduced to three, two, or one mere spines or protuberances of varying size at the broad end of the spicule; the other end tapering gradually to a more or less sharp or irregular apex. These spicules are of about the same dimensions as the oxea.

(2.) Oxea (Plate II., fig. 7, *e*); rather slender, usually slightly curved; more or less gradually sharp-pointed or irregularly ended; measuring about 0·74 millim. by 0·016 millim.

(3.) Spherasters (Plate II., fig. 7, *f*, *g*); with well-developed centrum and sharp, conical rays; total diameter about 0·024 millim., with rays about 0·008 millim. long; most numerous in the dermal crust, but also abundant below. (A rather noteworthy feature of these spicules, in many cases, in the boiled-out preparations, is the conspicuous nature of the central canal in the rays, which gives the spicule a very peculiar appearance.)

(4.) Oxyasters (Plate II., fig. 7, *h*, *i*); with very small centrum and a rather small number of slender, finely-pointed, smooth rays; total diameter up to about 0·024 millim. Abundant in the choanosome.

This species is particularly interesting on account of the extreme reduction of the cladi of the triænes, affording an absolute transition from the tetractinellid to the monaxonellid condition. This vestigial condition of the cladi, an approach to which is already seen in *Stelletta herdmani*, appears to be associated in this genus with the irregularly scattered arrangement of the triænes (compare the vestigial condition of the cladi of the dermal anatriænes in *Geodia peruncinata*, described later on).

R.N. 200A (Station LXVII., off Talaivillu Paar, 10–14 fathoms).

Ecionema, Bowerbank.

The microscleres include microrhabds in addition to euasters; the former are commonly minutely spined or roughened, and usually form a dermal layer.

Ecionema carteri, n. sp.—Plate I., fig. 5; Plate III., fig. 1.

There are three specimens of this sponge in the collection. The largest and only well-developed example (R.N. 175, Plate I., fig. 5) may be taken as the type of the species. This specimen is massive and quite irregular in shape, with a number of foreign bodies attached to it. The maximum diameter is about 35 millims. The surface appears, in most places, distinctly porous, even to the naked eye, owing to the presence of very numerous, thickly scattered, small pore-sieves (Plate I., fig. 5, *p.s.*) containing the inhalant pores. It is also very minutely and sparsely hispid, at any rate in parts. The vents (Plate I., fig. 5, *o*) are rather numerous, without prominent margins; circular or oval openings varying up to about 2 millims. in diameter; mostly congregated in a depression on what was apparently the upper part of the sponge. They are the apertures of wide, diaphragm-bearing oscular tubes. The texture of the sponge is fairly firm, but compressible. The colour in spirit is pale grey.

Another specimen (R.N. 188) is almost spherical and only about 11 millims. in diameter, without visible vents; it is probably immature. The third (R.N. 259) is an irregular fragment.

The main skeleton in the interior of the sponge is an irregular interlacement of large oxea which, towards the surface, collect into loose radiating wisps, ending in dense brushes of triænes whose cladomes lie at varying depths beneath the dermal membrane, but never very deeply. The dermal membrane is strengthened by a thin crust of spinose microstrongyles, interrupted by the very numerous dermal pores. The minutely hispid character of the surface is due to the presence of very slender, hair-like anatriænes projecting beyond the dermal membrane.

Spicules.—(1.) Plagiotriænes (almost orthotriænes) (Plate III., fig. 1, *a*, *b*); with long shaft tapering very gradually to a sometimes almost filiform extremity, and rather short, stout, sharply pointed or rather blunt cladi; shaft about 1·5 millims. by 0·033 millim., with cladi about 0·148 millim. by 0·027 millim.

(2.) Plagiotriænes (almost protriænes) (Plate III., fig. 1, *c*, *c′*); with long, slender shaft tapering to almost hair-like dimensions, and short conical cladi projecting forwards at an angle of about 45°; shaft about 1·8 millims. by 0·0094 millim.; cladi about 0·028 millim. by 0·008 millim. Not very numerous.

(3.) Anatriænes (Plate III., fig. 1, *d*, *d′*); with long, slender shaft and short, sharp-pointed, strongly recurved cladi; cladome somewhat flattened in front; shaft and cladi of about the same dimensions as in the preceding.

(4.) Very slender, hair-like anatriænes with minute cladomes projecting beyond the surface of the sponge. These spicules seem to be fairly numerous and characteristic, but the cladomes are nearly always broken off in the preparations.

(5.) Oxea (Plate III., fig. 1, *e*); long and comparatively slender, usually slightly curved; fusiform; gradually and usually sharply pointed at each end; measuring, when fully developed, about 1·8 millims. by 0·037 millim.

(6.) Chiasters (Plate III., fig. 1, *g*); with little or no centrum and very slender, cylindrical, very minutely roughened, tylote rays; total diameter up to about 0·016 millim.

(7.) Microstrongyla (Plate III., fig. 1, *f*); straight, rather slender and minutely spined or roughened; measuring up to about 0·02 millim. by 0·002 millim., most abundant in the dermal membrane, but also plentiful in the choanosome.

There is a well-developed cortex about 0·25 millim. thick, composed of a mixture of chondrenchymatous, collenchymatous, and fibrous tissue, the first-named developed chiefly towards the outside and the last towards the inside. The mesoglœa of the choanosome is finely granular, but with an admixture of collenchymatous and chondrenchymatous tissue. The flagellate chambers are approximately spherical, about 0·02 millim. in diameter, and eurypylous. The dermal pore-sieves form the thin roofs of wide chones, which pass vertically through the cortex and are continued directly into the inhalant canals of the choanosome, without any specially differentiated subcortical crypts.

The presence of a fibrous cortex, though not very strongly developed, seems to indicate SOLLAS's genus *Psammastra* for this species, which is nearly related to three sponges described by Mr. CARTER under the names *Stelletta geodides* (**18**),* *Stelletta*

* *Vide* also SOLLAS, "Challenger" Tetractinellida, p. 200.

bacillifera (**20**) and *Stelletta bacillifera*, var. *robusta* (**21**),* the first and third from Australia and the second from the Mergui Archipelago. SOLLAS places the first in his genus *Psammastra*, while he places the last in *Ecionema*, which he distinguishes from *Psammastra* by the absence of cortex, but Mr. CARTER'S specimens of *Stelletta bacillifera*, var. *robusta*, were dry, and it is extremely probable that they possessed a fibrous cortex like that of *Ecionema carteri;* the type of *Stelletta bacillifera* from the Mergui Archipelago may also have been corticate for anything we know to the contrary, and it is almost certain that CARTER'S three sponges and the Ceylon species belong to the same genus. Moreover, we do not even know whether BOWERBANK'S original type of the genus *Ecionema* (*E. acervus*) was corticate or not, a question which it is impossible to decide without properly prepared sections of good material.

R.N. 175 (Lagoon inside reef, Galle, shallow water); 188 (Muttuvaratu Paar, Gulf of Manaar, 8 fathoms); 259 (Ceylon seas).

Ecionema laviniensis, n. sp.—Plate III., fig. 2.

The single specimen is somewhat finger-shaped, but flattened and slightly bifurcate at one (? the upper) end. It measures about 30 millims. in length and 13 millims. in breadth. The greater part of the surface is encrusted with coarse calcareous débris, chiefly Foraminifera and shell-fragments; where these bodies are absent there is a tendency to be minutely and sparsely hispid. In places there is a minutely porous appearance, easily visible under a pocket lens, due to the presence of small thickly scattered pore-sieves. The vents are probably very minute and scattered—I have only observed one. The colour in spirit is pale grey throughout, the texture firm and very compact.

The main skeleton is a confused interlacement of large oxea, towards the surface disposed more or less nearly at right angles to it and occasionally projecting beyond it. At the surface there is a spicular cortex, about 0·13 millim. thick, composed of microstrongyla with a thin layer of minute chiasters externally. Beneath the spicular cortex lie the cladomes of the comparatively few triænes, with their shafts penetrating the deeper parts of the sponge at right angles. (It is, perhaps, worth noting that in the deep groove at one end of the sponge, where it is beginning to bifurcate, the spicular cortex is not developed and there are apparently no triænes, but the large oxea project much further beyond the surface than they do elsewhere.) There are also a few slender anatriænes and protriænes (?) with cladomes projecting far beyond the surface.

Spicules.—(1.) Dichotriænes (Plate III., fig. 2, *a*, *b*); with stout shaft which typically tapers very gradually to a fine point, but may be blunted; protocladi short and stout; deuterocladi about the same length or a little longer or shorter, conical,

* *Vide* also SOLLAS, "Challenger" Tetractinellida, p. 197.

typically sharp-pointed, but may be blunted. A typical example gave the following measurements: shaft, 1·0 millim. by 0·0328 millim.; protocladus, 0·05 millim. by 0·027 millim.; deuterocladus, 0·065 millim. by 0·0164 millim.

(2.) Protriænes?

(3.) Anatriænes (Plate III., fig. 2, *c*, *c'*); with slender, often hair-like shaft and small, variable, often abnormal cladome, perhaps characteristically flattened in front. These spicules are evidently becoming vestigial and are so variable that it would be useless to give measurements; they are, however, still present in abundance.

(4.) Oxea (Plate III., fig. 2, *d*) large and usually stout; nearly always more or less curved, often strongly so, sometimes crooked; gradually and sharply pointed at each end, or more or less blunted; measuring up to about 1·4 millims. by 0·049 millim., but very variable in thickness.

(5.) Chiasters, with short, blunt, sub-cylindrical rays (Plate III., fig. 2, *e*), total diameter about 0·008 millim.; very abundant in the dermal membrane, and often met with in the choanosome, where they are commonly about half as large again and may vary into oxyasters (?) with very slender rays (Plate III., fig. 2, *f*).

(6.) Microstrongyla (Plate III., fig. 2, *g*) almost cylindrical, usually with rounded ends, but occasionally oxeote; minutely spined all over; usually slightly curved; sometimes centrotylote. A typical example measures about 0·1 millim. by 0·008 millim., but they are often much more slender. These spicules are found chiefly in the cortex, but may also be met with occasionally in the deeper parts of the sponge.

(A few slender, smooth microxea (Plate III., fig. 2, *h*) also occur, possibly young forms of other spicules.)

There is no distinct fibrous cortex, at any rate over the general surface, but a dense spicular cortex formed as described above. In the deep depression at the end of the sponge, however, where the spicular cortex is not developed, a certain amount of fibrous tissue is present in its place, and it is quite possible that such is also present concealed between the spicules of the spicular cortex elsewhere. (These facts serve to emphasise the unsatisfactoriness of the fibrous cortex as a generic distinction between *Ecionema* and *Psammastra*, to which attention has already been called under the head of *Ecionema carteri*.) The spicular cortex contains an immense number of rounded pigment cells filled with pigment granules of a rich brown colour.

Scattered abundantly throughout the choanosome are rounded groups of minute highly-refractive granules, staining with borax carmine, but in themselves practically colourless. These at first sight look like flagellate chambers, each group being about 0·02 millim. in diameter, but I do not think that they are really of that nature.

The species is evidently closely related to *Ecionema carteri* and its allies, but is well characterised by the dichotriænes and by the comparatively large size of the microstrongyles.

R.N. 265 (Station XLVI., off Mount Lavinia, 30 fathoms).

FAMILY: GEODIIDÆ.

Astrophora, in which the characteristic microsclere is a sterraster, forming a dense cortical layer.

Geodia, LAMARCK.

Geodiidæ, in which the somal microsclere is a polyactinose aster.

Geodia perarmata, BOWERBANK.

1873, **Geodia perarmatus**, BOWERBANK (22); 1880, **Geodia perarmata**, CARTER (4); 1888, **Geodia perarmata**, SOLLAS (15).

There is an interesting series of specimens belonging to this species in the collection. The smallest is only 13 millims. in diameter, and is approximately spherical in shape; unfortunately, the surface of this specimen is considerably abraded, and I have not been able to make out the arrangement of either inhalant or exhalant apertures. The next in size, about 18 millims. in diameter, is also too much injured to show the arrangement of the apertures satisfactorily. The next is more irregular in shape, about 28 millims. in diameter, and flattened on one side so as to form an approximately circular oscular area about 14 millims. in diameter, but not definitely bounded. This area is covered by a pore-bearing, cribriform membrane, with pores about 0·08 millim. in diameter, and few, if any, larger apertures. The remainder of the surface of the sponge, outside the oscular area, is covered with a cribriform dermal membrane containing thickly scattered inhalant pores of somewhat smaller diameter than the exhalant pores. The specimen next in size is also irregular in shape, closely resembling a potato, and about 45 millims. in diameter. The oscular area now forms an ill-defined, but rather deep concavity on one side, whose floor is covered, as before, by a cribriform membrane, but with a few larger openings where the pores have apparently become confluent and thus formed small "vents"; the maximum diameter of this basin-shaped oscular area, which is not quite circular, is about 17 millims. The largest specimen is a very fine one, irregularly rounded in shape, and about 75 millims. in greatest diameter; it has been attached below at only a few points to calcareous débris. The depressed oscular area occupies the greater part of the flattened upper surface of the sponge, and is about 38 millims. in greatest diameter, and irregularly oval in shape. The floor of the depression is somewhat flattened, but rises up in the middle; the margin is much better defined than in the smaller specimens, but rounded off, except on one side, where it actually overhangs slightly. The pore-bearing membrane presents the same appearance as in the last-described specimen, but the small "vents," due to confluence of the pores, are more numerous; they are hardly 0·5 millim. in diameter. As before, the general surface of the sponge is covered by a richly porous cribriform membrane. There is also in the collection an irregularly-shaped sub-cylindrical specimen, about 36 millims. in length and 18 millims. in diameter, which does not show any distinct oscular area.

It appears, then, that the basin-like character of the oscular area, which was figured by BOWERBANK (22) in the type specimen, and which appears to form a characteristic feature of the adult sponge, is not developed until comparatively late in life, and it appears also that its development is due simply to more rapid growth of the surrounding parts. According to the classification adopted by SOLLAS in his work on the "Challenger" Tetractinellida, this mode of development would necessitate our placing the species in the genus *Cydonium.* SOLLAS himself, however, places the species in the genus *Geodia*, having been insufficiently acquainted with the characters in question. LENDENFELD, in his work on the Tetractinellida of the Adriatic, merges the genus *Cydonium* in *Geodia*, and in this I must agree with him, for the present instance demonstrates very clearly the impracticable character of a classification which involves a study of the development, at any rate until our knowledge is much more complete than at present.

The general surface of the sponge is smooth and, perhaps, even glabrous, where the dermal membrane is intact, but from a few points on the lower surface, in the immediate neighbourhood of the attachment, a few long, hair-like spicules (mostly anatriænes) project. The colour of the general surface (in spirit) is purplish brown, mottled with dull yellow, the pigment being lodged in an immense number of granular brown pigment cells which lie between the layer of sterrasters and the dermal membrane. Internally the sponge is nearly white.

The cortical layer of sterrasters is about 1·2 millim. thick in the largest specimen, and between this layer and the dermal membrane lies a zone about 0·27 millim. thick, in which the cladi of most of the triænes are found. The manner in which the shafts of these triænes pierce the layer of sterrasters, so that their cladi come to lie externally to it, is, as already pointed out by BOWERBANK, very characteristic of the species, and forms a conspicuous feature even in the smallest specimen which I have seen.

The spiculation, as observed in the largest specimen, is as follows:—

(1.) Dichotriænes; shaft stout, about 3·2 millims. by 0·07 millim.; chord, 0·48 millim. to 0·64 millim.

(2.) Protriænes; scarce (seen only in another specimen); cladi about 0·075 millim. long.

(3.) Anatriænes; shaft slender, about 4·2 millims. long; cladi about 0·07 millim. long.

(4.) Somal oxea; about 2·67 millims. by 0·042 millim.

(5.) Cortical oxea; about 0·3 millim. by 0·0083 millim.

(6.) Sterrasters; about 0·13 millim. in diameter.

(7.) Somal chiasters or spherasters; about 0·009 millim. in diameter.

(8.) Choanosomal spherasters with spined rays; about 0·04 millim. in diameter.

The spherasters with spined rays are found just beneath the layer of sterrasters and appear to be characteristic of the species. The fact that the spination of the rays is not figured by BOWERBANK in his illustration, nor mentioned in the text, makes me a little doubtful of the identification of the Ceylon species with that originally described by BOWERBANK (from an unknown locality). CARTER, however, made the identification in the first instance and SOLLAS has accepted it; and the differences, if they really exist, must be extremely slight.

R.N. 119, 121, 124, 125, 126, 135. (All from deep water, up to 100 fathoms, off Galle and onwards up the West Coast of Ceylon.)

Geodia peruncinata, n. sp.—Plate III., figs. 3, 3A, 3B.

The single specimen in the collection is, unfortunately, only a fragment, amounting to probably somewhat more than half of a small spherical sponge, attached to a small calcareous nodule. The diameter of the specimen is about 11 millims. The colour in spirit is nearly white, both on the surface and in the interior. The cortex is rather thin and very brittle, and the interior of the sponge is soft and friable. It is impossible to make out the arrangement of the exhalant canal-system, but the thin dermal membrane contains numerous small pores, presumably inhalant.

The layer of sterrasters (Plate III., fig. 3, *e*, *e*) is about 0·33 millim. thick, and is separated from the dermal membrane by an interval of about 0·165 millim. occupied by extensive sub-dermal cavities. The dermal membrane is supported on the cladomes of dichotriænes (Plate III., fig. 3, *a′*), whose shafts pierce the layer of sterrasters and the zone of sub-dermal cavities; it is also strengthened and rendered hispid by the presence of immense numbers of short anatriænes which project from the surface at various angles (Plate III., fig. 3, *c*, *c*). Some of the dichotriænes (Plate III., fig. 3, *a*) have their cladi extended beneath the layer of sterrasters, and the remainder of the skeleton is arranged in the usual way, with radiate primary lines.

Spicules.—(1.) Dichotriænes (Plate III., fig. 3, *a*, *a′*); with stout shaft tapering gradually to a narrow, but blunt apex, and short cladi; the deuterocladi usually two or three times as long as the protocladi, but variable and often unequal, gradually and sharply pointed, slightly curved towards one another, or straight. Shaft measuring up to about 2·4 millims. by 0·044 millim., with cladome 0·62 millim. in total diameter and protocladi 0·038 millim. thick.

(2.) Protriænes; a few stout protriænes, more or less broken and sometimes with four cladi, occur amongst the mass of spicules projecting from the base of the sponge.

(3.) Anatriænes (Plate III., fig. 3, *b*); with well-developed cladome and very long, slender shaft. Shaft measured up to about 4·9 millims. in length (and then broken off), with a thickness of 0·016 millim. near the cladome, and cladi stout, conical, and about 0·057 millim. long. (Projecting from the base of the sponge one finds anatriænes with long, hair-like shafts and slender, very sharply recurved cladi.)

(4.) Anatriænes (Plate III., fig. 3, *c*; fig. 3A); with short, slender, fusiform shaft and very small, often vestigial cladome, which may be reduced to a mere knob. The attachment of the cladome to the shaft is so slender that the former is generally broken off and the spicules then may easily be mistaken for the well-known dermal oxea of other species of *Geodia*. The proximal end of the shaft may be oxeote or rounded off, or even tylote. In a typical example the shaft measures about 0·21 millim. by 0·006 millim. The cladome varies so much in its degree of reduction that it is useless to attempt exact measurements, but is generally not more than 0·008 millim. in total diameter. These spicules are found for the most part hispidating the surface of the sponge, but a few occur beneath the layer of sterrasters. I have seen one example which appears to be a reduced protriæne, with a single remaining cladus, but the great majority are anatriænes.

(5.) Oxea (Plate III., fig. 3, *d*); very long and comparatively slender, frequently curved, sometimes very crooked; fairly gradually and sharply pointed; size variable, *e.g.*, 2·5 millims. by 0·029 millim.

(6.) Sterrasters (Plate III., fig. 3, *e*, *e'*; fig. 3B, *c*); markedly oval in shape and measuring about 0·12 millim. by 0·082 millim.

(7.) Small spherasters (or chiasters?) (Plate III., fig. 3B, *a*); with small centrum and numerous almost cylindrical or slightly tylote rays about as long as the diameter of the centrum; total diameter of the spicule about 0·008 millim. Most abundant in the dermal membrane, but plentiful also in the interior.

(8.) Comparatively large spherasters (Plate III., fig. 3, *f*; fig. 3B, *b*); with large centrum and very numerous short, conical rays, whose length is only about one-third the diameter of the centrum or a little more. Total diameter when fully grown about 0·024 millim. Sparsely scattered beneath the layer of sterrasters.

In the structure of the ectosome and the presence of dichotriænes this species is evidently closely related to *Geodia perarmata*. It is, however, distinguished by three characters: (1) the absence of brown pigment cells in the outer part of the cortex; (2) the form of the larger spheraster, which, in *G. perarmata*, has (? always) distinctly spined rays; (3) the presence of the numerous short-shafted, cortical anatriænes,* which are replaced in *G. perarmata* by cortical oxea, though I am inclined to think that a few of these oxea may still show a vestige of a cladome even in *G. perarmata*, while it is quite possible that a few true cortical oxea may occur amongst the reduced anatriænes in *G. peruncinata*.

The presence of the vestigial anatriænes is extremely interesting as indicating the anatriænal origin of the cortical oxea of *Geodia*. SOLLAS (*loc. cit.*, p. cxlvii) has already observed, in his general remarks on the family Geodiidæ, that "A second finer hispidation is frequently produced by small oxeas, which are confined to the cortex (cortical oxeas). Associated with these, in some few instances, are minute anatriænes, which much remind one of the cladose tylostyles described by DENDY and RIDLEY in *Proteleia sollasi*." We have here an admirable example of the evolution

* Very similar small cortical anatriænes occur in LINDGREN'S *Geodia arripiens* from Cochin China (**86**).

of a monaxonellid spicule from a tetractinellid form by subordination and final suppression of three of the rays.

R.N. 223 (Station XLI., 12 miles off Galle, 100 fathoms).

Geodia areolata, CARTER.

1880, **Geodia areolata,** CARTER (**4**); 1888, **Geodia areolata,** SOLLAS (**15**).

There are several specimens of this sponge in the collection. They are approximately spherical in shape, and in form and colour closely resemble young specimens of *G. perarmata*, but the largest sent to me is only 21 millims. in diameter. The surface of the sponge is smooth and characteristically marked out into small stellate areas of a pale yellow colour, separated from one another by a reticulation of chestnut-brown pigment. This pattern, however, is not recognisable everywhere. Numerous small apertures appear irregularly scattered over some parts of the surface, but with a tendency towards grouping. These frequently occupy the centres of the pale stellate areas, and they are often guarded by a fringe of convergent dermal oxea. They are frequently covered over by a reticulate dermal membrane. They are the openings of chones, which pierce the layer of sterrasters, but whether they are inhalant or exhalant, or both, I have been unable to decide.

The layer of sterrasters is about 0·46 millim. thick in the largest specimen. The triænes almost invariably extend their cladi beneath this layer, and do not pierce it to reach the dermal membrane. The dermal oxea are abundant and arranged more or less perpendicularly to the surface; they extend from the outer surface of the layer of sterrasters and project for a short distance beyond the dermal membrane. The granular brown pigment cells, to which the sponge owes its characteristic colour, are scattered in the ectosome outside the layer of sterrasters.

The spiculation is as follows:—

(1.) Orthotriænes; with shaft about 2·37 millims. by 0·06 millim.

(2.) Anatriænes; with very long and slender shaft and cladi about 0·054 millim. long.

(3.) Somal oxea; about 2·0 millims. by 0·029 millim.

(4.) Cortical oxea; about 0·2 millim. by 0·008 millim.

(5.) Sterrasters; about 0·08 millim. in diameter, oval or nearly spherical.

(6.) Somal chiasters or spherasters; about 0·0083 millim. in diameter.

(7.) Choanosomal oxyasters or spherasters; mostly with few long and slender, smooth rays; about 0·0165 millim. in total diameter.

No typical protriænes were seen, but only small plagiotriænes, which may be young forms of the large orthotriænes.

In this case, as in that of *G. perarmata*, we can include the species in the genus *Geodia* only by abandoning the restricted definition thereof given by SOLLAS.

The species, as already indicated, is at first sight easily confounded with *G. perarmata*. The specimens of the two were mixed together in the collection, and only a part of the total number was forwarded to me for investigation, under the impression that they were all specifically identical. I am therefore unable to say how many of each were really collected by Professor HERDMAN and his assistants. Even small specimens are, however, very easily distinguished by microscopical examination, as will be evident from the above descriptions, and the species are not really even closely related.

Mr. CARTER received his material of this species from the Gulf of Manaar.

R.N. 120, 122, 123 (deep water off Galle, up to 100 fathoms).

Geodia ramodigitata, CARTER.

1880, **Geodia ramodigitata,** CARTER (**4**); 1888, **Geodia (?) ramodigitata,** SOLLAS (**15**).

There is one specimen in the collection which appears to be referable to this species. It is of remarkably irregular shape, with one strongly curved, finger-like projection or branch. Unfortunately the specimen is a good deal injured on one side, so that the exact shape cannot be determined. The maximum diameter of the specimen in its present condition is about 40 millims. The colour (in spirit) is pale grey, and a good many foreign bodies are attached to the surface here and there. The vents are minute, for the most part irregularly grouped over the ends of large exhalant canals, with which they communicate by means of narrow chones penetrating the cortex. The outer ends of these chones are usually covered over by a sieve-like dermal membrane which sub-divides the vent into a group of comparatively small pores. Inhalant pores irregularly scattered, perhaps sometimes in groups, but of the numerous pore-sieves present in the dermal membrane it is extremely difficult to say which are inhalant and which exhalant.

The layer of sterrasters is about 1 millim. thick and lies close up to the dermal membrane, with the cladi of the triænes spreading out beneath it. The dermal membrane is very minutely hispid with projecting oxea.

The spiculation is as follows:—(1.) Orthotriænes; shaft stout, gradually and finely pointed, about 2·5 millims. by 0·08 millim; cladi stout, sharp pointed, up to about 0·35 millim. long, extended nearly at right angles to the shaft. Sometimes one or more of the cladi undergoes reduction or may even become obsolete, leaving the spicule with two, one or no properly developed cladi, as the case may be.

(2.) Protriænes; shaft very long and slender, measured up to about 3·7 millims. by 0·023 millim., with sharp-pointed cladi about 0·18 millim. long.

(3.) Anatriænes; shaft very long and slender, measured up to 4·0 millims. by 0·018 millim.; with stout, recurved, sharp-pointed cladi about 0·09 millim. long; not very numerous.

(4.) Somal oxea; gradually and sharply-pointed at each end, about 2·57 millims. by 0·04 millim., often slightly curved.

(5.) Cortical oxea; about 0·2 millim. by 0·007 millim.

(6.) Sterrasters; about 0·09 millim. by 0·075 millim.

(7.) Chiasters; extremely minute, with short, truncate or slightly tylote rays; total diameter about 0·006 millim.; very abundant in the dermal membrane.

(8.) Oxyasters; of unusually large size, with no distinct centrum, with large, slender, smooth, sharp-pointed rays, rather few in number; total diameter about 0·066 millim.; very abundant in the deeper parts of the sponge.

There are two points in which the spiculation of Professor HERDMAN'S specimen, as given above, differs considerably from that given by CARTER (4) for the type of the species. In the first place, CARTER mentions no cortical oxea, but he remarks that the surface is much worn, so that we need lay but little stress upon this difference. In the second place, the internal oxyasters appear to be twice as large in our specimen as in the type; this also I do not consider a very important difference, as the internal asters of *Geodia* are subject to much variation in size. Their form, on the other hand, agrees very closely in the two cases and appears to be characteristic. The other spicules, also, with the exception of the sterraster, appear to be somewhat larger in the present specimen; but on the whole there can be very little doubt of the correctness of the identification, especially when we remember that Mr. CARTER'S type specimen came from the Gulf of Manaar.

R.N. 136 (Station XLI., 12 miles off Galle, 100 fathoms).

SUB-ORDER: SIGMATOPHORA.

Tetractinellida with triænes; with sigmata for microscleres (when present); without asters.

FAMILY: TETILLIDÆ.

Sigmatophora with well-developed protriænes and with skeleton usually strongly radiate in arrangement.

Tetilla, SCHMIDT.

Cortex absent or feebly developed; no special cortical skeleton.

Tetilla hirsuta, DENDY.

1889, **Tetilla hirsuta,** DENDY (3).

This remarkable species is represented in the collection by three specimens which differ somewhat amongst themselves, but all agree in the possession of the highly characteristic, cup-shaped, poriferous pits. In all the surface is more or less strongly hispid from projecting spicules, and encrusted with a layer of dirt between, to which the colour of the surface is due, this colour varying with the nature of the foreign matter. Two of the specimens are more or less spherical, one (R.N. 129) being attached to a mass of Nullipore; the third (R.N. 241) is constricted and slightly elongated below, where it has been torn off from its attachment. In one specimen (R.N. 129) there are, in addition to the characteristic spicules, a fair number of quite small oxea, varying much in size, and irregularly scattered in the choanosome. Such small oxea do not appear to be present in the type, but, in view of their variability in size and sporadic distribution, one can hardly regard their presence as constituting a specific or even varietal distinction. It should be noted, however, that very similar spicules appear to be characteristic of the next species (*T. poculifera*).

The arrangement of the pores and vents in this sponge is very peculiar and might be thought by some authorities to deserve generic recognition. The former are congregated in more or less deep, cup-shaped pits, guarded by very slender projecting protriænes and prodiænes; these pits occur, mostly, at any rate, on the lower parts of the sponge and may slope upwards. The vents (or better, cloacal cavities) are represented by pits containing the openings of excurrent canals. As SOLLAS has pointed out (**15**, p. cxxv), a somewhat similar arrangement is found in his genus *Cinachyra*, closely related to *Tetilla*, but that genus is also characterised by the presence of a thick cortex containing cortical oxea. In *Tetilla hirsuta* the cortex is only feebly developed, more or less fibrous, but without special cortical spicules.

For further specific details I must refer to the original description, to which I may add that the flagellate chambers are apparently eurypylous.

In the choanosome of R.N. 129 numerous minute and apparently siliceous spherules were observed, up to about 0·004 millim. in diameter. The nature of these bodies will be discussed under the head of *Tetilla anomala*, in which species they also occur.

R.N. 129 (deep water off Galle and onwards up West Coast); 177 (lagoon inside the reef, Galle, shallow water); 241 (Ceylon seas).

Tetilla poculifera, n. sp.—Plate I., fig. 6; Plate III., fig. 4.

The type specimen (R.N. 230, Plate I., fig. 6) is somewhat pear-shaped, with the broad end attached to a mass of calcareous organisms (Polyzoa, &c.). The apex of the sponge is occupied by a deep cup-shaped cloaca (Plate I., fig. 6, *Cl.*), whose margin is fringed with spicules, and whose floor is a sieve-membrane. The surface of the sponge is uneven, irregularly hispid, and thinly encrusted with sand-grains. Colour (in spirit) yellowish grey. Height of specimen 16 millims., transverse diameter 14 millims. Diameter of cloacal aperture 2·5 millims.

The skeleton consists chiefly of bands of large oxea radiating outwards from a central "nucleus"; the ends of these bands commonly project slightly beyond the surface.

Spicules.—(1.) Plagiotriænes (Plate III., fig. 4, *a*, *b*); few in number, but evidently proper to the sponge, though, perhaps, not specifically characteristic. A typical example from a boiled-out preparation has a fairly stout shaft, tapering gradually to a hair-like extremity, and about 1·3 millim. long by 0·0185 millim. thick below the cladome; cladi short and stout, about 0·13 millim. long, with apices fairly sharp and slightly incurved. (I have also seen fragments of two large dichotriænes, but it is doubtful whether these are proper to the sponge.)

(2.) Protriænes (Plate III., fig. 4, *d*, *d'*); with long, slender shaft, and long, slender, sharp-pointed cladi; conspicuous around the cloacal opening; size variable.

(3.) Anatriænes (Plate III., fig. 4, *c*, *c'*); of ordinary form, with short cladi and very long, slender, hair-like shaft. A specimen in a boiled-out preparation has cladi about 0·037 millim. long and shaft about 2·8 millims. long.

(4.) Oxea of the main skeleton (Plate III., fig. 4, *e*); stout, straight, fusiform, and tapering very gradually to the extremities, which may be sharply pointed, or rounded off or irregular; size about 3·1 millims. by 0·046 millim.

(5.) Sigmata (Plate III., fig. 4, *h*); slender, more or less contort, measuring about 0·017 millim. from bend to bend; abundant.

(6.) Small scattered oxea (microxea) (Plate III., fig. 4, *f*, *g*); straight or slightly curved; smooth, slender, fusiform, gradually and finely pointed at each end; size about 0·23 millim. by 0·005 millim. These spicules are scattered irregularly in enormous numbers throughout both choanosome and ectosome; in the latter position they may form quite a dense layer at the surface of the sponge, in which most of them lie tangentially. They may, perhaps, be regarded as microscleres.

Stained sections show that there is no cortex, and that the ectosome, though fairly thick, is not sharply differentiated from the choanosome. The material is not in a fit condition for minute histological investigation, but I have been able to make out that the flagellate chambers are oval and about 0·029 millim. in greater diameter. The inhalant pores are apparently scattered over the surface, and the inhalant canals appear to originate in irregular lacunar subdermal cavities. The larger exhalant canals are provided with numerous diaphragms, and terminate below the sieve-like floor of the cloaca.

The most characteristic features of this species are the structure of the cloaca and the presence of the very numerous smooth microxea. In *Tetilla* (?) *australiensis* (Carter) minutely spined microxea, 0·21 millim. long, are present, and Sollas (**15**, p. 43) observes of this species that the oxeote microscleres are almost unique amongst the Tetillidæ.* The case of *T. hirsuta*, described above, however, seems to show that in the oxea of this genus (as in *Plakinastrella*, &c.) it is impossible to draw a hard and fast line between mega- and microscleres.

In addition to the type described above, there are in the collection two other specimens which may be referred to the same species, viz., R.N. 189 and 205. Both are somewhat imperfect. R.N. 205 has several cup-shaped (cloacal ?) cavities, with sieve-like floors, irregularly distributed; the other is too imperfect to show the character of the vents.

R.N. 189 (Muttuvaratu Paar, Gulf of Manaar); 205 (Gulf of Manaar); 230 (deep water off Galle and onwards up West Coast of Ceylon).

Tetilla anomala, n. sp.—Plate III., fig. 5.

There are two specimens of this sponge in the collection, the larger of which (R.N. 153) may be regarded as the type. It appears to be a fragment, amounting to

* Oxeote microscleres occur also in the genus *Paratetilla* (*vide infrà*).

nearly half, of an irregularly spherical sponge, about 35 millims. in greatest diameter. The surface is rather uneven, minutely hispid, and thinly encrusted with sand. Neither pores nor vents are visible externally. The colour, in spirit, is grey, the texture firm and compact and only slightly compressible.

The skeleton consists chiefly of stout bands of oxeote spicules radiating from a centrally (?) placed "nucleus" to the surface of the sponge. The outer portions of these bands are often abundantly echinated by the cladi of the anatriænes, lying chiefly in the ectosome.

Spicules.—(1.) Protriænes (Plate III., fig. 5, *a*); with rather short, stout cladi and fairly stout shaft, tapering to hair-like fineness. Shaft about 2·76 millims. by 0·015 millim. (at the thickest); cladi about 0·054 millim. by 0·00625 millim. The cladi may be slightly irregular, and I have seen one forked at the extremity. They are sometimes much longer than in the specimen measured. These spicules occur in positions similar to those of the anatriænes, but are very scarce.

(2.) Anatriænes (Plate III., fig. 5, *b*, *b'*); with fairly stout, sharp-pointed cladi and long hair-like shaft; length of shaft about 2·7 millims., of cladi about 0·058 millim. Abundant.

(3.) Oxea (Plate III., fig. 5, *c*); stout, fusiform, gradually and finely pointed at each end; size about 2·8 millims. by 0·046 millim.

(4.) Sigmata (Plate III., fig. 5, *d*); slender, usually contort; very numerous, especially in the walls of the inhalant canals; measuring up to about 0·01 millim. from bend to bend.

(5.) Spherules; smoothly rounded, but irregular in shape; up to about 0·004 millim. in diameter, but usually smaller. These bodies are enormously abundant in the choanosome, but are practically absent from the ectosome. In the type specimen they are thickly, but irregularly scattered; in R.N. 192 they are grouped in oval clusters about 0·11 millim. in longer diameter.

Stained sections show a fairly thick ectosome pretty sharply differentiated from the choanosome and, to some extent, fibrous, but composed chiefly of chondrenchyme with very numerous granular cells. The thickness of this ectosome, which almost amounts to a cortex, in the type specimen, is about 0·74 millim. It is penetrated here and there by narrow inhalant canals, leading almost vertically inwards from the surface. The flagellate chambers are oval or nearly spherical, up to about 0·033 millim. in diameter. Their mode of opening and the arrangement of the excurrent canal system have not been made out. The mesoderm of the choanosome ranges from collenchymatous to chondrenchymatous.

The extraordinary number of the siliceous spherules or globules in this sponge is very remarkable. In R.N. 192 they are, as already stated, grouped together in oval masses. They appear in this case to originate many together in special mother cells, in which they first appear as very minute, highly refringent points. The oval groups are probably still associated with the remains of the mother cells. The exact nature of these bodies and their taxonomic value are extremely doubtful. Sollas (15) mentions that such bodies occur in the Tetillidæ associated with sigmaspires, but in *Cinachyra barbata*, where they are said to be as much as 0·0535 millim. in diameter, he regards them as "accessory or accidental" forms, and the only species of *Tetilla* in which they are mentioned appears to be *Tetilla arabica* (Carter), where they are of about the same size as in *T. anomala*. I myself have seen similar bodies in one specimen of *Tetilla hirsuta* (*vide supra*), but only very locally developed. That the spherules are really siliceous appears to be tolerably certain, for they appear abundantly in preparations of *T. anomala* which have been boiled out with nitric acid. Whether they can be regarded as definite and characteristic spicules is, however, another question, and it appears to me not impossible that they may be simply reserves of siliceous material destined to be re-absorbed later on and used for spicule formation. This view is strongly supported by their very sporadic distribution.

There is possibly a close relationship between *T. hirsuta*, *T. poculifera*, and *T. anomala*.

R.N. 153 (Station V., off Chilaw, 10 fathoms); 192 (Station LVII., outside Dutch Modragam Paar, 11½ to 36 fathoms).

Tetilla limicola, n. sp.—Plate I., fig. 7; Plate III., fig. 6.

Sponge (Plate I., fig. 7) somewhat fig-shaped, constricted below, broadly rounded above; may be slightly lobose; may be laterally compressed; anchored in the mud by a great mass of fine silky spicules attached to the base. Surface glabrous, but at the same time minutely and sparsely hispid above, more strongly hispid on the sides; also very minutely reticulate on the upper parts. Texture soft and spongy, but very compact, *i.e.*, without wide canals or cavities in the interior. Colour in life, pink; in spirit, grey. Vents (Plate I., fig. 7, *o*) of fair size, several, slit-like, in deep or shallow depressions on the upper part of the sponge; each leading into a wide but shallow cloacal cavity with an almost flat floor perforated by numerous minute openings of very narrow exhalant canals. Inhalant pores scattered between the surface tufts of spicules. A spirit specimen (exclusive of the root tuft) measures about 43 millims. in height, 48 millims. in greatest breadth, and 31 millims. in greatest thickness. The root-tuft (Plate I., fig. 7, *r.t.*) is nearly as large as the specimen itself, and in its present condition consists of a mass of soft mud held together by the extremely long and slender silky anchoring spicules, which individually are scarcely visible to the naked eye.

The skeleton consists of the following parts:—

(1.) Loose longitudinal bands of very long, slender oxea run almost parallel to one another throughout the body of the sponge. In a longitudinal section taken across the greatest breadth of the sponge these fibres are seen to converge towards a point situated at a short distance below the depressed apex of the sponge. Owing to the constriction of the sponge below, the lower ends of these fibres approach the surface almost without diverging from one another.

(2.) More or less mingled with the foregoing in the lower parts of the sponge are long, silky bundles of the very long, sinuous, hair-like shafts of anatriænes, whose heads echinate the bundles at varying distances beneath the surface.

(3.) Dense surface brushes, composed partly of oxea which form the ends of the long fibres and partly of protriænes of hair-like thinness, whose cladomes project far beyond the surface.

(4.) Numerous oxea, much shorter than those of the fibres, scattered irregularly throughout the body of the sponge.

(5.) The root-tuft, composed of anatriænes with extremely long and slender shafts, irregularly matted together.

Spicules.—(1.) Protriænes (Plate III., fig. 6, *b*.), (and diænes); shaft and cladi often of hair-like thinness; cladi commonly of unequal length (one sometimes suppressed entirely), projecting forwards at only a very small angle with the shaft. In a perfect example in a boiled-out preparation the shaft is about 3·0 millims. long, about 0·004 millim. thick just below the cladi, and tapering to hair-like fineness at the other end. The longest of the cladi is about 0·05 millim. in length.

(2.) Anatriænes (Plate III., fig. 6, *a*); with extremely long, hair-like shafts, so long and slender that they appear to be invariably broken off even in boiled-out preparations, and I am therefore unable to give the measurements. The cladi are fairly stout, gradually sharp-pointed, recurved at a very acute angle to the shaft, and about 0·04 millim. long by 0·004 millim. thick at the base. In boiled-out preparations the shafts of these spicules stick together in silky wisps.

(3.) Oxea (Plate III., fig. 6, *c*.); long and slender, commonly slightly curved, very gradually and finely pointed, varying greatly in size according to position, measured up to about 2·1 millims. by 0·01 millim.

(4.) Sigmata (Plate III., fig. 6, *d*); slender and commonly contort, measuring about 0·008 millim. from bend to bend. Very numerous.

The material is hardly sufficiently well preserved for minute histological investigation, but the examination of sections prepared by the usual paraffin method shows us the following features. There is no cortex and no distinct dermal membrane, the ectosome not being sharply differentiated from the choanosome. The small inhalant pores, scattered between the dermal brushes of spicules, lead directly into narrow, elongated canals, which run inwards at right angles to the surface and unite below the spicular brushes in larger inhalant canals which penetrate the deeper parts of the sponge. The flagellate chambers are approximately spherical and about 0·025 millim. in diameter; they are probably eurypylous. The exhalant canals are all narrow, and converge towards the flask-shaped cloacal cavities already mentioned. Numerous large ova, many of them having very prominent pseudopodia, are scattered through the choanosome. These ova measure up to about 0·11 millim. in diameter. They have uniformly granular cytoplasm and large, well-defined nuclei, each typically with a single darkly-staining nucleolus.

Of this remarkable sponge eight specimens were found, anchored in the soft mud at the bottom of Tamblegam Lake (a large inlet from Trincomalee Bay); but only one was forwarded to Cape Town for more minute investigation.

The species is evidently nearly related to *Tetilla dactyloidea* (CARTER), which that author records (**20**, **34**, **43**) from the south-east coast of Arabia, Bombay, and the Mergui Archipelago. The principal difference apparently concerns the excurrent canal-system. In *T. dactyloidea* there appears to be a single vent at the summit of the sponge, and Mr. CARTER observes that the terminal aperture divides into a number of branches, which, sub-dividing, permeate the mass generally down to its base. In *T. limicola*, as we have seen, the sponge is very compact throughout, and there are no wide tubes in it, the excurrent canals being very narrow and opening by numerous minute apertures in the floors of somewhat flask-shaped cloacæ with slit-like vents on the surface of the sponge. It is highly probable that this arrangement is a special adaptation to the conditions of life, serving to hinder the entrance of the very fine soft mud, in which it lives, into the interior of the sponge; even as it is, a considerable amount of mud may be seen in the excurrent canals just beneath the floor of the cloaca.

R.N. 70 (one of eight specimens from Tamblegam Lake, Trincomalee).

Craniella, SCHMIDT.

The ectosome is differentiated into an inner fibrous layer, containing more or less radially arranged cortical oxea, and an outer collenchymatous layer excavated by large subdermal cavities.

Craniella elegans, n. sp.—Plate IV., fig. 1.

Sponge free, irregularly spherical. Surface covered with close-set conuli; hispid with brushes of spicules projecting from the conuli; minutely reticulate between the conuli. Vents not visible in the type specimen. Pores in the thin dermal membrane stretched between the conuli. Colour, in spirit, purplish grey externally, yellow internally. Greatest diameter of type (R.N. 193) about 20 millims. Consistence firm and compact.

The main skeleton consists of stout bundles of spicules radiating from a central "nucleus" and ending in the brushes which project from the surface conuli (Plate IV., fig. 1). These radiating bundles (*r.b.*) are separated from one another by fairly wide intervals, and are composed of large oxea, with anatriænes and protriænes. The cladi of the anatriænes are, for the most part, situated in the outermost part of the choanosome, just beneath the cortex, while those of the protriænes mostly project beyond the surface of the sponge in the hispidating brushes. The special cortical skeleton is, as usual in *Craniella*, confined to the inner, fibrous layer of the cortex, and is composed of stout oxea; these are not arranged strictly radially, but are inclined at various angles to the surface, with their outer extremities commonly abutting at more or less acute angles against the stout bundles of the main skeleton as the latter penetrate the cortex on their way to form the surface brushes.

Spicules.—(1.) Protriænes (Plate IV., fig. 1, *b*); with long shaft, rather stout distally but becoming setaceous proximally, and short, stout cladi of approximately equal length. Shaft in measured specimen 4·78 millims. by 0·0368 millim. (near cladome); cladi, 0·129 millim. long.

(2.) Anatriænes (Plate IV., fig. 1, *a*); with long and very slender, setaceous shafts, and short, stout, sharp-pointed cladi; shaft measured up to 4·87 millims. by 0·0138 millim. (near cladome), with cladi 0·0736 millim. long. Very numerous.

(3.) Oxea of the radiating bands (somal oxea); stout, aniso-actinate; more or less gradually sharp-pointed distally, but drawn out into long setaceous filaments proximally; size up to about 3·27 millims. by 0·046 millim.

(4.) Cortical oxea (Plate IV., fig. 1, *c.o.*); stout, fusiform, aniso-actinate, sharp-pointed at each end, the proximal end narrower than the distal, but not setaceous; commonly slightly curved; size about 1·0 millim. by 0·0368 millim.

(5.) Sigmata; slender, 0·0166 millim. from bend to bend.

The cortex of the type specimen measures, in places, as much as 1·8 millims. thick, and is very sharply differentiated into two layers, of which the outer appears to be usually somewhat thicker than the inner. The outer layer is excavated by very large subdermal (intra-cortical) cavities (Plate IV., fig. 1, *i.c.c.*), which occupy nearly all the space between the radiating spicule bundles of the main skeleton, with the thin dermal membrane stretched over them. The dermal membrane (*d.m.*), and also the deeper parts of the outer layer of the cortex, between the subdermal cavities, contain numerous small brown pigment granules grouped in more or less spherical cells. The inner layer of the cortex (*f.c.*) is densely fibrous and contains no pigment granules; it is strengthened by the special oxea above described, and the fibres lie, for the most part at any rate, parallel to the surface.

The flagellate chambers are about 0·02 millim. in diameter, spherical or oval, eurypylous or with short, wide excurrent canaliculi. The choanosome is crowded with large embryos (Plate IV., fig. 1, *emb.*).

In addition to the type above described, there is in the collection another very small specimen (R.N. 204) of pear-shaped form, with a single apical vent. The maximum diameter of this specimen is only about 8·5 millims. In the structure of the cortex and in the form and arrangement of the spicules, it agrees very well with the type, but the megascleres are all much smaller. This difference, however, is probably due to immaturity, the specimen being of very small size and containing no embryos, while the type, as we have seen, is crowded with them.

R.N. 193 (Station LVII., outside Dutch Modragam Paar, 11½ to 36 fathoms); 204 (Gulf of Manaar).

Paratetilla, n. gen.

Tetillidæ with a special layer of modified triænes, resembling calthrops, lying at the junction between the ectosome and choanosome (or in the ectosome).

The discovery by Professor Herdman of another species of Tetillid which shares the remarkable skeletal peculiarities of Carter's *Tethya merguiensis* (21), appears to justify the establishment of a new genus for the reception of the two. *Paratetilla merguiensis* is, like our species, an inhabitant of the Indian Ocean (Mergui Archipelago), but its area of distribution extends, according to Sollas (15), as far as Torres Straits. The synonymy of this species is, however, somewhat involved, according to Lindgren (86) and Thiele (87) it should be known as *Tetilla bacca* (Selenka), with which, according to Thiele, Kieschnick's *Tetilla ternatensis*, *T. amboinensis*, *T. violacea*, and *T. rubra* are again synonymous. If these identifications be correct the range of the species must be yet further extended.

Paratetilla cineriformis,* n. sp.—Plate III., fig. 7.

This species is represented in the collection by four specimens, ranging in diameter from about 12 millims. to about 41 millims. The shape is irregularly hemispherical. All but the smallest have been injured below by tearing off from the attachment, the base of the sponge having evidently been left behind. The smallest, which appears to be fairly perfect, is cushion-shaped, flat beneath and convex above. The surface is more or less uneven, and to some extent hispid, though not very markedly so; it may be very irregular. The consistence is rather soft and spongy. The colour externally (in spirit) is almost black; internally much paler, purplish grey. The arrangement of the vents and pores is very difficult to determine. A few small, pocket-like depressions, irregularly scattered over the surface, probably represent cloacal cavities; their floors are perforated by the numerous minute apertures of slender, exhalant (?) canals; their external openings may be narrow and slit-like. The inhalant pores are probably scattered irregularly over the surface, but I have not been able to make them out distinctly. Some of the specimens are infested by parasitic cirripedes, living beneath the surface in cavities whose external apertures simulate vents.

The main skeleton consists of stout bands of spicules radiating from a large central "nucleus." In addition to these there is the layer of modified triænes lying at the junction of ectosome and choanosome.

Spicules.—(1.) Modified triænes (Plate III., fig. 7, *a–d*), lying at the junction of ectosome and choanosome. These spicules are so irregular in size and shape that it is almost impossible to describe them; the following have been measured: (*a.*) with four simple unbranched rays, one much shorter than the others, resembling a plagiotriæne with shaft shorter than cladi; length of longest ray 0·165 millim., with two

* The specific name is derived from the close resemblance which the sponge bears to a black cinder.

others a little shorter, and the fourth much shorter; (*b.*) with one very short unbranched ray (shaft) and three much longer rays (cladi), of which two are forked; cladi of somewhat unequal length; maximum diameter of cladome from tip to tip of rays 0·276 millim.; maximum diameter of cladi about 0·0166 millim.; (*c.*) similar to (*a.*), but with cladi much curved; the very short shaft, as is commonly the case, rounded off at the extremity; (*d.*) with only three rays, two almost in the same straight line and the third, much shorter (? = shaft) at right angles to them; length of each of longer rays about 0·147 millim.; of short ray about 0·055 millim. The rays of these spicules are often irregularly bent or curved. They are probably, as pointed out by CARTER and SOLLAS in the case of *P. merguiensis*, modified "zone-spicules" (plagiotriænes).

(2.) Protriænes (Plate III., fig. 7, *e*, *e'*); few in number and very variable in dimensions, with shaft and cladi all very slender or fairly stout, and cladome sometimes irregular. The cladome may or may not project beyond the surface.

(3.) Anatriænes (Plate III., fig. 7, *f*, *f'*); with short, stout cladi, and very long slender shaft, often inflated in a bulbous manner at a short distance below the cladome and tapering to hair-like dimensions at the other end. Length of shaft in measured specimen 3·3 millims.; diameter between bulb and cladome 0·007 millim.; length of cladi 0·027 millim. The cladomes of these spicules sometimes project beyond the surface of the sponge.

(4.) Oxea of the main skeleton (Plate III., fig. 7, *g*, *g'*, *g''*); stout, straight or nearly so; fusiform, with the ends gradually and finely pointed, or more or less irregular; size about 2·9 millims. by 0·0365 millim., but usually more slender. Numerous much smaller oxea, apparently young forms, also occur.

(5.) Sigmata (Plate III., fig. 7, *h*); extremely slender, frequently, if not always, contort, about 0·014 millim. from bend to bend; abundant.

In stained sections of the largest specimen the cortex measures up to about 0·28 millim. in thickness. It is composed of a compact tissue which appears to be cystenchymatous rather than collenchymatous, and the cells contain numerous minute brown pigment granules. The choanosome appears to be mostly collenchymatous and contains brown pigment granules similar to those of the cortex, but fewer in number. The flagellate chambers are oval or nearly spherical, up to about 0·0249 millim. in diameter.

This interesting sponge is evidently nearly related to CARTER'S *Tethya merguiensis* (21) (*Tetilla merguiensis* of SOLLAS) from the Mergui Archipelago, off the coast of Burmah, but differs to such an extent that there can hardly be any question of specific identity. The characteristic inhalant pore-sieves and dermal reticulation of CARTER'S species are not recognisable here; the dermal microxea are absent, and the modified "zone-spicules" appear to be much more irregular in shape.

R.N., 184, 187 (Stat. VI., Muttuvaratu Paar, Gulf of Manaar); 214 (deep water outside pearl banks, Gulf of Manaar); 245 (Ceylon seas).

GRADE: LITHISTIDA.

Tetraxonida in which the megascleres form desmas, typically united with each other to form a continuous skeleton.

The relationships and classification of the Lithistida still require a great deal of investigation before we can consider our knowledge of the group as by any means satisfactory. They are, of course, usually considered as a sub-division of the Tetractinellida, but inasmuch as many of them have only monaxonid spicules this method of disposing of the group seems somewhat unjustifiable. There appear to be two logical alternatives. We may either regard the Lithistida as being of polyphyletic origin and partition them to the best of our ability amongst other groups, or we may regard them as representing another grade of evolution in a special direction and retain the group provisionally as a matter of convenience, without committing ourselves to an opinion as to whether it is a natural group or not. In the present state of our knowledge the latter appears to me the wisest course to adopt.

As regards the internal classification of the group, I have no doubt that important modifications of the existing arrangement of genera, which we owe to SOLLAS, must shortly be made. My own experience of the Lithistida is, however, so limited that I prefer not to experiment in this direction, but will content myself with a few critical remarks suggested by the investigation of certain species in Professor HERDMAN'S collection.

Discodermia, BOCAGE.

Lithistida with tetracrepid desmas and ectosomal discotriænes, and with microscleres in the form of microxea or microstrongyla.

Discodermia emarginata, n. sp.—Plate IV., fig. 4.

The single specimen is of massive form with spreading base attached to a mass of calcareous worm-tubes. The upper surface is strongly convex, rising into two low, mammiform projections, from the broad apices of which (where the small vents are situated) radiate shallow grooves, the outward indications of convergent exhalant canals. Colour throughout (in spirit) pale yellow; texture compact and stony. Diameter of massive central portion about 12 millims., with the basal portion spreading a good deal further as a thin crust.

Skeleton composed of a close reticulation of firmly united tetracrepid desmas with a single layer of discotriænes on the surface. Below the surface are a few slender oxea, which become more numerous and are sometimes collected into loose fibres in the neighbourhood of the vent.

Spicules:—(1.) Stout tetracrepid desmas (Plate IV., fig. 4, *a–e*), more or less tuberculated, especially at the ends of the branches, which proliferate into numerous rounded tubercles, by the interlocking of which the union of adjacent desmas is effected. There are no transitional forms intermediate between these desmas and the discotriænes of the surface, such as Mr. CARTER describes (4), and the desmas are evidently not derived from discotriænes. Each originates from a tetract crepis (calthrops) by branching of the actines and secondary deposition of siliceous material. The initial stages in the development of the desmas are to be found in abundance just beneath the superficial layer of discotriænes, where the skeleton is evidently growing. The young crepis (Plate IV., fig. 4, *a*) is a regular tetract calthrops with minutely roughened surface. In one of the youngest I have seen, the actines measure about 0·04 millim. by 0·004 millim. One actine may be longer than the other three; they are sometimes conical and suddenly constricted at the base. Having attained a length of about 0·08 millim., or it may be less, the actines swell out at their ends and begin to branch irregularly (Plate VII., fig. 4, *c*). Presently the original minute roughening of the surface is covered over by smooth secondary deposits of silica, and the adult, much larger tuberculation appears, though the more central portions of the spicule may often be nearly smooth when fully developed. The diameter of the actines of the fully formed spicule ("epactines" of SOLLAS), between the centre and the point where they commence to branch, is about 0·036 millim. This account of the development of the desmas, while differing widely from that given by CARTER, agrees with the views expressed by SOLLAS in his "Challenger" report.

(2.) Discotriænes (Plate IV., fig. 4, *f*, *g*); disk flat, about 0·23 millim. in diameter; outer surface beset with numerous minute, conical papillæ; margin approximately circular, but minutely crenulated and usually strongly emarginate at one, two or three places, so as to form semi-circular bays or indentations; shaft well developed, stout, conical, fairly sharp-pointed, up to about 0·147 millim. long. These spicules form a single layer on the surface, with overlapping disks. The youngest stage I have recognised in their development is shown in Plate IV., fig. 4, *f*.

(3.) Monaxonid spicules (rhabdi); probably oxeote; long and slender, and commonly tapering very gradually to a fine point. These spicules are so long and slender and so interwoven with the desmas that I have never succeeded in seeing both ends of the same spicule *in situ*, and even in boiled-out preparations they are always broken. They are particularly numerous in the neighbourhood of the vent, but do not, at any rate usually, project beyond the surface. I have measured one up to a length of about 1·2 millims., with a maximum diameter of about 0·006 millim.

(4.) Microrhabds (Plate IV., fig. 4, *h*); usually fusiform and strongylote, with very minutely roughened surface; sometimes slightly curved; size about 0·016 millim. by 0·0027 millim. These spicules are very abundant beneath the layer of discotriænes; and especially in the membrane which immediately surrounds the vent, where they form a continuous layer, the discotriænes being absent.

It is with some reluctance that I have been constrained to add another species of *Discodermia* to the six already described by Mr. CARTER (4, 5) from the Gulf of Manaar (*D. papillata*, *D. aspera*, *D. spinispirulifera*, *D. lævidiscus*, *D. sinuosa*, and

D. sceptrellifera), but I cannot identify Professor HERDMAN'S specimen, from deep water off Galle, with any of these. The richness of the Ceylon seas in species of *Discodermia* is very remarkable. It is strange that I have not been able to find any ot Mr. CARTER'S species in Professor HERDMAN'S collection, but they are apparently all small forms, which would not be likely to attract the attention of a collector.

R.N. 234 (Station XLI., 12 miles off Galle, 100 fathoms).

Aciculites, SCHMIDT.

Lithistida with monocrepid desmas and rhabdi, the latter forming a special dermal layer. Without microscleres.

SOLLAS, in his report on the "Challenger" Tetractinellida, places this genus in his family Scleritodermidæ in the "Sub-order" Hoplophora, but it seems to me that it would fall more naturally amongst the Azoricidæ (in the Sub-order Anoplia of SOLLAS). The fact that some of the rhabdi form a dermal layer can hardly be of sufficient importance to justify us in placing the genus not only in a different family, but even in a different "sub-order" from the Azoricidæ, to which it is naturally allied by the form of the desma, the presence of rhabdi, and the absence of microscleres.

Aciculites orientalis, n. sp.—Plate IV., fig. 3.

The single specimen is massive, compact, cushion-shaped, rather irregular, but with rounded outlines, somewhat flattened above and attached below by a broad base to a mass of calcareous débris. Height about 28 millims.; greatest breadth, 38 millims. Texture compact and stony, but with a comparatively soft dermal membrane, which, on the upper surface of the sponge, is easily separable from the underlying part. Vents numerous, minute (say about 0·2 millim. in diameter, but varying), scattered over the upper surface.* Pores scattered. Surface, in parts at any rate, slightly corrugated, with narrow, ramifying and meandering canals showing through the dermal membrane. Colour in spirit grey, both internally and externally.

The main skeleton is a very close and compact reticulation of monocrepid desmas, intermingled more or less abundantly with strongyla. In the dermal membrane the strongyla are very abundant and lie for the most part tangentially, forming a more or less continuous dermal skeleton. Beneath the dermal membrane, where the main skeleton is growing, the desmas are found in various stages of development, not as yet connected with one another.

Spicules.—(1.) Monocrepid desmas (Plate IV., fig. 3, *a–d*). The young spicule (*a*) is an irregular, elongated rod, with minutely roughened surface, which soon begins to branch. The fully grown spicule (*d*) usually consists of a strongly curved main axis with branches coming off chiefly on the convex side. These branches proliferate and

* One much larger opening looks as if it might be artificial.

end in rather sharp, conical papillæ. Similar papillæ may occur on the main axis, but when this is strongly curved they are usually absent from the concave side. The fully developed desma measures about 0·328 millim. in maximum length in a straight line from point to point.

(2.) Strongyla (Plate IV., fig. 3, *e*, *f*); slightly curved and a good deal broader at one end than at the other. The broad end, which may be slightly tylote, is covered with minute spines, while the narrow end is smooth, or nearly so, though often with a very few minute projections. Size, commonly about 0·328 millim. by 0·009 millim. (in the middle).

So far as I am aware, the only other species of *Aciculites* hitherto described is the type of the genus, *Aciculites higginsii*, SCHMIDT (**44**), from Havanna. Our species is evidently very closely related to the West Indian form, which has fortunately been re-examined and described by SOLLAS (**15**, p. 347). In fact, the only specific difference which the description of the latter has enabled me to detect lies in the fact that in the Ceylon species the vents are not protected by tent-like arrangements of radiating rhabdi as described by SOLLAS. Probably, however, other specific differences will be found to exist in the form of the desmas, &c.

We have here an interesting case of apparently discontinuous generic distribution, though the imperfect state of our knowledge of the sponge-fauna of intermediate localities makes it possible that the discontinuity is apparent rather than real.

It may be noted that TOPSENT's *Aciculites incrustans* has now been recognised by that author as belonging to a totally distinct genus, *Desmanthus* (**14**).

R.N. 150 (Ceylon seas).

Taprobane,* n. gen.

Lithistida of plate-like or cup-shaped form, with minute sphinctrate apertures abundantly scattered on each side of the plate; with monocrepid, tuberculate desmas and long, slender oxea; without special ectosomal spicules and with microscleres in the form of sigmata only.

We have here another proof of the artificial character of SOLLAS's classification of the Lithistida. It will be seen from the diagnosis that the sponge upon which the genus *Taprobane* is based might be regarded either as a Scleritodermid without ectosomal spicules or as an Azoricid with sigmata; it is thus very closely related on the one hand to *Scleritoderma*, and on the other to *Azorica*. We have already had occasion to notice, in speaking of the genus *Aciculites*, that SOLLAS places *Scleritoderma* and *Azorica* in different "sub-orders," his Hoplophora and Anoplia respectively, but the discovery of *Taprobane*, combining characters of these two groups, viz., the absence of special ectosomal spicules and the presence of microscleres, alone seems sufficient to necessitate a revision of SOLLAS's scheme.

* So called from the old Greek name for the Island of Ceylon.

Taprobane herdmani, n. sp. —Plate I., fig. 8 ; Plate IV., fig. 2.

Specimen (Plate I., fig. 8) consisting of a stout, erect plate or lamella, strongly curved (almost into the shape of a cup). Surfaces more or less uneven, especially on the outside (which bears numerous galls due to parasitic barnacles). The upper edge is broadly rounded, and the base of attachment is slightly expanded, like the foot of a cup. Both surfaces are slightly and unevenly hispid, the hispidation being almost confined to the more depressed portions. Both surfaces are thickly studded with minute, pustule-like, circular areas, hardly visible to the naked eye. These areas are only about 0·3 millim. in diameter, and each bears the single aperture of an incurrent or excurrent canal surrounded by a well-developed sphincter membrane. The colour (in spirit) is dirty grey ; the texture compact and stony. Greatest height about 70 millims. ; thickness of lamella about 15 millims.

The main skeleton is a very dense and compact reticulation of desmas, together with loose wisps or brushes of long, slender oxea running at right angles to the surface, beyond which their ends project so as to give rise to the hispidation. The oxea seem to disappear more or less completely from the deeper parts of the sponge, while around the apertures of the canal system, at any rate on the outer surface, they may project as a scanty fringe.

Spicules.—(1.) Desmas (Plate IV., fig. 2); monocrepid and rather sparingly branched, the branches usually coming off almost exclusively from one side of the main axis, which is usually more or less strongly curved. Main axis and branches more or less abundantly ornamented with rounded tubercles ; branches (? always) terminating in conical papillæ, which may be bifid at the apex. The union of these desmas is so close and compact that it seems almost impossible to isolate an adult spicule for measurement ; but the total length, measured in a straight line from point to point, appears to be about 0·36 millim. The thickness of the main axis, exclusive of tubercles, is about 0·028 millim.

(2.) Oxea ; very long and slender, gradually and sharply pointed at each end ; commonly more or less curved or crooked ; size variable ; they are usually broken, but two complete spicules measured about 1·0 millim. by 0·008 millim. and 1·88 millim. by 0·008 millim. respectively.

(3.) Sigmata ; slender, contort ; total length in a straight line from bend to bend, about 0·01 millim. ; abundant throughout the sponge.

One of the most characteristic features of this species is the arrangement of the apertures of the canal system. These appear to be identical in form and arrangement on the two sides of the sponge, but we may conclude from the analogy of other plate-like and cup-shaped sponges that the apertures on the outer side are inhalant pores, and those on the inner side vents. Each aperture, whether pore or vent, lies in the middle of a circular area, sharply defined by the sudden cessation of the reticulation of desmas at its margin. This area is occupied by a very well developed, iris-like diaphragm, with abundant circularly and perhaps also radially arranged myocytes, the contraction of the former of which has, in almost all cases, completely closed the aperture. The diaphragm contains sigmata, but no other spicules. A similar arrangement of the external apertures of the canal-system appears to be characteristic both of *Azorica* and *Scleritoderma*; indeed, our Ceylon species, except for the absence of microstrongyles, resembles very closely indeed SCHMIDT'S *Scleritoderma packardi* from the Gulf of Mexico, as described and figured by SOLLAS in his work on the "Challenger" Tetractinellida.

R.N. 40 (Stat. XV., Periya Paar, Gulf of Manaar, 9 fathoms).

Petromica, TOPSENT.

Lithistida of massive form; with scattered pores and vents; with thin dermal membrane destitute of special skeleton; with monocrepid desmas feebly united or quite separate; with monaxonid rhabdi often collected in fibres which may terminate in surface conuli; without microscleres.

This genus was founded by TOPSENT in 1898 (**45**) for a new Lithistid sponge from the Azores, very closely related to *Azorica*. TOPSENT gives the following diagnosis:—"Azoricidæ massives, en forme de cônes dressés, à surface conuleuse, à pores dispersés, à oscules membraneux, à ectosome dévellopé aspiculeux, à desmas peu ornés et faiblement reliés entre eux."

The discovery of a second species in Ceylon waters, closely related to the type of the genus, forms a further justification for separating *Petromica* from the other Azoricidæ.

Petromica massalis, n. sp.—Plate IV., fig. 5.

Sponge massive, may be attached by a broad base, may be compressed vertically or horizontally. Vents usually numerous, rather small, but variable in size; scattered on the upper part of the sponge, each forming the termination of a vertical oscular tube. Pores scattered. Surface uneven, variable, more or less corrugated; in places covered with a thin, reticulate, pore-bearing dermal membrane overlying large sub-dermal cavities and supported on bundles of large monaxonid spicules which sometimes terminate in conuli. Texture incompressible, but friable; colour (in spirit) yellowish grey throughout. The type specimen (R.N. 257) measures about 37 millims. in height, the same in breadth, and 24 millims. in thickness.

The main skeleton is a reticulation (sometimes close and sometimes so loose that the desmas do not touch one another) of much-branched monocrepid desmas, intermingled with numerous large monaxonid spicules which are partly collected together in coarse fibres (without being united together by any cementing substance). These fibres, as already noticed, sometimes terminate in surface conuli. There is no special dermal skeleton.

Spicules.—(1.) Monocrepid desmas (Plate IV., fig. 5, *a*); much and very irregularly branched; not tuberculate (or very slightly so); branches usually terminating in short, blunt, conical points, or in curved flattened expansions pressed against other desmas. Maximum length from apex to apex of branches about 0·74 millim., with main axis about 0·06 millim. thick.

(2.) Stout and slender monaxonid spicules (Plate IV., fig. 5, *b–e*); more or less curved and variously ended, ranging from oxeote to strongylote and stylote; size about 0·98 millim. by 0·0369 millim., 1·2 millims. by 0·0246 millim., 1·28 millims. by 0·0328 millim., &c.; very variable.

The most interesting feature of this sponge is the strong development of the monaxonid spicules (rhabdi), which, in three out of the four specimens (the fourth being dead and infested by another sponge), play an equal part with the desmas in the composition of the skeleton. This condition of the skeleton suggests that certain Monaxonellid sponges usually associated with the Axinellidæ may be derived from Lithistid ancestors by the suppression of the desmas, or that certain Lithistids with monocrepid desmas may possibly be derived from Monaxonellid ancestors.

Petromica massalis is evidently very closely related to TOPSENT'S *P. grimaldii*, the type of the genus, from the Azores. The principal difference appears to concern the ornamentation of the desmas, which, in *P. grimaldii*, are ornamented at the extremities with little conical tubercles, not pointed. These are absent or very feebly developed in the Ceylon species, but subsequent researches may make it desirable to unite the two.

R.N. 198; 216 (dead, and infested by another sponge; deep water outside pearl banks, Gulf of Manaar); 257 (type); 269 (young; deep water off Galle and onwards up West Coast of Ceylon).

GRADE: MONAXONELLIDA.

Tetraxonida in which the primitive tetraxonid and tetractinellid condition of the megascleres has been entirely lost and none but monaxonellid megascleres remain. No desmas are developed.

With the recognition of the true nature of the monaxonellid sponges as reduced Tetraxonida, it becomes once more desirable to modify the name of the group. The old name, "Monactinellidæ," which we owe to ZITTEL, was objectionable because implying that the spicules are necessarily monactinal (one-rayed), while, as a matter of fact, they may be also diactinal (two-rayed). SOLLAS therefore altered the name to "Monaxonidæ," which was afterwards altered to "Monaxonida," under which name the group appears in the '"Challenger" Reports' and other recent works.

The name "Monaxonida," however, becomes distinctly objectionable when used for a mere sub-division of the order Tetraxonida, contrasted with the Tetractinellida; and I therefore propose to again modify the name of the group, choosing this time the term "Monaxonellida," which is, I believe, both correct in meaning and in harmony with the scheme of classification adopted.

The Monaxonellida form, however, an unnatural group of polyphyletic origin, which we can only retain as a matter of convenience until we know more about their phylogeny. They are evidently descended from more than one group of tetractinellid ancestors by degeneration of the tetraxon megascleres, and have branched off into an immense number of genera and species, the classification of which, as in the case of all reduced forms, is extremely difficult.

We have seen that the two chief tetractinellid sub-orders are distinguished mainly by the form of the microscleres, the "Astrophora" possessing some form of aster and the "Sigmatophora" sigmata. This same distinction, broadly speaking, runs through the Monaxonellida also, and may be used as the basis of their sub-division into "Astromonaxonellida" and "Sigmatomonaxonellida," names which I now propose as the most appropriate for the two great groups into which the "Monaxonellida" are by general consent divided, and approximately equivalent to the "Clavulina" and "Halichondrina" of VOSMAER and of RIDLEY and DENDY, and to the "Hadromerina" and "Halichondrina" of TOPSENT, &c.

These two groups are sharply distinguished from one another. As far as I am aware, there are only three cases on record of the occurrence of astrose microscleres in association with sigmata or chelæ, and all three are probably to be explained as due to mixture of the spiculation of two distinct sponges—a very frequent occurrence.*

We may regard these two great monaxonellid sub-orders as being descended from the two corresponding tetractinellid sub-orders, though this is no doubt but a crude way of looking at the problem, and it may well be that some of the forms which we find most difficult to classify are descended directly from the Homosclerophora, and others from the Lithistida.

The great difficulty in following out this system of classification to its logical conclusions lies in the fact that in many cases the microscleres, as well as the tetract megascleres, have entirely disappeared, apparently by degeneration, and we are then dependent upon the much less trustworthy guidance of other characters. Thus the genera *Halichondria*, *Reniera*, *Axinella*, *Suberites*, &c., with a very simple spiculation composed exclusively of monaxonid megascleres, are in reality more modified forms than *Gellius*, *Sigmaxinella*, *Hymedesmia*, *Spirastrella*, and so on, which have not lost their microscleres.

SUB-ORDER: ASTROMONAXONELLIDA.

Monaxonellida in which the microsclere, when present, is some form of aster.

This sub-order is practically equivalent to the Hadromerina of TOPSENT, which

* The cases in question are SCHMIDT'S *Sceptrella regalis* (**23**), p. 58 [*vide* also RIDLEY and DENDY (**1**), p. lxii., footnote]; FRISTEDT'S *Desmacella peachii* var. *stellifera* (**24**); and TOPSENT'S *Hymeraphia toureti* (**25**); all very doubtful cases. The so-called amphiasters (or "birotulates") of certain Desmacidonidæ (*e.g.*, *Axoniderma*, *Iotrochota*, *Amphiastrella*) are not true asters at all, but merely modified isochelæ. [Further discussion on this subject, necessitated by the appearance of TOPSENT'S great work on the Sponges of the Azores (**62**), will be found in the general remarks on the sub-order Sigmatomonaxonellida.]

that author sub-divides into two sections, according to the prevailing form of megasclere, viz., "Clavulida" and "Aciculida." This sub-division, however, appears to me to be both unnecessary and unnatural, especially when its originator places the genus *Tethya*, with its stylote megascleres, in the division "Aciculida," which is characterized by oxeote megascleres.* I therefore propose to divide the sub-order immediately into families. Of these Topsent (26) makes nine, of which five are represented in the present collection.

In addition to these, I here include the family Chondrosidæ, which have completely lost their megascleres, and, in the genus *Chondrosia* itself, their microscleres also. Some of the old group Axinellidæ (*e.g.*, *Vibulinus*, with astrose microscleres) must likewise be included in this sub-order, and it may prove necessary to institute a new family—Astraxinellidæ—for their reception.

On the other hand, I am inclined to think that some of Topsent's families will prove to be superfluous. Thus I propose to abandon his "Coppatiidæ" and "Streptasteridæ" in favour of the older "Epipolasidæ" of Sollas.

Family: EPIPOLASIDÆ.

Astromonaxonellida with oxeote megascleres, and usually euasters for microscleres.

This family, founded by Sollas (15) for the reception of the genera *Amphius*, *Coppatias*, and *Asteropus*, is, at any rate as regards what we may consider to be its typical representatives, evidently very closely related to the Stellettidæ, a fact which has already been recognised by previous writers. In short, we may safely regard these forms as reduced Stellettids which have lost their tetraxon megascleres, and Sollas himself placed the family next to the Stellettidæ as an appendix to the Euastrosa, though apparently with some doubt.

Topsent divided the genera of Sollas's Epipolasidæ between his own families Coppatiidæ and Streptasteridæ. In the Coppatiidæ he also includes certain genera, such as *Spongosorites*, which have no microscleres at all. *Spongosorites* is well represented in the Sponge-Fauna of Ceylon, but, for reasons which will appear subsequently, I find it desirable to remove it to the Axinellidæ.

Coppatias, Sollas (15).

Epipolasidæ with the skeleton composed of an irregular interlacement of oxea, and microscleres in the form of euasters only.

This genus is almost synonymous with the genus *Stellettinopsis* as employed by Carter.

* It should be pointed out, however, that Sollas and Topsent regard the megascleres of *Tethya* as modified oxea, which they term strongyloxea, but it is impossible to distinguish these from styli.

Coppatias reptans, n. sp.—Plate V., fig. 2.

The single specimen is much elongated, irregularly sub-cylindrical, creeping over and to a slight extent encrusted by calcareous débris. It has apparently lain horizontally. The total length is about 11 centims., and the maximum thickness about 14 millims. One end is much narrower and forms a free digitiform process, strongly curved. The surface is slightly rugose, minutely conulose and minutely and slightly hispid. The colour (in spirit) is dark purplish-grey, paler below and internally. Vents small (mostly minute), numerous, scattered on the upper surface. Inhalant pores abundantly scattered.

The main skeleton is a very confused reticulation of oxeote megascleres, here and there collected into loose bundles. There is no special dermal layer of tangentially disposed oxea, but the surface is rendered more or less hispid by the projecting points of oxea which lie below it. There is, however, a thin dermal layer of densely crowded asters.

Spicules.—(1.) Oxea (Plate V., fig. 2, *a*, *b*, *c*) slightly curved and gradually and sharply pointed; varying a good deal in diameter; about 1·0 millim. by 0·022 millim. when fully grown.

(2.) Chiasters (Plate V., fig. 2, *d*); very minute, with rather numerous, slender, cylindrical rays and little or no distinct centrum; total diameter about 0·006 millim. (sometimes a little more); most abundant at the surface, but also plentiful in the choanosome.

The ectosome is fairly thick, but is excavated by numerous irregular, spacious sub-dermal cavities, into which the inhalant pores open and from which the inhalant canals of the choanosome take their origin. It is clearly differentiated into two layers: an inner, comparatively thin and densely fibrous layer, with the fibres mostly lying parallel to the surface, and an outer, much thicker layer composed of collenchyma with a considerable admixture of fibrous tissue, but with the fibres running irregularly in all directions.

It is a noteworthy fact that the fibrous cells of the ectosome contain a large proportion of the pigment to which the sponge owes its dark colour, arranged in them in the form of minute spherical granules. Similar pigment granules also occur in some of the ordinary stellate cells of the collenchyma, of which the fibre-cells are but a slight modification.

The outer part of the ectosome also contains immense numbers of large, spherical, darkly staining cells, crowded together in large groups or loosely scattered. Similar cells also occur very abundantly, scattered singly or grouped in dense masses, in the choanosome. They remind one strongly of the symbiotic Algæ of *Hexadella* and the corresponding cells of *Asteropus haeckeli*, and are probably of a similar nature. Their immense numbers and their occurrence in such dense masses in both ectosome and choanosome are alone enough to suggest that they are not true constituents of the sponge-tissues.

This species appears to be very closely related to CARTER'S *Stellettinopsis* (*Coppatias*) *tuberculata* (**18**), an Australian species from which the Ceylon sponge differs chiefly in its external form and reptant habit.

R.N. 242 (Stat. XXVII., Cod Bay, Trincomalee, 5 fathoms).

Asteropus, SOLLAS (**15**).

Epipolasidæ with two sorts of asters, oxyasters and sanidasters.

Asteropus haeckeli, n. sp.—Plate V., fig. 3.

The single specimen is a small, irregular crust which has probably been attached by the base, to which fragments of calcareous débris are still adherent. The upper surface rises up into a broad, low, mammiform projection, with a single, rather large vent (about 2·5 millims. in diameter) at its apex. Surface smooth, but uneven and harsh to the touch, owing to the presence of huge oxea lying tangentially beneath the surface or projecting slightly beyond it. Colour (in spirit) pale grey. Texture internally coarse and cavernous, owing to the large exhalant canals.* Inhalant pores scattered. The specimen may be only a fragment of a much larger crust; its maximum breadth is about 25 millims., and its greatest height (where the vent is situated) about 11 millims.

The skeleton is a very dense and very confused interlacement of huge oxea, sometimes collected into very loose, ill-defined, coarse strands, which run towards the surface.

Spicules.—(1.) Oxea (Plate V., fig. 3, *a*); usually large and stout, fusiform, gradually and fairly sharply pointed at each end; curved; varying much in size, up to about 1·9 millims. by 0·065 millim. Numerous much shorter and more slender forms also occur, which may be immature.

(2.) Sanidasters (Plate V., fig. 3, *c*, *d*); with straight, slender axis dividing into two spines at each end, and with two irregular whorls of spines dividing the total length into three approximately equal parts; or with the axis irregularly spined, and perhaps angulated, so that the whole closely resembles a *Spirastrella* microsclere; total length up to about 0·016 millim. These spicules are very abundant at the surface and also common in the interior.

(3.) Oxyasters (Plate V., fig. 3, *b*); with few, slender, very slightly spined or roughened (? sometimes smooth), sharp-pointed rays and no distinct centrum; total diameter measured up to about 0·04 millim. These spicules are found in the interior of the sponge, but are scarce and easily overlooked.

The ectosome is very thick, and composed of a mixture of cystenchymatous and collenchymatous tissue, slightly fibrous in places, and with numerous darkly staining, oval cells scattered through it, which somewhat resemble the symbiotic Algæ of *Hexadella*, and are probably of a similar nature.

* The oscular tube is occupied by a Polychæte worm.

This species is closely related to CARTER'S "*Stellettinopsis simplex*," from Australia (Fremantle and Port Phillip Heads),* for which SOLLAS (15) established the genus *Asteropus*, and which, with the doubtful exception of SCHMIDT'S *Stellettinopsis annulata*, has, up to the present time, remained the only described species of the genus. (TOPSENT has shown (28) that LENDENFELD'S *Asteropus incrustans* is not referable to the genus *Asteropus* at all.)

The occurrence of another species in Ceylon waters is extremely interesting and affords a good illustration of the close relationship which exists between the Sponge-Fauna of this region and that of Australia. That the two species are not identical I have been able to convince myself by personal examination of a fragment of an Australian specimen kindly forwarded to me some years ago by the authorities of the British Museum (Natural History). The differences concern chiefly the arrangement of the vents, the colour (tawny-brown in the Australian species), and the size of the oxea (which are considerably more robust in the Ceylon species). Still, it is possible that the future discovery of intermediate forms may justify us in uniting the two.

I have taken the liberty of naming this species in honour of the most distinguished author of 'Die Kalkschwämme.'

R.N. 219 (deep water outside pearl banks, Gulf of Manaar).

Cryptotethya, n. gen.

Epipolasidæ in which the ectosome is differentiated into a thin, inner fibrous layer, very dense, and a thick, outer, more or less gelatinous layer. The outer layer is produced into more or less elongated, finger-like projections, between the bases of which the more or less spherical body of the sponge is largely concealed by agglutinated foreign bodies. The main skeleton is radially arranged, consisting of large oxea extending through choanosome and ectosome alike. The microscleres are euasters.

As regards its spiculation, this genus agrees very closely with *Coppatias*, and, like the latter, is evidently very nearly related to *Stelletta*. In the structure of the ectosome it makes a close approach to *Stelletta herdmani*, in which also the triænes have undergone considerable reduction. In fact, *Cryptotethya* may be regarded as derived from some such form as *Stelletta herdmani* by further reduction of the triænes and by the outgrowth of the ectosome into finger-like processes. In the spherical form of the body, and the radial arrangement of the skeleton, it is also related to *Tethya*, but perhaps its nearest ally is SOLLAS'S genus *Magog*, established (15) for the reception of CARTER'S *Chondrilla sacciformis*, from Mauritius, and included by SOLLAS amongst the Tethyidæ. In *Cryptotethya*, however, the oxea are not confined to the choanosome as in *Magog*. Both genera appear to me to come most naturally amongst the Epipolasidæ, though they certainly seem to indicate the manner in

* Mr. CARTER (27) also records the species from Hayti, but the Haytian form is very likely specifically distinct from the Australian.

which the Tethyidæ may have originated, through the Epipolasidæ, from stellettid ancestors.

Cryptotethya agglutinans, n. sp.—Plate V., figs. 4, 5.

The single specimen (Plate V., fig. 4) consists of a more or less spherical body from which radiate irregular finger-like processes of varying shape, long or short, cylindrical or flattened, and sometimes expanded at the free end. Between these projections the surface of the sponge is for the most part concealed by a great quantity of calcareous débris which firmly adheres to the sponge, including melobesian nodules of considerable size, worm-tubes, Foraminifera, &c., the whole forming an irregular mass in the midst of which the body of the sponge is scarcely recognisable. Calcareous débris may also be found in the interior of the sponge, even within the choanosome. I have not succeeded in making out the arrangement of the vents and pores. Some small openings on the ends of some of the projections resemble vents, but on close examination are found to be merely the apertures of cavities inhabited by parasitic barnacles. One at least of the shorter projections (fig. 4, *x*), however, contains longitudinal canals which are evidently either inhalant or exhalant canals proper to the sponge. The surface of the sponge, where exposed, is very uneven and very harsh to the touch, owing to the projection of the large oxea, which readily break off in one's skin and thus make the sponge very unpleasant to handle. The colour of the surface and of the thick outer layer of the ectosome (in spirit) is grey, of the thin fibrous layer of the ectosome white, and of the choanosome nearly white. The maximum diameter of the body of the sponge is about 40 millims., the length of the longest projection about 25 millims.

In the body of the sponge the huge oxea of which the skeleton is composed are for the most part arranged radially and without any distinction between choanosome and ectosome, passing indifferently from one to the other through the dense fibrous layer. Some of the oxea are associated in loose bands which spread out in brushes as they approach the surface. In the projections the oxea naturally lie for the most part longitudinally, but at the expanded end of a broad projection (containing longitudinal canals) I have found a good many placed tangentially at or near the surface. The asters are for the most part arranged (very abundantly) in a thin dermal layer, through which the points of the oxea may project for a short distance.

Spicules.—(1.) Oxea (Plate V., fig. 5, *a*, *b*); stout, fusiform, usually gradually and fairly sharply pointed, but subject to some irregularity at the ends and occasionally stylote. Size very variable, say about 2·5 millims. by 0·073 millim. when fully grown, but often less.

(2.) Chiasters (Plate V., fig. 5, *c*), with little or no centrum and smooth, slender, sub-cylindrical rays, ending bluntly, but not tylote; total diameter commonly about 0·012 millim. These spicules are most abundant at or near the surface of the sponge, but a few precisely similar forms occur in the choanosome.

Owing, on the one hand, to the enormous quantity of foreign matter adhering to the surface, and, on the other, to the great size of the megascleres, which interfere greatly with the cutting of thin sections, the investigation of the canal system of this sponge is attended with exceptional difficulties, and I have come to no satisfactory conclusions on the subject.

One of the most striking features of the sponge is the dense fibrous layer of the ectosome, which, when the sponge is cut in half, is conspicuous even to the naked eye as a white layer about 0·4 millim. thick, dividing the body into inner and outer portions, and forcibly calling to mind the similar layer of fibrous tissue in *Stelletta herdmani*. This dense fibrous layer consists of bundles of fine fibres closely matted together and running in all directions. It does not, perhaps, form quite the innermost portion of the ectosome, for beneath it lies a thin gelatinous layer containing subcortical crypts, from which the inhalant canals of the choanosome probably take their origin.

The outer layer of the ectosome varies much in thickness. It is partly collenchymatous, consisting of a clear gelatinous matrix with an immense number of large granular stellate cells embedded in it, and partly fibrous, the fibrous condition being apparently arrived at by elongation of similar cells in a direction parallel to the surface. Roughly speaking, this fibrous tissue may be said to occur between two layers of the collenchyma, but the two kinds of tissue are not sharply differentiated from one another, and the fibrous layer is not nearly so well defined or so dense as the inner fibrous layer already described. The outer layer of the ectosome alone takes part in the formation of the finger-like projections on the surface of the sponge, the inner fibrous layer not being continued into these.

The choanosome is rather compact and finely granular, but, owing perhaps to want of penetration by the preserving medium, my sections do not enable me to make out details of the histology or the arrangement of the flagellate chambers.

R.N. 62 (Gulf of Manaar).

Family: TETHYIDÆ.

Astromonaxonellida with stylote megascleres and euasters for microscleres; with strongly developed fibrous cortex and radially arranged skeleton.

I have discussed the probable origin of this family in speaking of the genus *Cryptotethya*.

Tethya, Lamarck.

More or less spherical Tethyidæ, without highly specialised pore-bearing grooves and without a sand-layer in the choanosome.

Tethya lyncurium, Lin.

There are in the collection a number of specimens of *Tethya* which have given me a great deal of trouble as regards their correct nomenclature. I have finally decided to regard them as belonging to three varieties of the well-known and extremely variable *Tethya lyncurium* of European waters. For convenience of reference we may distinguish the Ceylon varieties as *a*, *b*, and *c* respectively.

Tethya lyncurium, Lin., var. *a*.

This variety is represented by two approximately spherical specimens growing side by side on a mass of calcareous and other débris. The larger of the two is about 20 millims. in diameter, the other only a little less. The colour in spirit is dull yellowish-grey. The surface is irregularly conulose and gemmiparous, not distinctly tessellated, and to a considerable extent covered by adherent foreign matter. Each has a single prominent and widely open vent, about 2 millims. in diameter, at the summit of a thin-walled tubular projection. The pore-sieves between the conuli are for the most part inconspicuous.

The cortex is very dense and more or less fibrous throughout, but the fibrous tissue is most strongly developed in its deeper portion. The inhalant canals in the cortex are lacunar near the surface and constricted into definite canals deeper down.

The main skeleton consists of stout radiating bundles of megascleres, breaking up into divergent brushes in the cortex. In the choanosome (but not in the cortex) loose spicules of similar form are abundantly scattered (mostly lengthwise) between the bundles.

The megascleres are rather slender, faintly tylote styli, of the ordinary *Tethya* form. The feebly developed head is narrower than the middle of the shaft, and the apex is gradually and more or less sharply pointed. These spicules measure about 1·3 millims. by 0·02 millim. in the main fibres, but are much smaller in the surface brushes, while between the main fibres, in the choanosome, the sizes are mixed.

The microscleres are of two forms only, spherasters and chiasters. The spherasters are mostly found in the cortex, where they are rather sparingly scattered. The centrum is fairly large, and they have sharp-pointed conical rays which may be (rarely) spined or branched. The rays are about 12 in number, and nearly or quite touch one another at their bases. Total diameter about 0·076 millim., with rays 0·02 millim. long. In the cortex the chiasters are most abundant at the surface and in the walls of the inhalant canals; they are also numerous in the choanosome. They have no centrum and about from 6 to 9 distinctly tylote, rather slender rays. The total diameter of the chiaster is about 0·012 millim. Those of the choanosome are commonly six-rayed, and the rays are occasionally more elongated and proportionately more slender than in the ordinary form, but they are almost always distinctly tylote, and the whole spicule is never more than about 0·02 millim. in diameter.

I am convinced that the two specimens described above cannot be distinguished more than varietally from the common European species. The chiasters are, it is true, more distinctly tylote than is usually the case in *T. lyncurium*, but I cannot regard this character as of specific value, for in a specimen from Budleigh Salterton, in Mr. CARTER'S collection (now in my possession), the rays of the chiasters are occasionally tylote, though not nearly so strongly as in the Ceylon specimens.*

R.N. 199, 200 (Stat. LXVII., off Talaivillu Paar, 10 to 14 fath., Gulf of Manaar).

Tethya lyncurium, LIN., var. *b*.

There are five specimens in the collection which may be referred to this variety, differing from the foregoing in the following respects:—

(1) There are no prominent vents.

(2) The surface is more or less distinctly tessellated.

(3) The spherasters are considerably larger and more numerous, and have more numerous rays and larger centra. Total diameter up to about 0·1 millim., with rays about 0·024 millim. long; sometimes they are a little smaller; usually they are densely crowded in the cortex; the number of rays appears to be usually about 25.

(4) The chiasters are more distinctly differentiated into two kinds, the rays of those of the choanosome showing a strong tendency to lose their tylote character and become strongylote or even oxeote, while at the same time elongating somewhat (but not much) and being (? always) slightly roughened.

The largest of the five specimens is only about 21 millims. in diameter. The colour in spirit is dull grey.

R.N. 180, 180A, 180B (all from Lagoon, Galle); 196; 211 (Gulf of Manaar).

Tethya lyncurium, LIN., var. *c*.

This variety is represented by a single specimen, about 24 millims. in maximum diameter, with very strongly tessellated surface and one prominent vent. The cortex is very lacunar between the polygonal, flattened tesseræ.

As regards spiculation, this variety differs from the preceding only in the presence of numerous well-developed oxyasters, chiefly in the choanosome. These spicules have little or no centrum and usually six rays. The rays are rather slender and sharp-pointed, sometimes slightly roughened, but very rarely spined or branched; usually straight or nearly so. Total diameter of the oxyaster about 0·04 millim.

This variety might be justifiably identified either with SELENKA'S *Tethya maza* or with PERCIVAL WRIGHT'S *T. seychellensis*, but the two preceding varieties unite it so closely with *T. lyncurium* that it seems to me quite unnecessary to make a specific distinction.

R.N. 19 (Gulf of Manaar).

The occurrence of these three varieties of *Tethya lyncurium* within the same limited area is a very interesting fact, and their discovery is likely to be of great assistance in elucidating the relationship of the so-called species of this extremely difficult genus. In this connection it is interesting to note that WILSON (**29**) has lately recorded the occurrence of both *T. lyncurium* and *T. seychellensis* in Porto Rico.

* TOPSENT, however, entertains (**14**) a different view as to the taxonomic value of the tylote character.

Xenospongia, GRAY.

Tethyidæ of discoidal form. Choanosome containing much sand in its deeper parts. Inhalant pores localized in well-defined grooves, partly concentric and partly radial in arrangement. Vents on slight prominences. Surface tuberculate. Skeleton composed of bundles of styli ending in brushes, which project from the surface tubercles and also form a slight marginal fringe. Microscleres euasters of various forms and sizes, forming a dense cortical layer, and also abundantly scattered in the choanosome.

The genus *Xenospongia* was established by GRAY (**30**) as far back as 1858 for the reception of two remarkable sponges from Torres Straits, of which he gave a very poor description accompanied by excellent figures of the external characters only. He made no attempt to describe the spiculation, and, although this defect was partially remedied by CARTER in 1882, our knowledge of the sponge has remained singularly incomplete up to the present day. The genus has only been recorded once since its original discovery, viz., by HOLDSWORTH (**9**) from the Ceylon pearl banks in 1873. No description, however, has ever been published of HOLDSWORTH's specimen, and the identification with GRAY's species, though doubtless correct, was quite unsupported by evidence. HOLDSWORTH's record and specimen (which appears to have been forwarded to GRAY for further investigation) both seem to have been lost sight of by subsequent writers.

Under the circumstances, it is not remarkable that the systematic position of *Xenospongia* has hitherto remained doubtful. GRAY himself, in 1868 (**31**), made it the type of a new family, for which he proposed the name "Xenospongiadæ." CARTER, in 1875 (**32**), referred it to his group "Donatina," along with *Tethya lyncurium*, but expressed the opinion that it might ultimately have to come amongst the "Suberitida." In 1882, however, this author (**33**) reverted to GRAY's opinion, and proposed "a group named Xenospongina = Xenospongiadæ, GRAY." SOLLAS, in 1888 (**15**), referred the genus doubtfully to the Tethyidæ, pending further information. TOPSENT, in 1898 (**26**), made a new departure by referring it to the Spirastrellidæ, though, as it seems to me, with very slight justification.

The minute investigation which I have been able to make of Professor HERDMAN's well-preserved specimen proves beyond doubt that the opinion of SOLLAS is correct, and that *Xenospongia* is very closely related to *Tethya* itself, alike in spiculation, skeleton arrangement, histology, and canal system, although the external form and the arrangement of the inhalant pores are very peculiar. Even the surface tubercles or conuli, and the somewhat pinkish colour in spirit, remind one strongly of the genus *Tethya*. In *Tethya* also one sometimes sees the beginning of the development of pore-bearing grooves between the conuli, and the branching of the rays of the asters, which takes place so extensively in *Xenospongia*, may also be observed occasionally.

Xenospongia patelliformis, GRAY—Plate VI.

1858, **Xenospongia patelliformis**, GRAY (**30**); 1867, **Xenospongia patelliformis**, GRAY (**31**); 1873, **Xenospongia patelliformis**, HOLDSWORTH (**9**); 1875, **Xenospongia patelliformis**, CARTER (**32**); 1882, **Xenospongia patelliformis**, CARTER (**33**); 1888, **Xenospongia patelliformis**, SOLLAS (**15**); 1898, **Xenospongia patelliformis**, TOPSENT (**26**).

The single specimen in the collection (Plate VI., fig. 1) has the form of an almost circular disk, about 28 millims. in diameter, with convex upper and slightly concave lower surface and rather thin and slightly undulating margin. The lower surface is formed by the agglutinated sand which makes up the greater part of the thickness of the disk. The upper surface is covered with rather small, rounded tubercles or conuli, thickly scattered at fairly regular intervals. These tubercles are about 1 millim. in diameter, and are normally hispid from the projection of the ends of large spicules, now generally broken off short. The margin of the sponge is also very shortly hispid from the same cause (figs. 1, 2, *m.f.*). Just above the margin two narrow grooves (figs. 1, 2, *m.p.g.*) run round the disk, separated from one another by an interval of about 1·5 millim., across which they occasionally communicate with one another by oblique connecting grooves. The width of the grooves varies up to about 0·5 millim., and the floor is crossed at right angles by narrow parallel bands of fibrous tissue of a whitish appearance, arranged very regularly at short intervals. The inhalant pores are very minute and arranged in transverse rows between the fibrous bands in the floor of the grooves (fig. 2). (In the specimens described by GRAY similar grooves radiate more or less abundantly from near the centre of the disk towards the margin; in our specimen these radiating grooves are very feebly developed and recognizable in only a few places, fig. 1, *r.p.g.*) The vents, now more or less closed, are situated at the apices of three low, monticular elevations near the centre of the disk (figs. 1, 2, *o*); these elevations are not very conspicuous and are apparently formed each by the agglomeration of three or four of the surface conuli.* (Dr. GRAY appears to have mistaken the inhalant pores, or groups of pores, for vents; some of the prominent elevations figured by him on his larger specimen probably bear the true vents, though one, at least, of these elevations appears to contain a parasitic barnacle; there appear to be no barnacles in our specimen, but a parasitic worm occupied one of the larger exhalant canals.)

The colour of the sponge on the upper surface (in spirit) is pale yellowish grey, with a faint pinkish tinge in places, reminding one much of *Tethya*. The texture is firm and compact, leathery above, but the greater part of the thickness of the disk is composed almost entirely of coarse sand (fig. 2, *s.g.*), firmly cemented together by the tissues of the sponge. This sand is exposed only on the lower surface. The total thickness of the disk in the middle is about 6 millims.

The main skeleton consists in the lower two-thirds of the thickness of the disk, or

* In addition to the vent-bearing elevations, there is one larger, wart-like protuberance containing some hard foreign body (fig. 1, *a*).

thereabouts, of the above-mentioned sand-grains, between which there are also numerous styli, arranged, partly at any rate, in irregular bundles, and various forms of asters. The upper third of the thickness of the disk is free from sand, and includes a considerable thickness of the choanosome as well as the cortex. Here the main skeleton is formed by stout bundles of styli running vertically to the surface and entering the tubercles, from which they project as dermal brushes (fig. 2, *d*, *b*). These vertical bundles of styli are crossed at right angles by similar bundles which lie near the inner limit of the sand-free layer of the choanosome and terminate in the feebly-developed spicular fringe (*m.f.*) at the margin of the disk.

The cortex (figs. 2, 3, *cort.*) is strengthened by an immense number of asters of various shapes and sizes, forming a very dense skeleton, especially towards the surface. Asters of various kinds are also very abundantly scattered through all parts of the choanosome.

Spicules.—(1.) Styli (Plate VI., fig. 4); long, slender, nearly straight, evenly rounded off at the base and tapering very gradually to the apex. The size of these spicules is so variable that it seems almost useless to give measurements. The largest are so long that it is difficult to get them unbroken; 1·7 millims. by 0·012 millim. is perhaps a fair average size for the full-grown spicule, but considerably stouter (and presumably also longer) examples frequently occur (broken) in boiled-out preparations, while the styli which fringe the edges of the pore-bearing grooves, for example, are, on the other hand, very much smaller than the measurements given above.

(2.) Euasters (Plate VI., figs. 5, 6); enormously abundant and varying so greatly in form and size that it is impossible to separate the different kinds sharply from one another. The following may, however, be regarded as the principal types:—

(*a.*) Spherasters with very small centrum and long, conical, stout, sharply and gradually pointed, often slightly curved actines, about 11 in number; total diameter of spicule about 0·1 millim., with centrum 0·02 millim. in diameter and actines 0·044 millim. long. These asters pass gradually on the one hand into smaller oxyasters, and on the other into larger forms with very irregularly curved and more or less (often much) branched actines; the most copiously branched forms appear to be characteristic of the sandy layer of the choanosome, where they may attain a total diameter of as much as 0·18 millim.

(*b.*) Minute chiasters, with about 8 fairly stout, sub-cylindrical, tylote actines; total diameter about 0·008 millim.

(*c.*) Oxyasters or spherasters, with small centrum and about 11 slender, conical, oxeote, minutely spined actines; total diameter about 0·02 millim. The actines are occasionally branched.

(*d.*) Similar to (*c.*), but with tylote actines; this is perhaps the most uncommon form of the aster.

After carefully removing the sand-grains from below, it is possible to prepare microtome sections of the outer portion of the sponge, including the cortex and that portion of the choanosome which is free from sand. The cortex (Plate VI., figs. 2, 3, *cort.*) is about 0·13 millim. thick between the surface tubercles, but much thicker in the tubercles themselves, which are composed exclusively of cortical tissue and spicules. The greater part of the substance of the cortex is made up of asters of various forms and their accompanying scleroblasts, but it also contains bands of fibrous tissue running in various directions. Stout bands of dense fibrous tissue (figs. 2, 3, *f.b.*) also run vertically inwards from the cortex through the outer part of the choanosome to the sandy layer, where they appear to assist in binding the sand-grains together. The vertical spicule-bundles which run into the surface tubercles are also accompanied by similar bands of fibrous tissue (fig. 2), and the same kind of tissue is also developed in connection with the vents and the pore-bearing grooves.

A noteworthy feature of the cortex is the presence of the very numerous, approximately spherical, vesicular scleroblasts (fig. 3, *scl.*), about 0·016 millim. in diameter; each resembles a cystenchyme cell and encloses one of the smaller asters, the ends of whose actines abut against the thin limiting membrane of the cell, or perhaps sometimes project beyond it. Similar scleroblasts may be observed in the choanosome. The outermost part of the cortex is composed of small-celled chondrenchymatous tissue; the inner part is more or less fibrous, and between the two we find collenchyma with stellate connective-tissue cells.

The flagellate chambers (fig. 3, *fl.c.*) are oval or nearly spherical, closely crowded together in the choanosome and about 0·028 millim. in diameter where least contracted by shrinkage. The state of preservation is not sufficiently good to enable me to make out minute details very satisfactorily, but the chambers are apparently eurypylous.

The inhalant pores are, as I have already observed, minute openings in the floor of the pore-bearing grooves (fig. 2, *m.p.g.*). They are very numerous, and 10 or more may be indicated in a single transverse section of the groove. From each pore a very narrow inhalant canal runs vertically inwards and opens, with its fellows, into a system of irregular crypts which lie beneath the thick floor of the groove and from which wider inhalant canals take their origin and run inwards to the choanosome, in which they sub-divide into smaller branches. Stout bands of dense fibrous tissue run across in the floor of the groöve from side to side, between the transverse rows of inhalant pores and pore-canals. Probably, by the contraction of these bands of fibrous tissue, the prominent lips of the groove can be brought together and the groove thus closed.*

The main exhalant canals are only moderately wide and converge towards the vents. Owing to the state of contraction I am unable to say whether there is a single large vent or a group of small ones on each of the vent-bearing prominences. Sections indicate that there may also be small vents between the conuli, and it appears as if one exhalant canal sometimes opens through several small apertures.

* A very similar arrangement is found in a very different sponge, *Esperella murrayi*, as described in the Report on the 'Challenger' Monaxonida.

The geographical distribution of *Xenospongia patelliformis* is, as pointed out by HOLDSWORTH (**9**), very interesting; the only records up to the present time being Torres Straits and Ceylon. That the specimens met with in these two localities are specifically identical, I have little doubt. GRAY, in describing the species from Torres Straits, gave no description of the spicules, and did not even mention the occurrence of asters. CARTER, to some extent, remedied this defect in 1882 (**33**), but he only figured two forms of aster, and those not very characteristic. His microscopical preparations, however, which are now in my possession and which were presumably made from one of the Torres Straits specimens (for HOLDSWORTH'S specimen and record from Ceylon appear to have been entirely lost sight of ever since his note on the subject was published), show both large and small asters of various forms, and the actines of the large ones may occasionally branch. Mr. CARTER'S preparations are only teased; had they been boiled out from all parts of the sponge, they would probably have shown all the forms of aster described above from Professor HERDMAN'S example.

The external form is, of course, extremely characteristic, and so little does it look like a sponge that the specimen described above was in the first instance placed amongst the Clypeastroids.

R.N. 375. (Stat. I. First haul of trawl, off Negombo, 12 to 20 fathoms, January 31, 1902.)

FAMILY: SPIRASTRELLIDÆ.

Astromonaxonellida usually of massive or encrusting form. Skeleton usually irregular or reticulate, at any rate internally. Megascleres usually stylote or tylostylote. Microscleres asters of various forms.

Hymedesmia, BOWERBANK.

Thin encrusting Spirastrellidæ whose spiculation consists of smooth tylostyli and euasters of various forms (occasionally passing into spirasters).

TOPSENT has given an excellent account of the literary history of this genus in his Monograph of the Sponges of France (**14**). A very large proportion of the known species come from the Gulf of Manaar, and were described by Mr. CARTER (**4**) in 1880: viz., *H. stellivarians*, *H. moorei*, *H. spinatostellifera*, *H. capitatostellifera*, and *H. trigonostellata*. Of these five species I have only met with one in Professor HERDMAN'S collection.

The genus is an extremely interesting one from the phylogenetic point of view, for we see here, in the first place, the first appearance of the characteristic suberitid "pin-head" spicule (tylostyle), and, in the second place, the evolution of the typical spirastrellid microsclere from the euaster.

Hymedesmia forms a connecting link between *Coppatias* and *Spirastrella*.

Coppatias, as we have already seen, is simply a reduced Stellettid in which the cladi of the triænes have become completely aborted, and the megascleres now consist solely of oxea. From the oxeote to the tylostylote form appears at first sight a big jump, but I think it is evident that the pin-headed type in *Hymedesmia* is simply the result of the thinly encrusting habit. The megascleres in this genus are typically arranged at right angles to the base of support, with their apices projecting outwards, often beyond the surface of the sponge, an arrangement which is admirably adapted both to support the soft tissues and to protect the sponge from the attacks of parasitic Crustaceans or other enemies. In this position the proximal end of the megasclere, pressed against the hard base of attachment, is unable to elongate in the normal manner, and siliceous material, which would otherwise have been devoted to its elongation, is accumulated in a swelling or knob—the "pin-head."

Such is, I believe, the origin of the spirastrellid and suberitid tylostyle, and an exactly analogous process appears to have taken place in the echinating spicules of the Ectyoninæ, which are commonly swollen into a "head" at the end which abuts against the skeleton fibre. The at first sight tempting idea that the head of the tylostyle is the vestige of the cladome of a triæne is put completely out of court by the fact that it lies at the wrong end of the spicule, viz., the proximal instead of the distal end.

The evolution of the typical spirastrellid spiraster from the euaster has evidently taken place by elongation and bending of the centrum of the latter, and various stages of the process may be seen in different species of *Hymedesmia*; indeed, the two forms of aster pass so insensibly into one another that it is impossible to base a generic distinction upon their character alone. In the spirastrellid spiraster the rays (actines) are commonly reduced to mere spines or minute blunt projections.

Hymedesmia stellivarians, CARTER.

1880, **Hymedesmia stellivarians,** CARTER (4).

The single specimen forms a thin yellowish crust, attached to a small melobesian nodule, in company with *Paresperella serratohamata*, &c. In spite of the somewhat meagre character of Mr. CARTER's description and figures, I think there can be little doubt of the correctness of the identification, especially as Mr. CARTER's specimen also came from Ceylon waters.

All three forms of aster mentioned by Mr. CARTER are present, but they are not all of the same size, as might, perhaps, be inferred from his description and figures. Moreover, in our specimen the megascleres are usually a good deal longer in proportion to their thickness than Mr. CARTER's figure indicates, but they are also very variable in dimensions.

Under the circumstances it seems desirable to give the following particulars as to the spiculation :—

(1.) Tylostyli; only slightly curved, if at all; with oval head at one end and gradually and more or less sharply pointed at the other; size variable, up to about 0·47 millim. by 0·01 millim.

(2.) Spherasters; (*a*) comparatively large, with large centrum and stout, smooth, conical, sharply pointed rays; closely resembling the large spherasters of *Tethya;* total diameter about 0·02 millim.; (*b*) of medium size, with moderately developed centrum and stout, sub-cylindrical, very distinctly tylote rays (? heads sometimes roughened), about as long as the diameter of the centrum; total diameter of spicule about 0·012 millim.; (*c*) small, with very small centrum and comparatively long, slender, sharp-pointed rays; total diameter about 0·008 millim. (possibly young forms of one or both of the others).

R.N. 220B (deep water off Galle and onwards up West Coast of Ceylon).

Hymedesmia curvistellifera, n. sp.—Plate V., fig. 6.

Sponge thin, encrusting. (The single specimen has evidently been removed from the surface of some Alcyonarian, the large calcareous spicules of which still adhere in great numbers to the base of the sponge.) Surface uneven, corrugated, very slightly hispid. Colour (in spirit) light brown; texture rather friable. Vents and pores not seen. Average thickness of specimen about 0·5 millim.

The main skeleton consists of loose fascicles of tylostyles, springing from the base of attachment and running to the surface, where they spread out in loose brushes and give rise to the more or less hispid character.

Spicules.—(1.) Tylostyli (Plate V., fig. 6, *a*); straight, or nearly so, with large, oval or sub-globular heads and rather slender, sub-fusiform shafts, gradually and usually finely pointed at the apex. Size, when fully developed, about 0·38 millim. by 0·006 millim. Many much more slender forms, with proportionally larger heads, sometimes pear-shaped, also occur; these I take to be immature spicules.

(2.) Asters (Plate V., fig. 6, *b*, *c*, *d*); with strongly-curved centrum and stout, conical, sharp-pointed, smooth spines (rays). The spines show a tendency in some cases to arrange themselves in three groups, one group at each end of the centrum and one in the middle, on the convex side of the curve. The middle of the concave side of the centrum is free from spines, but the curvature is so great that this part of the centrum is often concealed from view, and the spicule then resembles a spheraster. The total diameter of the aster, when fully developed, is about 0·032 millim., but numerous smaller (young) forms also occur. The asters are most abundant in the dermal layer, where they form an almost continuous crust.

This species finds a near relative in TOPSENT'S *Hymedesmia tristellata* (**14**), from Banyuls and the Azores. Closely similar asters occur in that species, but their rays are often covered with minute spines, which I have never seen in the Ceylonese form. I cannot agree with TOPSENT'S view that the "triple spherasters" (as he terms them) have resulted from the concrescence of three centra covered with actines; it appears to me, on the other hand, that they have arisen by elongation of the centrum and grouping of the actines, and that we have here the first stage in the evolution of the typical *Spirastrella* microsclere. From this point of view it is of great interest to compare RIDLEY'S *Spirastrella transitoria* (**16**), from the Amirante Group. This is a thinly encrusting species, with "spinispirular, extremely concentrated, composed of only one entire bend," in fact, very closely resembling the aster of *Hymedesmia curvistellifera.* As RIDLEY further observes, "in *S. transitoria* we have the spini-spirular almost in the form of the stellate, with which SCHMIDT . . . . . and CARTER . . . . . consider it to be homologous."

S. transitoria is evidently closely related to *S. curvistellifera*, but differs in the proportions of the spicules. Both species, together with *H. tristellata*, and possibly some others, undoubtedly occupy a position intermediate between the typical species of *Hymedesmia* on the one hand and of *Spirastrella* on the other, so that they might, with almost equal propriety, be referred to either genus.

R.N. 320 (Ceylon seas).

Spirastrella, SCHMIDT.

Massive Spirastrellidæ with styli or tylostyli for megascleres and spirasters for microscleres; the spirasters usually forming a dermal crust.

Spirastrella vagabunda, RIDLEY.

1884, **Spirastrella vagabunda**, RIDLEY (**16**).

There are in the collection a number of specimens which, while differing greatly in external form, agree so closely in spiculation that I am obliged to regard them merely as varieties of one and the same species, which appears to be identical with RIDLEY'S *Spirastrella vagabunda.* This species was originally described by RIDLEY from Torres Straits, but at the same time he assigned to it certain specimens in the British Museum Collection which came from Trincomalee and the Galle Coast, Ceylon, a fact which, of course, strongly supports my identification of Professor HERDMAN'S specimens. The Trincomalee specimen referred to was very briefly described by CARTER (**33**) under the name "*Suberites* ? sp." RIDLEY, having examined the same specimen, suggested (*loc. cit.*) that it should be distinguished as "*S. vagabunda* var. *trincomaliensis*," on account of certain slight differences in spiculation. In Mr. CARTER'S cabinet, now in my possession, there is a preparation, labelled in his handwriting "*Suberites trincomaliensis*," which is evidently from the specimen examined and described by him. Subsequently, in 1886, Mr. CARTER (**20**) described a sponge from the Mergui Archipelago under the name *Suberites trincomaliensis*, identifying it with the Ceylonese form.

Spirastrella vagabunda thus appears to be a widely-distributed and variable species. RIDLEY'S *Spirastrella congenera*, from Torres Straits, is probably a mere variety of the same, and perhaps, also, his *S. punctulata*, from Mozambique and Mauritius. The principal characters of the species appear to be the dense, confused arrangement of the main skeleton, the usually stout and distinctly headed tylostyles, and the slender, more or less elongated spirasters.

I propose to regard Professor HERDMAN'S specimens as belonging to four varieties of the species, which may be distinguished as *trincomaliensis*, *tubulodigitata*, *fungoides*, and *gallensis* respectively.

Spirastrella vagabunda, var. **trincomaliensis,** RIDLEY.

1882, "**Suberites,** ? sp., undescribed, Trincomalee," CARTER (**33**); 1884, **Spirastrella vagabunda,** var. **trincomaliensis,** RIDLEY (**16**); 1886, **Suberites trincomaliensis,** CARTER (**20**).

The single specimen in the collection evidently agrees very closely with the specimen examined by CARTER and RIDLEY. It consists of a massive base rising up into a few short, stout, finger-shaped processes. The surface is sub-glabrous, but slightly corrugated vertically; not warty as described by CARTER (this character having probably been due to drying). The colour (in spirit) externally is nearly black, with a greenish tinge, internally dark greenish-brown. Texture compact throughout, but fleshy and fairly compressible, with little or no imbedded foreign matter. The exhalant canals are (in spirit) extremely narrow and surrounded by gelatinous tissue almost free from spicules; they run vertically upwards through the finger-shaped processes in considerable numbers and probably open by minute vents (now nearly all closed) at the apices of these projections. Greatest height of specimen 56 millims.; greatest breadth of massive base 52 millims.; length of finger-shaped projections about 23 millims.

The skeleton is a very dense and confused reticulation of megascleres, interlaced in all directions. On the surface some of them form, in places at any rate, very poorly developed surface brushes.

Spicules.—(1.) Styli and tylostyli; moderately stout, usually more or less curved or crooked; apices, and heads when developed, very variable and apt to be irregular; size of fully grown spicule about 0·62 millim. by 0·009 millim., but variable.

(2.) Spirasters; not very abundant and varying in form from the ordinary zig-zag to one with a simply but strongly curved axis with blunt projections on the convex side; length about 0·012 millim. These spicules agree closely in form and size with those in Mr. CARTER'S preparation, although a good deal shorter than in the type of the species (according to RIDLEY'S measurements).

R.N. 52 (Gulf of Manaar).

Spirastrella vagabunda, var. **tubulodigitata,** nov.

In this variety the sponge consists of hollow, finger-shaped processes or "fistulæ" rising from a sandy base to a total height of about 50 millims. Each process contains several wide, longitudinal exhalant canals, separated from one another by narrow partitions, and usually ends in a single conspicuous vent. The colour varies from light to dark grey.

The skeleton arrangement and spiculation agree closely with those of the last-named variety. The surface brushes of megascleres may or may not be well-developed in different parts of the same specimen.

In one specimen (R.N. 246) a single finger-shaped process swells up at its free end into an irregular nodular mass, and thus makes an approach to the variety *fungoides*.

In R.N. 218 the spirasters are rather longer and the megascleres have better developed heads, and are perhaps usually somewhat stouter than in the type of the variety.

R.N. 154 (type of variety); 218 (deep water outside pearl banks, Gulf of Manaar); 246; 352 (Ceylon seas).

Spirastrella vagabunda, var. **fungoides**, nov.

The type of this variety is an extremely irregular, massive specimen, growing amongst a quantity of nullipore and other calcareous débris. It is characterised especially by the presence of definite porous areas, either forming irregular depressions on the surface, like large pock-marks, or on the flattened tops of fungoid outgrowths. These are probably inhalant pore-areas, for there are at least two fairly large vents forming the outlets of wide oscular tubes; one of these vents is situated on a level with the general surface of the sponge, and the other on a low mammiform projection. The structure internally is somewhat cavernous, and the specimen contains a great deal of imbedded foreign matter. The size of the entire mass is about 88 millims. by 47 millims. by 47 millims., but a large proportion of it consists of nullipore, &c. The colour in spirit is pale yellowish-grey.

The main skeleton is dense and confused; surface brushes are developed in the pore-areas and, as usual, many at any rate of the spicules in these brushes are much smaller than those of the main skeleton.

Spicules.—(1.) Tylostyli; usually slightly curved; with stout fusiform shafts, well-developed, oval heads and finely and evenly pointed apices; size in main skeleton about 0·5 millim. by 0·0167 millim.

(2.) Spirasters; mostly long, slender and zig-zag; occasionally up to as much as 0·048 millim. long, but usually much shorter. Rarely more than 0·002 millim. thick, exclusive of spines; occasionally nearly straight.

In the possession of the occasionally much elongated spirasters this variety resembles RIDLEY and DENDY'S *Spirastrella solida* (1) from the Philippine Islands, which should perhaps be regarded merely as another variety of *S. vagabunda*.

R.N. 54 (type of variety, Gulf of Manaar); 253 (Ceylon seas).

Spirastrella vagabunda, var. **gallensis**, nov.

The larger of the two fragments by which this variety is represented in the collection is an irregularly cylindrical piece, about 52 millims. in length, and varying in diameter from about 10 millims. to about 19 millims. The texture is compact and firm and the specimen contains a good deal of coarse sand imbedded in it. The colour (in spirit) is pale yellowish-grey. The surface is smooth, but rather uneven. No vents visible. Pores scattered in small groups ?

The main skeleton is a very dense and confused reticulation of stout megascleres. The preparation only shows very feebly developed surface brushes.

Spicules.—(1.) Tylostyli; usually curved, with stout, fusiform or sub-fusiform shafts and well-developed ovoid heads; apex gradually and evenly and fairly sharply pointed. Size when full grown about 0·5 millim. by 0·019 millim.

(2.) Spirasters; short and slender, closely resembling those of var. *trincomaliensis;* about 0·012 millim. long; not very abundant.

R.N. 178 (type of variety), 179 (both from Lagoon, Galle, June, 1902).

Spirastrella tentorioides, n. sp.—Plate V., fig. 7.

The single specimen bears a striking resemblance in external form to *Tentorium semisuberites*, consisting of a short columnar body ending above in a strongly convex and sharply-defined pore- and vent-bearing area of darker colour* than the remainder of the surface. The surface of the column is subglabrous and irregularly furrowed longitudinally. On one side a much smaller column is given off as a vertical offshoot, terminating above like the large one. The specimen is attached below to a mass of calcareous débris by a broad base and narrows somewhat towards the apex of the column. Total height about 24 millims. Diameter of the column in the middle about 15 millims. Colour (in spirit) light grey. There are several wide exhalant canals running vertically through the column, and probably several smallish vents at the apex. Only one vent, however, is now visible, forming the outlet of the largest canal, and measuring only about 1·5 millim. in diameter. The inhalant pores are scattered between the surface brushes of spicules on the rounded apex of the column, around the vents.

The main skeleton is a very dense, confused reticulation of megascleres, permeating the whole of the soft tissues, close up to the walls of the canals, on the one hand, and to the dermal surface on the other. In this reticulation the spicules lie in all directions, but around the inhalant canals they are mostly placed lengthwise, with their apices pointing upwards. Surface brushes are confined to the rounded summit of the column, where they are well-developed.

Spicules.—(1.) Tylostyli (Plate V., fig. 7, *a*, *b*); straight or slightly curved, with stout, sub-fusiform shafts gradually and sharply pointed at the apex, and well-developed oval heads; size when full grown about 0·66 millim. by 0·0164 millim., but much smaller in the surface brushes.

(2.) Spirasters (Plate V., fig. 7, *c–g*); varying much in shape and size, usually slender, but sometimes stout; *e.g.*, (*a*) short, slender, simply curved, with projections (hardly spines) on the convex side; length about 0·008 millim.; (*b*) short, slender,

* The darker colour is due to the entanglement of dirt amongst the spicule-brushes.

zig-zag, with projections on all sides; length about 0·016 millim., thickness about 0·002 millim. (excluding projections); (*c*) long, slender, zig-zag or crooked, with small, sharp spines on all sides; size about 0·048 millim. by 0·0027 millim. (excluding spines); (*d*) short, stout, zig-zag, with stout conical spines on all sides; size about 0·022 millim. by 0·004 millim. (excluding spines), with spines about 0·006 millim. long. The spirasters are abundant and form a thin dermal crust.

The canal system of this sponge is somewhat remarkable and, like the external form, reminds one of *Tentorium.* The wide exhalant canals, running vertically upwards to the apex of the sponge, have already been noticed. The inhalant pores, situated also at the summit of the sponge, lead into subdermal cavities from which very narrow inhalant canals run vertically downwards, more or less parallel with the oscular tubes. These canals unite together as they descend and, even in hand-cut and unstained sections, can be easily traced by the brown colour of their walls.

Considering the extraordinary variation which the species of *Spirastrella* exhibit, alike in external form and in the arrangement of pores and vents, I should hardly have considered characters of this nature alone sufficient to justify the establishment of a new one, but should have regarded this form as yet another variety of *Spirastrella vagabunda.* We have here, however, a stout form of the spiraster which is, perhaps, not represented in any of the varieties of that species, and this fact, taken in conjunction with the other characters, seems to me to justify a specific separation.

R.N. 239 (Ceylon seas).

Placospongia, GRAY.

Spirastrellidæ with a stony spicular axis and a similar cortex, both composed of closely packed sterrospiræ; with bundles of tylostyles radiating from the axis towards the periphery. Cortex divided into polygonal areas by grooves containing the inhalant and exhalant apertures.

Placospongia carinata (BOWERBANK).

[For Literature and Synonymy, see VOSMAER and VERNHOUT (**35**).]

In view of the very recent publication of the elaborate monograph on the genus *Placospongia*, by VOSMAER and VERNHOUT, it is unnecessary to say much about this interesting species. The presence of numerous parenchymatous spirasters ("spinispiræ"), and the fact that the dermal spicule is a microspire, justify the specific identification according to the views of the authors quoted. I also agree with KELLER in placing the genus amongst the Spirastrellidæ, it having been shown that the "sterraster" of this sponge is a modified spiraster.

CARTER (**4**) has described a species of *Placospongia* from the Gulf of Manaar which he identified as *P. melobesioides*, and this identification will no doubt hold good, for he expressly mentions the absence of spirasters ("spinispirulæ"). He has also (**5**) recorded the same species from the vicinity of the Basse Rocks, off the south-east coast of Ceylon. It appears, therefore, that the two species, *melobesioides* and *carinata*, both occur in Ceylon waters.

R.N. 118 (Stat. V., off Chilaw, 10 fathoms).

Negombo, n. gen.

Spirastrellidæ consisting (? always) of tubular processes (? arising from a common base). Megascleres smooth styli; microscleres sanidasters.

This genus may, perhaps, have arisen independently from some sanidastrose form of Tetractinellid, but as regards its existing characters it is so closely related to *Spirastrella* that it may be included in the same family. It is also quite possible that its sanidaster may be merely a modified spiraster.

Negombo tenuistellata, n. sp.—Plate V., fig. 8.

Sponge consisting of a group of short, rather thin-walled tubes of very variable diameter, growing up close together, side by side, and more or less fused with one another laterally. Each tube ends above in a single widely-open vent, ranging in diameter from about 3 millims. to about 8 millims. All the tubes are broken off and widely open below, so that it is impossible to say whether or not there was a basal mass from which they sprung, but probably there was. The walls of the tubes contain a great number of large sand-grains embedded rather sparsely in them. The colour (in spirit) is pale yellowish-grey, translucent; the texture rather soft and flexible, but fairly tough. The tubes do not vary greatly in height, the height of the longest being about 31 millims., while its width in the middle is about 6 millims.; the tube next to it is of about the same height, but as much as 12 millims. wide in the middle. The walls of the tubes are scarcely 2 millims. thick in the middle, thinning out somewhat towards the margin of the vent and thickening slightly towards the base. The outer surface of the tube-wall is rough, with more or less embedded sand-grains, and also, between the grains, irregularly reticulate with slightly-projecting ridges; I have not been able to find dermal pores in it. The inner surface of the tube-wall, on the other hand, is covered by a kind of dermal membrane, strengthened by a reticulation of megascleres, and bearing numerous small pores, resembling dermal pores but presumably exhalant, in the interstices of this reticulation.

The main skeleton consists of long styli, not forming definite fibres but sometimes collected into loose wisps. They mostly lie lengthwise in the thickness of the tube-wall and are more abundant in the middle of its thickness than elsewhere. On the inside of the tube-wall there is, as already indicated, a well-developed "dermal" reticulation of styli, crossing one another singly, or in twos or threes, in all directions parallel with the surface. On the outer surface of the tube-wall the dermal membrane contains very numerous microscleres and the megascleres lie at a slightly lower level. On both surfaces the dermal membrane is supported to some extent on the outer ends of very loose, irregular wisps of styli which come off from the dense central portion of the main skeleton.

Spicules.—(1.) Styli (Plate V., fig. 8, *a*, *b*, *c*); rather long and rather slender, subfusiform, with the base rather narrower than the middle and the apex fairly gradually sharp-pointed; usually slightly curved; size about 0·54 millim. by 0·012 millim., but variable. The apices have a tendency to be irregular and occasionally the spicule becomes oxeote.

(2.) Sanidasters (Plate V., fig. 8, *d*); each in the form of a very slender rod, straight or slightly crooked, terminating at each end in a slight swelling or, perhaps, a couple of small spines, and bearing very slender spines along its length, usually most strongly developed in, or perhaps even confined to, a whorl on each side of the middle of the spicule. Total length about 0·012 millim.; maximum diameter, including spines, about 0·004 millim. These spicules appear to be almost, if not quite, confined to the dermal membrane on the outer surface of the sponge.

R.N. 362 (Stat. I., hauls 1–4, January 31, 1902, off Negombo, 12 to 20 fathoms).

FAMILY: CLIONIDÆ.

Astromonaxonellida of boring habit; forming excavations in the shells of Mollusca and other calcareous bodies.

Cliona, GRANT.

Clionidæ of which the complete spiculation is composed of tylostyli, oxea, and spirasters. One or two of these forms of spicule may be absent by atrophy.

It will be seen that I have adopted TOPSENT'S views (**36, 37**) as to this genus and its systematic position, in preference to those expressed in the Report on the "Challenger" Monaxonida.

Cliona margaritiferæ, n. sp.—Plate V., fig. 9.

The specimens in the collection consist of pieces of the shell of *Margaritifera vulgaris* (the Ceylon Pearl Oyster), abundantly excavated by the sponge. The chambers which it makes are rounded or oval in form, more or less crowded together, according to age, and connected with one another by narrow tunnels. From the inner sides of the chambers slender, elongated, conical canals radiate at various angles towards the inner surface of the shell. These outgrowths are shaped like spines, and, as in certain other species which I shall refer to later on, give the chambers a very characteristic appearance when viewed by transmitted light. From the outer side of each chamber are given off usually about two cylindrical canals, which perforate the outer layer of the shell at right angles to the surface and terminate in circular vents or pore-areas (fig. 2, on p. 144, shows a shell excavated by this sponge).

The walls of the excavations have a finely granulated or, under the microscope, frothy appearance, due to the presence of innumerable shallow, conchoidal depressions, which are in contact with one another all over the surfaces of the walls.

There is only room in the thickness of the shell for a single layer of chambers. When these have attained their full size, their transverse diameter is about 1·5 millims., but they may be considerably elongated. The diameter of the cylindrical canals which terminate on the outer surface of the shell varies up to about 0·65 millim. The outer end of each is closed, completely or partially, by a thin membrane containing numerous micro- and megascleres. Where the membrane in question stretches completely across the end of the canal, I assume it to be an inhalant pore-sieve, though the pores cannot now be seen; such a membrane may be supported by bundles of tylostyles converging towards the centre. The vents, on the other hand, are more or less widely open and surrounded by a thin, membranous diaphragm, also supported by tylostyles.

The body of the sponge itself (in spirit) forms for the most part a very thin lining (of a pale yellowish-brown colour) to the chambers.

Spicules.—(1.) Tylostyli (Plate V., fig. 9, *a*); straight, or nearly so, slender, very gradually and sharply pointed, and with well-developed globular heads; size about 0·25 millim. by 0·004 millim., with head about 0·006 millim. in diameter. These spicules occur scattered generally, as well as in the neighbourhood of the vents and pores.

(2.) Spirasters (Plate V., fig. 9, *b*, *c*, *d*); usually with about four angulations, fairly stout, and abundantly but rather minutely spinous, size about 0·024 millim. by 0·004 millim., but variable. These spicules pass by transitional forms (Plate V., fig. 9, *e*, *f*, *g*) into

(3.) Spined microxea (Plate V., fig. 9, *h*, *k*); usually bent or angulated in the middle, and measuring about 0·06 millim. by 0·0027 millim., but variable. These forms are extremely numerous in the deeper parts of the sponge. The gradual transition between spirasters and microxea in this species is extremely interesting.

The excavations made by *Cliona margaritiferæ*, even down to the spine-shaped outgrowths of the chambers, are closely similar to those of Hancock's *Cliona spinosa* (**38**) and *Thoosa cactoides* (**38**), but the spiculation is very different. *Cliona spinosa* occurs in shells of *Perna* and *Placuna*, and *Thoosa cactoides* in shells of *Meleagrina margaritifera*. Another distinct species, of closely similar form, occurs in shells of *Meleagrina albina?* and has been described by the same author (**38**) under the name *Cliona cervina;* the spiculation of this species makes a much closer approach to that of *C. margaritiferæ*, but the two appear to be quite distinct.

Topsent (**37**) has already described, under the name *Cliona indica*, a boring sponge infesting a pearl oyster from Ceylon. This species is evidently nearly related to ours, but the describer gives no information as to the character of the excavations or apertures, and the spiculation differs so much from that of our species that it is impossible to suppose that the two are identical. Both belong, however, to TOPSENT'S third division of the genus *Cliona*.

THIELE'S *Cliona concharum* (**39**), from Japan, perhaps comes nearer to our species than any other, at any rate so far as the spiculation is concerned, the differences in this respect being so slight that subsequent researches may make it desirable to consider the two as being only varietally distinct. In the Japanese form, however, the chambers excavated by the sponge seem to be much smaller, while the spined microxea are a good deal longer (0·09 millim.), than in that from Ceylon.

CARTER'S *Cliona warreni* (**5**), also from the Gulf of Manaar, on the other hand, is a very different species, and, according to TOPSENT (**37**), is identical with the European *Cliona celata*.

R.N. 261 (Gulf of Manaar—very abundant, and destructive, on the pearl banks).

FAMILY: SUBERITIDÆ.

Astromonaxonellida in which the megascleres are styli or tylostyli, and the microscleres have completely disappeared.

Suberites, NARDO.

Suberitidæ of varying form, but without mammiform projections on the surface. Spicules tylostylote (nearly always). Skeleton usually arranged radially, with surface brushes of spicules smaller than those of the main skeleton.

The genus *Suberites*, at any rate so far as its typical species are concerned, for it may possibly be of polyphyletic origin, is, as I have already indicated, probably derived from *Spirastrella* by loss of the spirasters. CARTER even admitted into the genus certain species with spirasters.

It is remarkable that there is only one species of the genus, and of that only a single specimen, in the present collection. In making my preliminary examination in Liverpool (which had to be done very hastily), I identified one of the specimens as *Suberites inconstans*, var. *digitata*, a form previously described by me from near Ceylon, but more careful examination subsequently revealed the presence of spirasters and thus proved that the specimen was really a *Spirastrella*.

Curiously enough, THIELE (**39**) has come to the conclusion that *Suberites inconstans* is in reality a *Spirastrella* in which I have overlooked the spirasters, these being, according to him, small and scarce. This is, of course, possible, but it is by no means proved. THIELE has apparently never seen specimens from Ceylon or India, but identifies certain specimens from Celebes with the species, under the name *Spirastrella inconstans*. Unfortunately I am unable to re-examine the types of the species here in South Africa, as the original specimens and preparations remained in the British Museum.

TOPSENT has sub-divided the old genus *Suberites* into a number of separate genera, and there is a great deal to be said in favour of such a proceeding, though it is doubtful whether all of his distinctions can be maintained. *Suberites cruciatus*, for example, combines certain characters of TOPSENT'S *Laxosuberites* and *Axosuberites* with peculiarities of its own, and I prefer to make use of the old generic name in this instance.

Suberites cruciatus, n. sp.—Plate V., fig. 10.

Specimen consisting of a number of long, slender, flattened branches, springing from a short pedicel of similar structure to themselves and branching in an almost dichotomous manner, but with some of the branches fusing together again higher up. Total height of specimen about 91 millims.; length of pedicel to first fork about 14 millims., breadth 3·5 millims., thickness 2 millims.; breadth of separate branches about 2·5 millims.; thickness about 1·5 millims. Surface rather uneven, very minutely hispid, and beset with very numerous small rounded translucent areas, apparently pore-areas. Vents probably minute and scattered. Colour (in spirit) pale brown; consistence soft and very flexible.

The main skeleton consists of numerous loose bands of tylostyles running lengthwise through the sponge; with numerous similar spicules scattered between in a loose, irregular reticulation. I have not detected any spongin cement. Towards the surface this arrangement gives place to radiating brushes of tylostyles, whose apices project slightly beyond the dermal membrane. Between these brushes lie the fairly extensive sub-dermal cavities.

Spicules.—Tylostyli (Plate V., fig. 10), of rather peculiar form. Usually straight, slender, gradually and finely pointed at the apex; with heads usually elongated transversely at a little distance from the base of the spicule, so as to form a cross. This cruciate character is most pronounced in the youngest and slenderest spicules; in the mature forms the arms of the cross form rounded knobs projecting from the shaft usually at a very slight distance from the base; occasionally there are three of these knobs instead of two. The full-sized spicules measure about 0·31 millim. by 0·005 millim., with head about 0·0093 millim. across.

The shape of the tylostyle in this curious little sponge reminds one of the corresponding spicule in CARTER'S *Hymedesmia spinatostellifera* (**4**).

R.N. 315 (Stat. LV., outside Periya Paar, 24 fathoms).

FAMILY: CHONDROSIIDÆ.

Corticate Astromonaxonellida with complex canal system and small flagellate chambers. Without megascleres.

These sponges appear to be Astromonaxonellida in which the megascleres (and in the case of *Chondrosia* the microscleres also) have been lost by degeneration. Their strongly developed cortex and complex canal system show that they are not primitively simple forms like the Myxospongida, and, as the megascleres probably passed through a monaxonellid condition before finally disappearing, we may include the family in the monaxonellid rather than in the tetractinellid grade, though, perhaps, logically speaking, it ought to occupy a distinct grade of its own. The form of the microscleres (when present) and the corticate character suggest a close relationship with the Tethyidæ.

The family will always be historically interesting as having formed the subject of one of F. E. SCHULZE's classical memoirs (**40**).

Chondrilla, SCHMIDT.

Chondrosiidæ with microscleres in the form of euasters of various kinds.

Chondrilla australiensis, CARTER.

1873, **Chondrilla australiensis**, CARTER (**41**); 1885, **Chondrilla australiensis**, LENDENFELD (**42**).

The specimens of this sponge form thin crusts of a greyish colour (in spirit) and irregular outline, spreading over masses of calcareous débris. One large specimen is about 80 millims. in greatest breadth. The surface is smooth and sometimes glabrous; it may be minutely reticulate when seen under a lens, and in one specimen (R.N. 185) it is very minutely papillate, with the spherasters so thickly aggregated in the papillæ that they touch one another. The vents are minute and scattered.

Having in my possession several of Mr. CARTER's own microscopical preparations of this species, evidently from the original types, I have been able to make a direct comparison and to assure myself of the correctness of the identification. In both Mr. CARTER's and Professor HERDMAN's specimens the spheraster, with smooth conical rays, measures about 0·028 millim. in diameter, and the oxyaster, with minutely spined rays, sometimes branched at the ends, measures nearly as much. In a Ceylonese specimen I find that neither spicule is strictly confined to either the cortex or the interior of the sponge, but while the spherasters are much more abundant in the cortex, the oxyasters are much more abundant in the interior.

It is noteworthy that Mr. CARTER has recorded (**5**) the occurrence of *Chondrilla nucula*, the common European species, from the Gulf of Manaar. This species appears to be of very wide distribution.

R.N. 17 (Gulf of Manaar); 185 (Donnan's Paar); 251; 376 (encrusting a shell of *Margaritifera vulgaris*, Cheval Paar).

Chondrilla australiensis, var. **lobata**, nov.

This variety is represented by two specimens (apparently obtained together) which differ conspicuously from the thin, encrusting form above described, being massively lobose, with comparatively large vents placed singly on the top of the lobes. The base of attachment is constricted to a few narrow projections on the lower surface, and the entire body of the sponge exhibits a swollen, tumid appearance. The vents measure up to 2 millims. in diameter, and each is surrounded by a thick, membranous margin, which, in its turn, is usually surrounded by a shallow groove. The surface is sub-glabrous, but uneven and very minutely reticulate. The colour below (in spirit) is very pale grey, but on the upper parts of the lobes the grey is mottled with brown. The texture is compact and fleshy; compressible.

The two specimens are of about equal size; the one selected for measurement is about 42 millims. in length, 17 millims. in breadth, and 18 millims. in height. The cortex is about 0·164 millim. thick.

The spicules agree closely in form with those of the thin, encrusting variety. The spherasters are, however, rather smaller. They have, in both varieties, a strongly marked tendency for their rays to be reduced to low warts or even, perhaps, to disappear, so that in some cases the large centrum is left almost smooth, as in KELLER's *C. globulifera*, which is, however, specifically distinct.

A lobate variety of *C. australiensis* occurs also in Australia.

R.N. 286, 286A (deep water off Galle and onwards to Colombo. Hauls off Kaltura and off Mount Lavinia, 20 to 30 fathoms, February 19, 1902).

Chondrosia, NARDO.

Chondrosiidæ in which all the spicules have completely disappeared.

Chondrosia reniformis, NARDO.

This well-known Mediterranean species is represented in the collection by two specimens, both attached to the same fragment of a horny sponge. Each is roughly hemispherical in form, with wide base spreading out into a broad, thin "stolon" on one side. The surface is covered with low, irregular tubercles, which may be due in part to contraction. The vents are small and difficult to make out, sometimes, at any rate, on low mammiform projections. The structure of the dense fibrous cortex, with its pigment cells, and that of the choanosome, agree very closely, so far as can be made out in the material at my disposal, with SCHULZE's classical description (**40**). The pigment cells, however, appear to be mostly in the inner part of the cortex, instead of in the outer part as figured by SCHULZE; but this is not an important difference. Each specimen is about 13 millims. in diameter, and the colour (in spirit) is mottled grey and brown on the surface, and pale greyish-yellow internally.

R.N. 226 (two specimens; deep water off Galle and onwards up West Coast of Ceylon).

SUB-ORDER: SIGMATOMONAXONELLIDA.

Monaxonellida in which the typical microscleres are sigmata, or forms derived therefrom, normal astrose microscleres being absent.

The sponges which comprise this large sub-order may be regarded as descended from the tetractinellid sub-order Sigmatophora (family Tetillidæ) by reduction of the megascleres, in the same way that the Astromonaxonellida may be regarded as being derived from the tetractinellid Astrophora.

In dealing with the Astromonaxonellida I have already had occasion to point out that no reliable instance of the occurrence of true astrose microscleres in conjunction with sigmatose forms has ever been recorded, a fact which argues very strongly in favour of the primary cleavage of the Monaxonellida into two great groups corresponding to the tetractinellid sub-orders Astrophora and Sigmatophora. Since that part of my report was completed, however, and sent to England, TOPSENT's latest work on the 'Sponges of the Azores' (**62**), has been received here. In this work the author describes two apparent Sigmatomonaxonellida in which asters were met with, viz., *Yvesia alecto* and *Leptosastra constellata*, but in neither of these are other microscleres present.

In *Yvesia alecto* the asters are, as TOPSENT himself shows, simply transformed megascleres (spined oxea) with the spines greatly developed, so that they are clearly of secondary origin. It may be pointed out, further, that an analogous transformation takes place in the echinating megascleres of the genus *Cyamon*,* and, probably, also in the genus *Trikentrion*, giving rise to spicules which simulate true asters. It appears, therefore, that in certain Sigmatomonaxonellida astrose spicules have arisen secondarily by transformation of spined megascleres. It is obvious, however, that these cases do not affect the primary division of the Monaxonellida here adopted.

The case of *Leptosastra constellata* offers a more serious difficulty, for here there is no indication that the asters, which form a superficial crust, are other than true astrose microscleres. It is, however, a suggestive fact that the sponge in which they occur is an Ectyonine with spined styli. Two explanations appear to me possible :—(1.) The asters may not belong to the same sponge as the megascleres. Considering the well-known and frequent accidental admixture of the spicules of different species, caused either by the sponges growing over one another or by the taking in of foreign spicules in the same way that grains of sand are taken in, and especially in view of the fact that only a single specimen of the sponge has been obtained; although TOPSENT has assured himself to the contrary, I venture to think that we may be here dealing with a composite spiculation. (2.) It is not impossible that the asters, if proper to the sponge, may be derived secondarily from the spined styli, in much the same way as in the genus *Cyamon*. Their position at the surface of the sponge, however, and their apparently normal form, are opposed to this view. However, until we have further evidence before us, it is quite unnecessary to allow this isolated case of a single specimen to make us alter our views on the classification of the Monaxonellida.

Assuming then that the Sigmatomonaxonellida are derived from the tetractinellid Sigmatophora, the question arises where are we to seek for the point of contact between the two groups? The answer to this question is easily given, for in the genus *Gellius* we have a near approach to the massive species of *Tetilla*, such as *T. limicola*. The replacement of the tetractinellid megascleres by oxea in a massive

* See later under *Cyamon*.

Tetilla, accompanied by the complete loss of the radiate skeleton arrangement, both of which changes are already partially accomplished in such forms as *T. limicola*, would give us a typical *Gellius*, and in *Gellius* I believe we have the starting point of the entire sigmatomonaxonellid series.

From this starting point the Sigmatomonaxonellida have branched off in various directions in the course of their evolution. Total loss of microscleres has given rise to forms with the spiculation composed entirely of oxeote megascleres, constituting the family Homorrhaphidæ of Ridley and Dendy, and the strong development of spongin cement has led to the evolution of the very large sub-family Chalininæ, from which in turn some of the so-called Ceratosa have been derived by total suppression of the spicules and their replacement by horny fibre. The arrangement of the megascleres in a characteristic plumose fashion, accompanied in most cases by the replacement of many of the oxea by styli and the loss of microscleres, has given rise to the family Axinellidæ. The development of a new type of microsclere—the chela—by modification of the sigma, has given rise to the great family group Desmacidonidæ, within which the Ectyoninæ have arisen by development of spined echinating spicules.

In the Report on the "Challenger" Monaxonida, published 17 years ago, Mr. Ridley and I proposed to divide the Sigmatomonaxonellida (= Halichondrina) into four families, viz., Homorrhaphidæ, Heterorrhaphidæ, Desmacidonidæ and Axinellidæ, an arrangement which has been variously modified by subsequent writers, chief amongst whom is Topsent. This author (**59**) has united our Homorrhaphidæ and Heterorrhaphidæ in one family which he terms "Haplosceridæ," a proceeding which appears to me justifiable in view of the obviously close relationship between the two, and especially in view of the fact that the Renierinæ and Chalininæ have very probably arisen independently from different though closely related genera, the Renierinæ from *Gellius* (and perhaps other genera), and the Chalininæ from *Gelliodes* and *Toxochalina*, as well as, perhaps, in some cases from Renierinæ.

Topsent has also proposed the name "Pœcilosceridæ" in replacement of "Desmacidonidæ"—a proceeding which appears quite unnecessary, although the extent of his family is not quite the same as that of ours.

I therefore propose in this Report to sub-divide the Sigmatomonaxonellida amongst three families, viz., Haplosceridæ (including the Homorrhaphidæ and Heterorrhaphidæ of Ridley and Dendy), Desmacidonidæ and Axinellidæ. The Haplosceridæ, there can be little doubt, should stand first, and indeed occupy the position of a parent group from which the other two families have descended.

Family: HAPLOSCLERIDÆ.

Sigmatomonaxonellida in which microscleres when present are usually in the form of sigmata, or derivatives thereof, but never chelæ. The skeleton is reticulate and the fibre is typically not plumose. The megascleres are usually diactinal.

The most primitive sub-family of this group is undoubtedly the Gelliinæ, from which the Renierinæ and Chalininæ are clearly derived. The other sub-families may be in part Desmacidonidæ which have lost their chelæ; this I am able in the present Report to demonstrate pretty clearly in the case of the Phlœodictyinæ, which I have accordingly removed. TOPSENT has already removed the Tedaniinæ, Desmacellinæ, and Hamacanthinæ as being Desmacidonidæ without chelæ; this may be quite right, but until clear evidence that they are descended from chela-bearing forms is forthcoming, it seems to me equally justifiable to leave them in the parent group. A *Desmacella*, for example, may very well be an *Esperella* which has lost its chelæ, but it seems at least equally probable that it has never reached the stage of having any.

SUB-FAMILY: GELLIINÆ.

Haplosceridæ with diactinal megascleres, and sigmata or toxa or microxea for microscleres.

Gellius, GRAY.

Gelliinæ with little or no spongin, the main skeleton being formed by a reticulation of oxea.

Gellius fibulatus (SCHMIDT).

1862, **Reniera fibulata**, SCHMIDT (**47**); 1880, **Reniera fibulifera**, CARTER (**4**); 1892, **Gellius fibulatus**, TOPSENT (**48**).

There is in the collection a considerable quantity of this sponge growing amongst the branches of a Floridean Alga. I identify it with the European species by direct comparison with a preparation from a specimen from Budleigh Salterton in Mr. CARTER's cabinet. The differences in spiculation are very slight. In our specimen the slightly curved and gradually sharp-pointed oxea measure about 0·184 millim. by 0·007 millim., and the sigmata about 0·02 millim. from bend to bend.

R.N. 51 (Gulf of Manaar); 299; 348; 350 (all growing in association with apparently the same kind of alga; the last three probably fragments of one and the same specimen).

Gellius angulatus (BOWERBANK), var. **canaliculata**, nov.—Plate IX., fig. 7.

[For synonymy and references *vide* RIDLEY and DENDY (**1**)].

The single specimen is massive, rounded and slightly elongated, about 18 millims. long by 12 millims. in transverse diameter. It was probably attached by one end, and bears a group of vents at the other. The surface is even and smooth, conspicuously veined by ramifying exhalant canals, which run towards the (upper ?) end of the specimen and open there by means of the moderate-sized vents. Many of these exhalant canals lie just beneath the surface and are covered over only by a thin, translucent membrane, which easily gets rubbed off, leaving the canals as open grooves. Between the exhalant canals there is no separable dermal membrane, and there are no conspicuous sub-dermal cavities. Texture between the canals very compact, but not very hard and rather friable. Colour (in spirit) very pale grey.

The skeleton is a very close and pretty uniform reticulation of single oxea, crossing one another in every direction. The dermal skeleton consists only of scattered oxea placed tangentially.

Spicules.—(1.) Oxea (Plate IX., fig. 7, *a*); rather slender, slightly curved, usually somewhat abruptly or even hastately pointed; about 0·25 millim. by 0·008 millim. to 0·01 millim.

(2.) Sigmata (Plate IX., fig. 7, *b*); slender, C-shaped, with shortly and sharply incurved and sharply pointed ends; often with a slight indication of enlargement or angulation near the middle; measuring about 0·028 millim. from bend to bend when full grown.

(3.) Toxa (Plate IX., fig. 7, *c*); rather short and moderately stout; sharply angulated in the middle and only slightly recurved at the extremities; length up to about 0·044 millim.

This is a pretty little sponge, evidently very nearly related to the European *Gellius angulatus*, from which it differs in the somewhat shorter oxea, the considerably larger sigmata, and the much shorter toxa. It is possible also that the arrangement of the exhalant canals may be characteristic. It is interesting as indicating that sigmata and toxa are simply slightly different modifications of the same form of microsclere.

R.N. 140 (deep water off Galle and onwards up West Coast of Ceylon).

Gelliodes, Ridley.

Gelliinæ with much spongin, more or less completely enveloping or even replacing the megascleres and forming distinct fibres. The microscleres are sigmata.

Gelliodes carnosa, Dendy—Plate VII., fig. 5.

1889, **Gelliodes carnosa,** Dendy (**3**).

There is one fine specimen of this sponge in the collection, easily recognized by its characteristic external form (Plate VII., fig. 5). The megascleres are much slenderer than in the types and appear to be becoming vestigial, as in so many chalinine sponges, being functionally replaced by the strongly developed horny fibre. The sigmata are still numerous, about 0·02 millim. long, but very slender.

This species forms a conspicuous feature of the Ceylon Sponge-Fauna.

R.N. 69 (Stat. XXVII., Cod Bay, Trincomalee, 5 fathoms; also Gulf of Manaar).

Gelliodes incrustans, n. sp.—Plate IX., fig. 6.

Sponge thin, encrusting; the single specimen growing over both valves of a *Pecten* (which was evidently alive when collected). Maximum thickness about 7 millims.

Surface smooth, but rather uneven. Vents numerous and conspicuous, circular, from about 1 millim. to 2·5 millims. in diameter; mostly flush with the surface, but occasionally on low prominences. Colour (dry) dull greyish-brown, with a purplish tinge in places, which seems to indicate that it was purple in life. Texture (dry) compressible and resilient, but rather stiff.

The main skeleton is a rectangular-meshed network of horny fibre cored by spicules, in which the meshes vary greatly in size. The principal fibres are about 0·033 millim. in diameter, and contain a multispicular core of small oxea which occupy only about one-third (or less) of the total thickness of the fibre. The secondary fibres are more slender and contain fewer spicules. The dermal skeleton (Plate IX., fig. 6) is, for the most part, a unispicular reticulation of oxea with comparatively little spongin; sometimes one sees brushes of projecting oxea, but I am not sure how far these are proper to the dermal skeleton.

Spicules.—(1.) Oxea (Plate IX., fig. 6, *o*); short, slender, slightly curved, subfusiform, gradually and sharply pointed at each end; size about 0·1 millim. by 0·004 millim. A number of very slender, hair-like oxea, probably young or vestigial forms, also occur.

(2.) Sigmata (Plate IX., fig. 6, *s*); very slender and hair-like, C-shaped, up to about 0·02 millim. from bend to bend. Abundant.

This species is nearly related to *Gelliodes licheniformis* (LAMARCK),* but differs, at any rate from the "Challenger" specimen of that species, both in external form and in the much smaller size of the spicules and more regular arrangement of the skeleton.

R.N. 112 (Gulf of Manaar, dry).

Gelliodes petrosioides, n. sp.—Plate IX., fig. 3.

Sponge massive, depressed, cushion-shaped; flattened below, where it has apparently been attached by a broad base; evenly rounded off and strongly convex above. Surface coarsely granular, not hispid. Vents not visible. Pores numerous, scattered in the thin dermal membrane which roofs over the numerous small, rounded subdermal cavities. Colour (in spirit) pale yellowish-grey. Texture compact; hard and almost stony. Greatest diameter of specimen, which is irregularly rounded in outline, about 24 millims.

The main skeleton is a very dense but quite irregular reticulation of very coarse, stout, densely spicular fibre, with a great many loose megascleres scattered between. The stout fibres have a thickness of about 0·164 millim., and probably contain a certain amount of spongin, which, however, is not visible in ordinary sections. The dermal skeleton cannot be sharply distinguished from the main skeleton, and consists of an irregular reticulation of coarse spicular fibre, the interspaces in which are occupied by the thin, pore-bearing dermal membrane.

* *Vide* RIDLEY and DENDY, '"Challenger" Monaxonida,' p. 48.

Spicules.—(1.) Short, stout, fusiform, slightly curved oxea (Plate IX., fig. 3, *a*, *b*, *c*), usually sharply and fairly gradually pointed at each end (often becoming strongylote or stylote); measuring about 0·25 millim. by 0·017 millim., but varying a good deal in thickness.

(2.) Sigmata (Plate IX., fig. 3, *d*); slender, C-shaped or contort, about 0·022 millim. from bend to bend; very numerous.

Were it not for the presence of the sigmata, this species would be a typical *Petrosia.* It appears to be very nearly related to TOPSENT'S *Gelliodes fayalensis*,* from the Straits of Pico-Fayal, but is distinguished by the absence of the large oscula, and, perhaps, by other characters.

R.N. 146 (deep water off Galle and onwards up West Coast of Ceylon).

Gelliodes petrosioides, var. **fibrosa**, nov.

I propose this name, at any rate provisionally, for a single small, much-damaged specimen of irregular shape and cavernous structure, with large exhalant canals and vents (?) and very soft, fibrous texture; agreeing very closely with the type of the species in spiculation and in the structure of the main skeleton fibres, but with the fibres better defined and the meshes of the reticulation mostly very wide and not filled up by scattered spicules. The soft texture of the specimen, which is in striking contrast with the hardness and density of the type, is due simply to this greater laxity in the skeleton arrangement.

Except for the presence of the sigmata, this variety closely resembles a *Pachychalina.* It may ultimately, when better specimens are forthcoming, have to be considered as a distinct species.

R.N. 272 (deep water off Galle and onwards up West Coast of Ceylon).

Toxochalina, RIDLEY.

Gelliinæ with much spongin, more or less completely enveloping or even replacing the megascleres, and forming distinct fibres. The microscleres are toxa.

This genus differs from *Gelliodes* only in the replacement of the sigmata by toxa, and in view of the occurrence of both these forms in the same species of *Gellius* (*vide* under *Gellius angulatus*, var. *canaliculata*), it may be questioned whether the two should be kept distinct. They are interesting as forming an obvious starting point in the evolution of the great sub-family Chalininæ.

Toxochalina robusta, RIDLEY.

1884, **Toxochalina robusta**, RIDLEY (**16**).

There are a number of specimens of this sponge in the collection, agreeing closely, both as regards external form and skeletal characters, with RIDLEY'S description of the type from Port Jackson. It is perhaps noteworthy, however, that the megascleres

* TOPSENT (**48**), p. 78.

are abundant *between* the stout horny fibres, as well as (sometimes) in their axes. The species has also been recorded from off Bahia (" Challenger ").

R.N. 8, 9, 38 (all three from Gulf of Manaar); 351 (Ceylon seas).

Toxochalina robusta, var. **ridleyi**, nov.—Plate IX., fig. 2.

The type specimen is very irregular in shape; massive and angular, with a slight tendency towards branching. It has evidently been attached by a broad base to one valve of a Lamellibranch shell (? *Margaritifera vulgaris*), the impress of which is still clearly visible. The surface is smooth and sub-glabrous, but uneven and very distinctly granular when viewed under a lens. The vents are rather numerous (five), about 4 millims. in diameter, with very prominent margins; each is the opening of a wide, deep oscular tube of the same diameter as itself. The texture (in spirit) is compressible and resilient, but stiff and tough. Colour, pale brown. The specimen is about 66 millims. long, 38 millims. broad, and 31 millims. high.

The main skeleton is a reticulation of horny fibre, with very few and slender spicules (Plate IX., fig. 2). The primary fibres are very stout, sometimes as much as 0·164 millim. in diameter, but very variable; typically they run at right angles to the surface and are united by short secondaries to form rectangular meshes, but the network often becomes very irregular and the size of the meshes is very variable. The secondary fibres are usually, but not always, more slender than the primaries. The primaries are cored by a multispicular axis of slender oxea arranged in a plumose manner (as in typical Axinellidæ), but all entirely enveloped in spongin to such an extent that the entire column of spicules only occupies one-third (or less) of the thickness of the fibre. The secondary fibres contain only a few isolated spicules arranged uniserially.

The dermal skeleton consists of a rather close-meshed reticulation of rather slender, unispicular horny fibre. From the nodes of this reticulation brushes of oxeote spicules project vertically. In certain places this dermal skeleton appears to become many layers deep, and the vertical brushes of oxea are continued inwards as more or less plumose columns enveloped in spongin and connected by numerous unispicular cross-fibres, so as to form a close skeleton network beneath the surface, very conspicuous in vertical section, and strongly contrasted with the much coarser, more widely meshed and less abundantly spicular main skeleton below it.

Spicules.—(1.) Oxea (Plate IX., fig. 2, *o*); short and rather slender, slightly curved, fairly gradually sharp-pointed at each end; measuring about 0·08 millim. by 0·004 millim. near the surface, but usually smaller, and especially more slender, in the fibres of the main skeleton. These spicules—at any rate, in the main skeleton—are evidently becoming vestigial.

(2.) Toxa (Plate IX., fig. 2, *t*); slender, more or less strongly curved in the middle, very slightly re-curved at the apices; sometimes slightly roughened in the middle, gradually sharp pointed at the ends; size varying up to about 0·08 millim. (in a straight line from end to end) by 0·002 millim. (in the middle); very abundantly distributed through the soft tissues in association with scattered oxea.

R.N. 109 (Gulf of Manaar. Type); 306 (Stat. XXIV., off Trincomalee).

Strongylophora, n. gen.

Gelliinæ with the skeleton composed of a reticulation of strongyla of various sizes, partly collected in fibres, but with little (if any) spongin. With microscleres in the form of smooth microxea, chiefly found in the dermal membrane.

This is a remarkable genus of somewhat doubtful systematic position. The presence of the fusiform (and often angulated) dermal microxea suggests an affinity with the Homosclerophora and Pachastrellidæ amongst the Tetractinellida, rather than with the Sigmatophora. We cannot, however, lay very much stress upon this character when we remember the generalized character of microxea and the fact that such spicules also occur in the Ectyonine genus *Fusifer* (*vide* DENDY, **10**).

Strongylophora durissima, n. sp.—Plate IX., fig. 1.

Sponge massive, irregular; may be depressed and cake-like or subcylindrical and slightly ramose. Surface very uneven, sometimes with angular grooves and ridges, giving it a curious crumpled appearance; minutely and uniformly granular. Vents few, scattered; circular and often rather large, up to about 4 millims. in diameter; each the opening of a wide cylindrical oscular tube which runs vertically inwards for a considerable distance. Inhalant pores minute, abundantly scattered in the meshes of the dermal reticulation. Colour (in spirit) greyish-brown throughout. Texture hard and stony, but brittle, and rather cavernous internally owing to the presence of the numerous canals of varying diameter. The larger of the two specimens measures about 45 millims. in maximum diameter.

The main skeleton is an irregular but fairly close-meshed and, towards the surface, sub-rectangular reticulation of more or less stout spicular fibre composed of closely packed strongyla, with numerous loose strongyla scattered between the fibres. The dermal skeleton (Plate IX., fig. 1) is a reticulation of mostly large and single strongyla; their ends come in contact with one another, many together, at the principal nodes of the reticulation, from which they radiate, and at each of these nodes there is also a little heap of very short strongyla. The presence of these nodal heaps gives the characteristic granular appearance to the surface of the sponge.

Spicules.—(1.) Strongyla (Plate IX., fig. 1, *s.*); usually stout, more or less curved or angulated in the middle; evenly rounded off at each end; ranging in size from about 0·026 millim. by 0·006 millim. (or perhaps even less) to about 0·26 millim. by 0·02 millim. (A few long and very slender spicules, oxeote and strongylote, occur in the interior of the sponge; they are probably abnormal forms of the strongyla, with which they are connected by intermediates.)

(2.) Microxea (Plate IX., fig. 1, *m.*); fusiform and usually angulated in the middle, from which they taper gradually to a very sharp point at each end; size fairly uniform, about 0·028 millim. by 0·002 millim. Very abundant in the thin transparent dermal membrane in the meshes of the dermal skeleton; also found less frequently in the interior of the sponge.

R.N. 156; 244 (Ceylon seas).

Sub-Family: RENIERINÆ.

Haploscleridæ in which the microscleres have entirely disappeared and the skeleton consists of a reticulation of oxeote megascleres with little or no spongin.

This sub-family is apparently derived from the Gelliinæ by loss of microscleres. Inasmuch, however, as the microscleres constitute the most important guides to the classification of monaxonellid sponges, their total loss may in certain cases leave one in considerable doubt as to the true systematic position of the species concerned. The close relationship of *Reniera* to *Gellius* I take to be fully established by the form of the megascleres and by their arrangement. In the genus *Halichondria*, on the other hand, there appears to me to be less certainty, and the long, slender, slightly curved form and confused arrangement of the oxea suggest a possible origin from some astromonaxonellid genus, such as *Coppatias*, by loss of the astrose microscleres. It is impossible in the present state of our knowledge to decide this question definitely, but it is quite likely that, as regards the genera *Reniera* and *Halichondria*, we are dealing with a case of convergent evolution rather than of close genetic relationship.

Reniera, Nardo.

Renierinæ in which the skeleton is composed of a close reticulation of usually single megascleres, each forming one side of a rectangular, triangular or polygonal mesh. Spicules short, oxeote or strongylote, usually united together at the ends only by spongin cement.

Reniera implexa, Schmidt.

1868, **Reniera implexa**, Schmidt (**50**); 1887, **Reniera implexa**, Ridley and Dendy (**1**).

I identify with this species a single small specimen consisting of a few irregularly branched tubes, mostly about 5 millims. in diameter and widely open at the end. The surface has a minutely reticulate or porous appearance. The colour (in spirit) is brownish-yellow, and the consistence very soft, compressible and tender.

The skeleton is a rather irregular, triangular-meshed reticulation, for the most part of single spicules, with occasional loose plurispicular bands feebly developed.

The spicules are slender, slightly curved oxea, gradually sharp-pointed at each end and measuring up to about 0·136 millim. by 0·004 millim., usually perhaps a little less.

This species has been recorded from the Adriatic by Schmidt, and from the Azores by Ridley and Dendy (**1**) and Topsent (**62**).

R.N. 201 (Stat. LXIV., south of Modragam Paar, 5 fathoms, March 17, 1902).

Reniera pigmentifera, n. sp.—Plate IX., fig. 10.

This species is represented in the collection by a large number of small fragments which may perhaps represent only a single specimen. The external form appears to have been more or less flabellate, with rounded margin. The vents are about 2 millims. in diameter and appear to have been scattered singly along the margin (and elsewhere ?). The surface has a porous appearance to the naked eye, and is very minutely hispid. The colour (in spirit) is dark brown throughout, sometimes with a purplish tint, and the texture is very soft and crumbling.

The skeleton is an irregular "Isodictyal" network of short spicules, sometimes connected together at their ends by spongin cement; primary fibres, from one to about three spicules in thickness, are recognisable in places. There is no distinct dermal skeleton.

Spicules.—(1.) Oxea (Plate IX., fig. 10, *a*); slightly curved and gradually sharp pointed at each end; measuring about 0·144 millim. by 0·007 millim., but often much more slender.

(2.) Strongyla (Plate IX., fig. 10, *b*); stout, very slightly curved, broadly rounded off at each end; variable in length, up to about 0·12 millim. by 0·009 millim.; may be shorter and at the same time somewhat stouter.

(3.) Styli (Plate IX., fig. 10, *c*, *d*); short and stout, very similar in size and shape to the strongyla, but pointed at one end. Of course, intermediate forms of spicules also occur.

A remarkable feature of this sponge is the immense number of granular, brown or purple-coloured pigment cells which it contains. These cells are rounded in outline and about 0·002 millim. in diameter, and are thickly scattered all through the sponge.

R.N. 290 (numerous fragments. Jokkenpiddi Paar, 10 fathoms).

Reniera zoologica, n. sp.—Plate IX., fig. 8.

The single specimen appears to be half of a pear-shaped sponge which has been torn in two longitudinally. It has probably been fixed by the narrower end, and bears a single rather large vent (?) opening out of a wide oscular tube near the broad upper end. The surface is encrusted with large Foraminifera and sand-grains. The colour (in spirit) is pale grey, and the texture (internally) crumb-of-bread-like. Total height of specimen 34 millims., greatest breadth about 20 millims.

The main skeleton is an irregular network of spicules, partly arranged singly in an "Isodictyal" manner and partly collected in irregular multispicular bands. No spongin cement is recognisable in my preparation.

The dermal skeleton is a dense but thin layer of oxea, lying very close together and crossing one another in all directions parallel with the surface.

Spicules.—Oxea (Plate IX., fig. 8); moderately stout, slightly curved, gradually sharp pointed at each end; size when fully developed about 0·18 millim. by 0·007 millim. Numerous very slender forms, probably young, also occur.

R.N. 262 (Gulf of Manaar).

Reniera, sp. ?

A small massive specimen with a couple of short, mammiform, vent-bearing projections. Surface smooth. Colour (in spirit) pale yellow; texture compact and firm, but brittle.

Main skeleton a compact, irregular, "Isodictyal" reticulation of spicules without any fibres. Dermal skeleton a dense but thin layer of tangentially placed oxea crossing one another in all directions parallel with the surface.

Spicules.—Oxea; slightly curved, usually gradually sharp-pointed at each end; occasionally strongylote; size about 0·164 millim. by 0·008 millim.

This species may possibly be identical with one of the numerous imperfectly known European species of *Reniera* (*Isodictya*).

R.N. 232 (deep water off Galle and onwards up West Coast of Ceylon).

Petrosia, Vosmaer.

Renierinæ usually of hard or even stony texture, owing to the density of the skeleton, which is composed of an irregular reticulation of oxeote or strongylote megascleres (usually short and thick), packed close together, sometimes in stout fibres.

Those species of this genus which have a more or less fibrous skeleton make a close approach to the genus *Pachychalina*.

Petrosia testudinaria (Lamarck).

[For literature and synonymy *vide* Dendy (**3**).]

This handsome sponge (see text-figure 1) has been recorded from Queensland (Ridley)

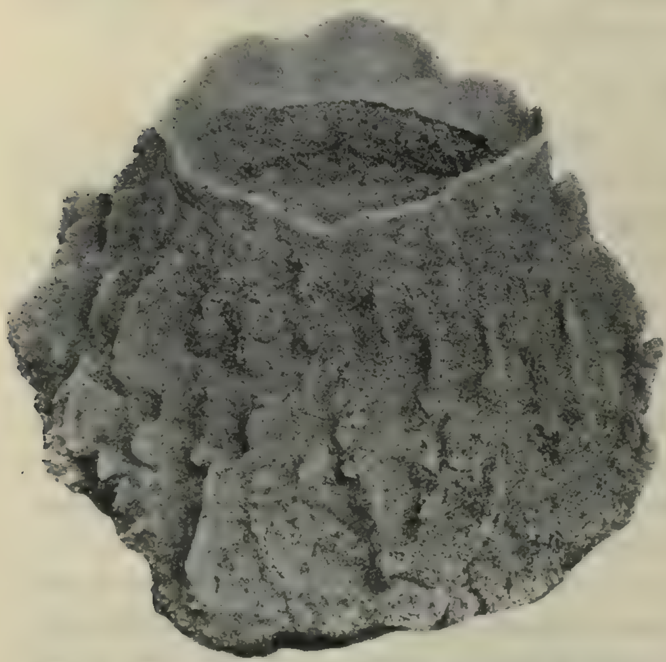


Fig. 1. *Petrosia testudinaria* (Lamk.), Gulf of Manaar; reduced one-half.

Fig. 2. Pearl-oyster shell honeycombed by *Cliona margaritifera* Dendy (see p. 128).

and from the Mergui Archipelago (Carter, Dendy), as well as from the Gulf of Manaar (Dendy).

R.N. 42 (Stat. LXI., Gulf of Manaar); 238 ? (deep water off Galle; fragments).

Petrosia similis, Ridley and Dendy.

1887, **Petrosia similis**, Ridley and Dendy (1).

There are in the collection a number of irregular, massive or more or less lobate specimens, with numerous rather large, scattered vents, which I refer to this species. The spicules measure about 0·22 millim. by 0·014 millim. The character of their ends varies greatly, from strongylote to apiculate and sharp-pointed.

The species was originally obtained by the "Challenger" from south of the Cape of Good Hope and between Kerguelen and Heard Islands.

R.N. 12, 61 (both from Gulf of Manaar); 289; 327 (Ceylon seas).

Petrosia similis, var. **delicatula**, nov.

This variety is distinguished from the typical form of the species by its more delicate texture and smaller vents, which are usually more or less blocked up by a strong development of gelatinous tissue. The spiculation differs little, if at all, from that of the types.

R.N. 84, 133, 276 (all from deep water off Galle and onwards up West Coast).

Petrosia similis, var. **halichondrioides**, nov.

In external appearance this variety closely resembles *P. similis*, var. *delicatula*. The single specimen is strongly compressed, with the rather small but conspicuous and widely open vents placed on prominent ridges. The texture (in spirit) is firm and compact, but brittle. The skeleton is very confused and dense, without distinct fibres, and the spicules are much more slender and *Halichondria*-like than in the typical form, being gently curved oxea, for the most part gradually sharp-pointed at each end, and measuring, say, about 0·2 millim. by 0·006 millim.

R.N. 79 (Gulf of Manaar).

Petrosia densissima, n. sp.—Plate IX., fig. 9.

Sponge massive, sub-conical, attached by the broad base; with rather irregular surface bearing feebly developed, meandering grooves. Surface minutely granular, without distinct dermal membrane, slightly sandy. Vents very small and scattered. Colour (in spirit) rather dark greyish-brown on the surface; pale yellowish-grey internally. Texture extremely compact and hard; stony; incompressible. The larger of the two specimens (R.N. 138A) measures about 40 millims. in height by 42 millims. in greatest breadth.

The skeleton is extraordinarily dense and compact, consisting of a sub-rectangular-meshed reticulation of very stout spicular fibres, in which both primary and secondary fibres are about as thick as the width of the meshes between them, say about

0·13 millim. The fibres are compact, but the arrangement of the spicules in them is very confused and there is no visible spongin. Many spicules occur scattered irregularly between the fibres, so that the whole skeleton forms an almost solid mass of spicules. There is no special dermal skeleton.

Spicules.—Stout, fusiform oxea (Plate IX., fig. 9); slightly curved and usually sharply and fairly gradually pointed; size when fully developed about 0·24 millim. by 0·02 millim., but with numerous smaller forms which are presumably young.

This species is evidently very closely related to THIELE'S *Petrosia imperforata* from Celebes (**39**).

R.N. 138, 138A (both from deep water off Galle and onwards up West Coast of Ceylon).

Halichondria, FLEMING.

Renierinæ in which the skeleton consists of a confused reticulation of long and slender oxea (or strongyla) with little or no spongin; the spicules sometimes associated in ill-defined bands or fibres.

I have already indicated the doubt which exists as to the true relationship of this genus. Possibly it is, as at present understood, of polyphyletic origin, including species derived from several ancestral forms by loss of microscleres.

Halichondria panicea, JOHNSTON.

[For literature and synonymy *vide* RIDLEY and DENDY (**1**) and DENDY (**2**).]

This widely distributed species is represented in the collection by two well differentiated form-varieties, so that it seems desirable to distinguish them by varietal names. In both varieties many of the more superficial oxea are arranged more or less at right angles to the surface, with their apices projecting to a greater or less extent, thus making an approach to the genus *Trachyopsis.* In both the full-grown spicules measure up to about 1·0 millim. in length and are of the usual *Halichondria* type. Their arrangement in the interior of the sponge is quite irregular and confused.

Halichondria panicea, JOHNSTON, var. **megalorhaphis**, CARTER.

1881, **Amorphina megalorhaphis**, CARTER (**5**).

This variety is irregularly encrusting, growing out into lobose or digitiform processes, and with small scattered vents.

R.N. 87, 231, 248 (all from deep water off Galle and onwards up West Coast).

Halichondria panicea, JOHNSTON, var. **hemispherica**, nov.

This variety is massive and compact, more or less hemispherical or cushion-shaped, with vents usually arranged in conspicuous groups on the convex upper surface. It attains a considerable size, the largest specimen measuring about 100 millims. in greatest diameter and about 40 millims. in thickness in the middle.

R.N. 67 (Gulf of Manaar); 96 (Gulf of Manaar, dry); 141 ?, 142 (both from deep water off Galle and onwards up West Coast); 249 (Stat. XV., Periya Paar).

Trachyopsis, n. gen.

Renierinæ in which the main skeleton is composed of a dense, irregular network of oxea, while the surface is protected by similar (or perhaps more slender) spicules arranged in dense vertical brushes, which support the pore-bearing dermal membrane.

This genus is of somewhat doubtful systematic position; in certain features it recalls the genera *Trachya* and *Spongosorites*, and it differs from typical Renierinæ in the replacement of the reticulate dermal skeleton characteristic of that group by radially arranged brushes of oxea.

Trachyopsis halichondrioides, n. sp.—Plate X., fig. 10.

Sponge massive (or thickly encrusting ?); upper surface slightly convex, rising up at irregular intervals into a few short, thick-walled, cylindrical, tubular processes, each terminated by a single circular vent. General surface smooth and almost glabrous, but uneven; very minutely reticulate as seen under a lens. Inhalant pores minute and scattered. Colour in spirit, pale yellowish-grey. Texture of body hard and compact, penetrated by numerous narrow vertical canals. Greatest diameter of specimen, which is irregular in outline, 44 millims.; thickness about the middle 15 millims. (but the specimen has evidently been cut off from its base). Height of largest projection about 8 millims.; diameter in the middle about 5·5 millims.; diameter of the vent at its apex 2·5 millims.

The main skeleton is an extremely dense and very irregular reticulation of stout oxea, with a tendency to arrange themselves in ill-defined tracts running towards the surface. Immediately beneath the surface the oxea, here perhaps somewhat more slender than usual, are arranged in dense brushes perpendicularly to the dermal membrane, beyond which their apices may project very slightly.

Spicules.—Oxea (Plate X., fig. 10); short, usually stout, sub-fusiform, gently curved or (often) biangulate, fairly gradually and sharply pointed at each end; size, when fully developed, about 0·64 millim. by 0·0328 millim.; frequently more slender.

R.N. 147 (deep water off Galle and onwards up West Coast of Ceylon).

SUB-FAMILY: CHALININÆ.

Haplosceridæ without microscleres and with diactinal megascleres. Skeleton a network of more or less strongly developed horny fibre cored by megascleres.

It is highly probable that this sub-family is of polyphyletic origin, being derived from several genera of Gelliinæ and Renierinæ by loss of microscleres and strong development of spongin. Some species have probably been derived from *Toxochalina* and *Gelliodes* simply by loss of microscleres, the horny fibre being already strongly developed in those genera, while others have probably arisen from *Reniera* and *Petrosia* simply by strong development of the horny fibre, the microscleres having been already lost.

The excessive development of spongin appears to have taken place independently in many genera, and this fact, coupled with the loss of the characteristic microscleres and the uniform character of the megascleres, renders it extremely difficult to arrive at a natural classification of the Chalininæ.* The subject is, however, much too complex to be discussed here at length, especially as there are not a very large number of species in the collection. For our present purposes it will suffice to make use of the established genera, *Pachychalina*, *Chalina*, *Ceraochalina*, and *Siphonochalina*, without committing ourselves to an expression of opinion as to their genetic relationships. Owing to their degenerate character, it is impossible to define even these in such a way as to distinguish them quite sharply from one another.

Pachychalina, Schmidt.

Chalininæ of various external form, lobose or digitate, not tubular; with stout skeleton fibres, containing very numerous well developed spicules arranged multiserially.

Pachychalina subcylindrica, n. sp.—Plate X., figs. 1, 2.

Sponge elongated, rather slender, irregularly cylindrical or angular, probably branched and repent. Surface fairly smooth but uneven, with a very few coarse aculeations; minutely reticulate to the naked eye. Vents fairly large (about 2·25 millims. in diameter), irregularly scattered, with slightly prominent margins. Colour (in spirit) light brown. Texture compressible, resilient, rather coarsely fibrous, but somewhat fragile. The largest piece measures about 95 millims. in length, with a very variable thickness up to about 9 millims.

The main skeleton is a sub-rectangularly meshed network of very stout multispicular fibre, about 0·066 millim. in diameter; with meshes varying greatly in size, and with numerous spicules scattered irregularly between the fibres. The fibres themselves contain a very large number of spicules, but no visible spongin. The dermal skeleton (Plate X., fig. 1) is an irregular, polygonal-meshed network of similar coarse multispicular fibre.

Spicules.—Oxea (Plate X., fig. 2); more or less curved or angulated; when fully developed stout and very sharply pointed at each end; measuring about 0·14 millim. by 0·008 millim. Numerous slender forms also occur, probably immature.

In the feeble development of the spongin this species occupies an intermediate position between the genus *Petrosia* and the more typical Chalininæ.

R.N. 292; 360 (Stat. II., north of Negombo, 9 fathoms).

* Compare Lendenfeld (**51**) and Dendy (**63**). In the paper referred to I have explained the reasons why I cannot accept Lendenfeld's classification of the Chalininæ.

Pachychalina delicatula, Dendy.

1889, **Pachychalina delicatula,** Dendy (**3**).

With this species I identify three specimens, all characterized by their great softness and delicacy of texture, but all containing a good deal of sand.

R.N. 55, 264 (both from Gulf of Manaar); 364 (Stat. I., hauls 1–4, January 31, 1902, Colombo to Negombo, 12 to 20 fathoms).

Pachychalina brevispiculifera, n. sp.—Plate X., fig. 7.

The single specimen is compressed, digitate to flabellate (presumably erect), branching and anastomosing. The branches or fronds are sometimes narrow and sometimes broad, but always greatly flattened, and only about 6 millims. in thickness. The surface is beset with small conical aculeations, which form the principal nodes in a very strongly developed dermal skeletal reticulation. Vents rather large (about 4 millims. in diameter) but very shallow; numerous, but confined almost or quite entirely to one of the flattened sides of the frond or branch. Colour (in the dry state) light brown; texture coarsely fibrous, compressible, resilient, fragile. The single specimen measures about 120 millims. in height by 110 millims. in greatest width.

The main skeleton is a very coarse, sub-rectangularly or irregularly meshed network of very stout horny fibre almost filled with well developed and very abundant spicules arranged multiserially in all the fibres. The primary fibres, running lengthwise through the branches, measure up to about 0·164 millim. in thickness, and the secondaries are sometimes nearly as stout, though usually a good deal slenderer. Sometimes two or more primary fibres run close together side by side, connected with one another at frequent intervals by numerous very short secondaries. The dermal skeleton is a coarse, irregular reticulation of similar fibre, varying greatly in thickness and with meshes of varying diameter. The fibres, especially those of the dermal skeleton, are occasionally echinated by projecting oxea.

Spicules.—Oxea (Plate X., fig. 7); slightly curved; sub-fusiform; short, stout and sharp-pointed at each end; measuring about 0·1 millim. by 0·0055 millim.

R.N. 110 (Gulf of Manaar, dry).

Pachychalina spinilamella, Dendy—Plate VII., fig. 4.

1889, **Pachychalina spinilamella,** Dendy (**3**).

I identify with this species a number of specimens of somewhat variable external form, but all characterised by their strongly conulose surface and with closely similar skeleton arrangement. A fairly typical example is represented in Plate VII., fig. 4. R.N. 14, 296 and 326 are characterised by their more slender, irregularly branching form and smaller vents.

R.N. 14, 25, 94 (Periya Paar, &c., Gulf of Manaar); 172, 296, 326 (Ceylon seas).

Chalina, Grant.

Chalininæ of various external form; not tubular. Skeleton reticulation typically rectangular; fibres usually slender, with much spongin and few but usually well developed spicules.

Chalina subarmigera (Ridley)—Plate X., fig. 5.

1884, **Cladochalina subarmigera,** Ridley (**16**); 1887, **Chalinopora subarmigera,** Lendenfeld (**51**); 1898, **Chalina subarmigera,** Lindgren (**86**).

This species is represented in the collection by two specimens, which agree very well with Ridley's original description, except that the margins of the vents are slightly prominent and there are fewer spicules in the fibres of the main skeleton. The characteristic external form is shown in Plate X., fig. 5.

The species was obtained by the "Alert" in Torres Straits and at Albany Island (north coast of Australia), and has also been recorded by Lendenfeld from Port Jackson, and by Lindgren from the Coast of Cochin China.

R.N. 116 (Gulf of Manaar, dry); 288 (Ceylon seas).

Chalina obtusispiculifera, n. sp.—Plate X., fig. 9.

Sponge elongated, slender, cylindrical; may be irregularly branched (? erect or repent). Surface even, very minutely hispid in its present condition. Texture (in spirit) soft and resilient, but fairly tough. Colour pale yellowish-brown. Vents and pores not seen. The largest specimen (R.N. 370) is about 130 millims. long by 3·5 millims. in diameter.

The skeleton is a well-developed reticulation of pale-coloured horny fibre cored by strongyla. The principal fibres run lengthwise through the sponge, branching as they go, and the branches curve outwards towards the surface; they are connected by short secondary fibres to form an irregular network. The principal fibres are about 0·04 millim. in diameter and contain many spicules arranged multiserially as well as much spongin extending well beyond the spicular core. The secondary fibres are only about half as thick and contain fewer spicules. There is no specially differentiated dermal skeleton, unless we consider the outermost secondary fibres of the main skeleton as such (Plate X., fig. 9).

Spicules.—Cylindrical strongyla (Plate X., fig. 9); broadly rounded off at each end, never pointed; nearly straight; measuring up to about 0·12 millim. by 0·007 millim., but frequently much more slender.

This species is easily recognised by its external form and blunt cylindrical spicules. Both specimens are more or less washed out and contain numerous foreign spicules and other débris. In R.N. 285 none of the spicules appear to attain as great a thickness as that given above for the type.

R.N. 285 (deep water off Galle and onwards up West Coast); 370 (deep water outside pearl banks, Gulf of Manaar).

Chalina clathrata, n. sp.—Plate X., fig. 3.

Sponge massively encrusting, the single specimen being attached to the valve of a *Pinna;* clathrous; with very uneven surface proliferating into numerous small, blunt outgrowths. Vents numerous and large (up to about 8 millims. in diameter), scattered singly, each at the end of a short tubular projection and forming the termination of a wide cylindrical oscular tube. Surface minutely reticulate. Texture very delicate, soft, compressible, resilient; colour (after drying) light yellowish-brown, with a tinge of purple. The single specimen measures about 220 millims. in maximum diameter.

The main skeleton is a sub-rectangularly or irregularly meshed network of very pale-coloured horny fibre. The fibre varies greatly in diameter (averaging, say, about 0·025 millim.) and contains very few spicules, arranged for the most part uniserially and absent altogether in places. The dermal skeleton is a close, polygonally or rectangularly meshed network of horny fibre cored by uniserially arranged spicules; the fibres being about 0·0165 millim. in diameter and the meshes about 0·1 millim. in diameter.

Spicules.—Very slender, usually slightly curved oxea or strongyla, measuring about 0·112 millim. by 0·002 millim., occurring in and between the fibres and often reduced to vestiges (Plate X., fig. 3).

With its large prominent vents and deep oscular tubes this species makes an approach to the genus *Siphonochalina*, while its massive (though clathrous) form recalls Ridley's *Acervochalina.*

R.N. 102 (Gulf of Manaar, dry).

Chalina cymæformis (Esper ?).

? 1798–1806, **Spongia cymæformis**, Esper (**6**); ? 1870, **Spongia cymæformis**, Ehlers (**58**).

Sponge shortly stipitate, bushily lamellar or frondose or sub-digitate. Lamellæ about 9 millims. thick, with broadly rounded margins. Surface rather uneven, minutely conulose, especially where the dermal membrane has been rubbed off. Vents small (about 2 millims. in diameter), more or less abundantly scattered, chiefly on the inner surfaces of the lamellæ. Inhalant pores scattered in the dermal membrane. Texture (in spirit) soft and compressible, but very tough and resilient; rather woolly. Colour brown. The most typical specimen (R.N. 16) is about 67 millims. high by 90 millims. in greatest breadth, with a stalk about 22 millims. high and 18 millims. thick. It bears a very close resemblance to the figure of *Chalina palmata*, given by Ridley and Dendy (1), as well as to Esper's figure of his *Spongia cymæformis* (Plate 69).

The main skeleton consists of what, at first sight, look like rather slender, ill-defined, plurispicular fibres running towards the surface at irregular intervals and branching as they go, connected by still less well-defined secondary fibres from one to about four spicules broad. No spongin is at first sight visible, but closer examination shows that a very large quantity is really present in the fibres, more or less completely imbedding the spicules; owing to its very pale colour and great transparency, however, it readily escapes observation. Numerous spicules occur scattered irregularly between the fibres. There is no special dermal skeleton, the dermal membrane being practically destitute of spicules.

Spicules.—Slender, slightly or rather strongly curved oxea; more or less gradually sharp-pointed at the ends; size variable, say about 0·12 millim. by 0·003 millim.

It is probable that this species is identical with ESPER's *Spongia cymæformis* (from Ceylon). It also appears to be nearly related to *Chalina palmata* from European, Indian and Australian waters; differing, however, in the absence of the dermal skeleton reticulation. In habit the species reminds one very much of some species of *Axinella*, a resemblance which appears from EHLERS' description to have been increased in the case of ESPER's specimen by the presence of styli mingled with the oxea.

R.N. 16 (Gulf of Manaar); 349 (Stat. LV., west of Periya Paar, 20 fathoms).

Ceraochalina, LENDENFELD.

Chalininæ of various external form; not tubular. Texture hard, owing to the great thickness of the skeleton fibres, in which the spongin is very strongly developed and the spicules much reduced in size and sometimes also in number.

Ceraochalina retiarmata, n. sp.—Plate X., fig. 4.

The single specimen forms an erect, thin lamella, attached below by a constricted base; sub-dividing into flattened branches and giving off irregular digitiform processes almost exclusively in one plane; the branches to a slight extent anastomosing with one another. Surface glabrous, minutely granular under a lens; rather uneven. Vents minute, about 0·5 millim. in diameter, mostly arranged uniserially on the narrow margins. Inhalant pores scattered in the meshes of the dermal reticulation. Colour (in spirit) rather dark brown; texture compressible, resilient, tough and fibrous. Total height of specimen about 33 millims.; greatest breadth about 66 millims.; thickness of lamella about 3·5 millims.

The main skeleton is a network of stout horny fibre, sparingly cored by very slender vestigial oxea. The primary fibres are about 0·1 millim. in diameter and curve upwards and outwards towards the surface, branching as they go. They are connected together by short secondaries about 0·05 millim. in diameter and containing fewer spicules. There is also a system of tertiary fibres, much more slender (from about 0·008 millim. to about 0·024 millim. in diameter) and containing from one to about four rows of well-developed oxea imbedded in spongin. These tertiary fibres form an irregular network which seems to bear no relation to the rest of the main skeleton, except that its fibres are attached frequently to those of the latter.

The dermal skeleton is very strongly developed, forming a close polygonal-meshed reticulation of horny fibres cored by usually two or three rows of well developed oxea and echinated abundantly by similar oxea projecting from the fibre singly or in small groups. The diameter of the dermal fibre is about 0·024 millim.; of the meshes between the fibres about 0·16 millim., but variable.

Spicules.—Rather short, slightly curved, gradually sharp-pointed oxea (Plate X., fig. 4), measuring about 0·084 millim. by 0·004 millim. in the dermal skeleton and in the tertiary fibres of the main skeleton, but becoming more or less vestigial in the other fibres.

R.N. 342 (Stat. V., off Chilaw, 10 fathoms).

Ceraochalina reticutis, n. sp.—Plate X., fig. 8.

The type specimen (R.N. 58) forms an agglomeration of short, irregular, sub-cylindrical or angular branches, slightly anastomosing with one another and branching with great irregularity. The branches vary greatly in diameter, from about 4 millims. to about 11 millims., and have a slightly nodose appearance. The entire mass measures about 80 millims. in greatest breadth. Vents small (about 1 millim. in diameter), but conspicuous and with slightly projecting margins; scattered abundantly and sometimes in ill-defined longitudinal series. The dermal membrane is parchment-like, and under a pocket lens appears very finely and regularly reticulate in triangular meshes, which are the coarser meshes of the dermal skeleton composed of dark brown spongin fibre. Texture (in spirit) compressible, very resilient, tough; colour dark brown.

The main skeleton is a fairly regular, sub-rectangularly meshed network of strong horny fibre. The principal fibres run longitudinally through the branches, sub-dividing as they go and curving outwards to the surface. They measure up to about 0·08 millim. in diameter, and contain a considerable number of slender vestigial spicules, irregularly and multiserially arranged. The secondary fibres are about as thick as the primaries, but contain fewer spicules (which are also vestigial). The meshes of the main skeleton reticulation vary a good deal in size; averaging, say, about 0·33 millim. in diameter.

The dermal skeleton (Plate X., fig. 8) is a very well developed, close, polygonal-meshed reticulation of horny fibre containing only a very few slender spicules scattered here and there. The fibres of which this reticulation is made up are of two principal sizes; (*a*) stout, about 0·03 millim. to 0·05 millim. in diameter, radiating from the ends of the primary fibres of the main skeleton and forming the coarser triangular-meshed reticulation visible under a pocket lens; (*b*) more slender, but very variable in diameter, forming a very close-meshed but irregular reticulation in the meshes of the coarser reticulation. A large number of well developed spicules may be irregularly scattered in the dermal membrane outside the horny fibres of the dermal skeleton.

Spicules.—Oxea; varying greatly in degree of development; in the horny fibres very slender and vestigial (Plate X., fig. 8, *v.s.*), but often well developed in the soft tissues between the fibres, especially in the dermal membrane (Plate X., fig. 8, *o*). When fully developed they are slightly curved and somewhat hastately sharp-pointed, measuring about 0·072 millim. by 0·00265 millim.

R.N. 58 (Gulf of Manaar); 321; ? 346 (distinguished from the type chiefly by the numerous well developed oxea arranged uniserially in the slenderer fibres of the dermal skeleton and multiserially in the stouter fibres; while the spicules themselves are occasionally strongylote).

Ceraochalina multiformis, LENDENFELD, var. **manaarensis**, DENDY—Plate VII., fig. 2.

1889, **Pachychalina multiformis**, var. **manaarensis**, DENDY (**3**).

I identify with this variety a single specimen attached to a pearl oyster, which is represented in Plate VII., fig. 2. A feature which I omitted to mention in my original description of the variety is the echination of the fibres of the dermal skeleton by projecting oxea, singly or in groups.

The species was recorded by LENDENFELD (**51**) from Australia and New Zealand.

R.N. 98 (Gulf of Manaar, dry).

Ceraochalina ceylonica, n. sp.—Plate VII., fig. 3; Plate X., fig. 6.

Sponge (Plate VII., fig. 3) massive, irregular, sometimes clathrous, with a slight tendency to become lobose or digitate. Surface strongly and copiously aculeated by sharp-pointed conuli about 4 millims. in height; minutely fibro-reticulate between the conuli. Vents numerous, scattered, about 4 millims. or 5 millims. in diameter; the openings of deep, cylindrical oscular tubes. Colour (in spirit) pale brown; texture firm and tough, but compressible and resilient. The largest specimen (R.N. 5, figured) measures 200 millims. by 160 millims. in horizontal dimensions, by 90 millims. in height.

The main skeleton is a very strongly developed, irregular or rectangularly meshed network of stout, horny fibre, containing usually a large number of small oxea scattered irregularly throughout the spongin substance, but almost always more or less parallel with the long axis of the fibre. Occasionally (R.N. 5) the spicules are much less strongly developed and may be completely absent from some of the fibres. Numerous spicules also occur scattered between the fibres. The thickness of the fibres is variable, say about 0·08 millim. for the primaries and not much less for the secondaries

The dermal skeleton is a polygonally meshed network of fibre containing a very large proportion of spongin and a good many spicules. The latter are, for the most part, imbedded in the spongin substance more or less longitudinally; at frequent intervals, however, little groups of oxea, or single spicules, project more or less at right angles from the fibre in an echinating manner, and thus give a rather characteristic appearance to the dermal skeleton. The meshes of the dermal reticulation are about 0·2 millim. in diameter, and the fibres from about 0·008 millim. upwards.

Spicules.—Slender oxea (Plate X., fig. 6), slightly curved and more or less gradually and sharply pointed; size about 0·088 millim. by 0·003 millim., but subject to a good deal of variation, and frequently, if not usually, more slender.

R.N. 4, 5, 50, 108, 113 (all from Gulf of Manaar).

Siphonochalina, SCHMIDT.

Chalininæ of tubular form. Tubes smooth, both inside and out, usually narrow; each with a large circular vent at the summit.

Siphonochalina communis (CARTER), var. **tenuispiculata**, nov.—Plate VII., fig. 1.

This variety (Plate VII., fig. 1) agrees very closely in external form with the specimens of *Siphonochalina communis* described by CARTER (**5**) and myself (**3**) from the Gulf of Manaar. Mr. CARTER gave no measurements of the spicules in the case of the type of the species, but the specimens in Professor HERDMAN'S collection differ rather strikingly from that collected by Mr. THURSTON and described by myself, in that the spicules are very much more slender and very much more numerous in both primary and secondary fibres and in the fibres of the dermal skeleton. In fact, the spicules, though very abundant in all the fibres and occurring throughout the entire, or almost the entire, thickness of each fibre, are so slender as to be almost vestigial, measuring about 0·072 millim. by 0·001 millim.

In skeletal characters, although the spicules are more slender, this variety agrees much more closely with my *Siphonochalina crassifibra* from the same locality (**3**) than with CARTER'S *S. communis;* differing from *S. crassifibra* chiefly in the smaller size of the tubes. Thus it has the external form of *S. communis* combined with the skeletal characters of *S. crassifibra*, and I therefore propose to regard all three forms as mere varieties of one and the same species.

Professor HERDMAN informs me that the sponge in life had a violet-pink colour.

RIDLEY (**16**) records the species (under CARTER'S name *Tabulodigitus communis*) from Port Jackson, Australia, and also from Kurrachee.

R.N. 6, 7, 117 (dry, figured; all from Gulf of Manaar, Stat. II., 8 fathoms).

SUB-FAMILY: DESMACELLINÆ.

Haploscleridæ with monactinal megascleres. Microscleres various.

Desmacella, SCHMIDT.

Desmacellinæ with reticulate skeleton composed of styli or tylostyli. Microscleres sigmata, toxa and trichodragmata variously combined.

Desmacella tubulata, n. sp.—Plate IX., fig. 4.

Sponge consisting of cylindrical, tubular processes, more or less widely open above

(? always) and (sometimes, at any rate) united together below. (Possibly they may have been attached to a common body, but only fragmentary tubes are present in the collection.) Diameter of individual tubes about 6 millims.; thickness of tube-wall about 1·25 millims. Outer surface slightly granular and very minutely hispid. Inner surface with numerous very minute openings of exhalant canals. Colour (in spirit) pale greyish-yellow. Texture very soft, compressible, fragile.

The main skeleton is a very irregular but close reticulation of slender styli, either isolated or in loose bundles; with no visible spongin cement. There is no special dermal skeleton.

Spicules.—(1.) Long slender styli (Plate IX., fig. 4, *a*, *b*); slightly curved or bent, broadly and evenly rounded off at the base, sharply and more or less gradually pointed at the apex; size about 0·28 millim. by 0·005 millim.

(2.) Trichodragmata (Plate IX., fig. 4, *d*); extraordinarily abundant, especially beneath the outer surface, and very variable in size, sometimes forming wisp-like fibres, sometimes breaking up into separate microxea (Plate IX., fig. 4, *e*); varying in length from about 0·02 millim. upwards, and always very slender.

(3.) Sigmata (Plate IX., fig. 4, *c*); also extraordinarily abundant; slender, commonly much contort, also C-shaped; occasionally in small bundles (sigmodragmata); length from bend to bend variable, say about 0·02 millim.

This appears to be a very well characterized species, and I know of no other which comes very near it. The immense number of microscleres is very remarkable.

R.N. 209 (Gulf of Manaar); 324.

SUB-FAMILY: HETEROXYINÆ.

Haploscleridæ with a dense cortex composed of radially arranged megascleres. Megascleres smooth and spined oxea. Microscleres present or absent.

I propose this sub-family for the reception of the genera *Heteroxya*, TOPSENT, and *Acanthoxifer*, n. gen., the former of which is, apparently with very slight justification, placed by its founder amongst the Tethyidæ.

Acanthoxifer, n. gen.

Heteroxyinæ with a dense spicular cortex broken up into polygonal plates by pore-bearing grooves. Main skeleton a confused reticulation of oxea. Cortical skeleton composed chiefly of dense brushes of oxea arranged at right angles to the surface. Megascleres smooth and spined oxea. Microscleres trichodragmata.

This remarkable genus is evidently nearly related to TOPSENT'S *Heteroxya* (**45**), but differs in several respects, notably in the presence of trichodragmata, which indicates that the true position both of *Acanthoxifer* and *Heteroxya* is amongst the Haploscleridæ and not amongst the Tethyidæ, where TOPSENT has placed *Heteroxya*. The presence of the spined oxeote megascleres suggests a possible relationship to the Spongillinæ.

The breaking up of the cortex into polygonal plates or nodules by pore-bearing (and ? vent-bearing) grooves remind one forcibly of the genus *Placospongia* amongst Spirastrellidæ, but the resemblance is entirely superficial.

Acanthoxifer ceylonensis, n. sp.—Plate IX., fig. 5.

Sponge massively encrusting, irregular, with flattened or convex upper surface and broad base of attachment. Surface very minutely hispid or granular, uneven, nodular or tubercular, the nodules or tubercles being very low and roundedly polygonal in shape, separated by grooves of varying distinctness. Generally the grooves are broad and shallow; sometimes they are narrow, with prominent margins. Diameter of nodules, say, about 4 millims., but variable and irregular. Colour (in spirit) light brown. Texture compact, fleshy, but with much calcareous débris embedded. Pores and vents not recognisable externally. The largest specimen is cake-shaped, about 42 millims. in horizontal diameter, and up to 17 millims. in thickness.

The main skeleton is a quite confused, lax reticulation of very abundant, long, oxeote megascleres, occasionally collected together into loose, ill-defined bands, but without any distinct fibre, and with a little spongin becoming visible in stained sections. The cortical skeleton is very strongly developed and consists of dense brushes of oxea placed side by side and lying at right angles to the surface, beyond which their apices project (but are now nearly all broken off). These brushes are backed up internally by a very dense, irregular reticulation of oxea. The cortical skeleton is absent beneath the grooves which separate the surface nodules. Thus there is a separate section of the cortical skeleton for each nodule or tubercle, thinning out as it approaches the grooves in such a manner as to become strongly convex on the inner aspect.

Spicules.—(1.) Smooth oxea (Plate IX., fig. 5, *a*); long and rather slender, slightly curved or bent, variously and often irregularly ended, sometimes stylote (Plate IX., fig. 5, *b*). Size variable, say about 0·74 millim. by 0·012 millim. Abundant in the main skeleton and occasionally met with in the surface brushes.

(2.) Spined oxea (Plate IX., fig. 5, *c*); usually slightly and symmetrically curved (or angulated) in the middle; tapering fairly gradually to a sharp point at each end; provided with numerous very minute, sharp spines, most abundantly developed towards the two ends; size about 0·38 millim. by 0·008 millim. Characteristic of the cortical skeleton, but also common in the interior of the sponge.

(3.) Trichodragmata (Plate IX., fig. 5, *d*); oblong bundles of extremely slender rhaphides, which do not usually become dissociated even on boiling with nitric acid. Size usually about 0·016 millim. by 0·004 millim.; occasionally much longer.

Stained sections show that the ectosome (between the spicules) is chiefly collenchymatous, sometimes with a tendency to become fibrous near the surface. In both ectosome and choanosome are an immense number of minute granules of a pale yellowish colour, aggregated in rounded masses of very varying size. These may be symbiotic algæ.

R.N. 213, 217 (both from deep water outside pearl banks, Gulf of Manaar); 247.

FAMILY: DESMACIDONIDÆ.

Sigmatomonaxonellida in which some of the microscleres are chelæ (except when these have been lost by degeneration).

The presence of microscleres in the form of chelæ constitutes a natural character by which the Desmacidonidæ are, as a rule, easily distinguished from all other sponges. Unfortunately, however, the chelæ are very apt to disappear by degeneration, especially in the sub-families Ectyoninæ and Phlœodictyinæ, and we have then to depend upon other characters—such as the presence of spined echinating styli—for guidance in classification. That the chela, one of the most remarkable forms of microsclere known to us, has originated by modification of the sigma, there can, I think, be little doubt. In the Report on the "Challenger" Monaxonida* we showed that in ontogeny the chela arises from a sigmoid form (*Esperella mammiformis*) and that sigmata and chelæ must therefore be grouped in the same category. Nor are intermediate forms of adult spicules unknown to us, such as the curious "bipocilli" of the genus *Iophon*, especially those of *Iophon chelifer*, RIDLEY and DENDY (**1**), and, most notable of all, the bidentate sigmata of TOPSENT'S *Gellius bidens* (**64**).

We are, therefore, justified in regarding the Desmacidonidæ as derived from the Haplosceridæ by modification of the sigmoid microscleres into chelæ, though why this modification should have taken place is very hard to understand. It is extremely difficult to see how the very peculiar and highly specialized chelate form of microsclere can be of any special advantage to its possessor, and we have here one of those numerous cases in which, so far as we can see at present, the theory of natural selection signally fails to account for the facts.

I have already pointed out that the sub-family Phlœodictyinæ must be transferred to the Desmacidonidæ on account of the presence of chelate microscleres in the genus *Histoderma*, certain species of which are obviously very closely related to *Phlœodictyon* and *Oceanapia*. For the purposes of this Report the three sub-families Esperellinæ, Phlœodictyinæ and Ectyoninæ will be sufficient. TOPSENT'S sub-family Dendoricinæ appears to me to be an unnatural group which cannot be maintained, the differentiation of the ectosomal megascleres being far too general and widespread a character to be utilised as distinguishing the sub-family, whose members fall very naturally in one or other of the remaining sub-families. The sub-family Bubarinæ, proposed by the same author, has, I am glad to see, been again abandoned by him in his latest work (**62**).

* Page xx.

SUB-FAMILY: ESPERELLINÆ.

Desmacidonidæ without echinating spicules, and without fistular outgrowths of the sponge body.

Esperella, VOSMAER.

Esperellinæ of various external form, usually massive, lobose or ramose. Skeleton usually fibrous, often with much spongin. Megascleres monactinal, stylote or tylostylote. Characteristic microscleres palmate anisochelæ, to which may be added smooth sigmata, toxa, trichodragmata and small isochelæ* in various combinations.

Esperella parishii (BOWERBANK ?), RIDLEY.

[For synonymy and literature *vide* RIDLEY and DENDY (**1**), p. 65.]

There is one small, thinly encrusting specimen of this sponge in the collection, growing on a calcareous nodule in association with *Paresperella serratohamata* and *Hymedesmia stellivarians*. The specimen agrees very closely in spiculation with the description given by RIDLEY (**16**), except that the megascleres are a little larger and the trichodragmata contain many more spicules.

The species has been hitherto recorded from the Straits of Malacca (BOWERBANK); Port Darwin, Australia (RIDLEY), and the Philippine Islands ("Challenger"). Re-examination of the "Challenger" specimen, however, has convinced me that it does not belong to the same species as those described by RIDLEY from Australia and found by Professor HERDMAN in Ceylon waters, as it possesses toxa. It must be remembered that BOWERBANK (**49**) originally described toxa as forming part of the spiculation, but RIDLEY regarded these as foreign elements. It is probable that we have here a confusion between two species.

It appears not improbable that the "thin fragment" recorded by CARTER (**4**) from the Gulf of Manaar, under the name *Esperia tunicata*, SDT., may be specifically identical with our specimen.

R.N. 220A (deep water off Galle and onwards up West Coast of Ceylon).

Esperella plumosa (CARTER).

1882, **Esperia plumosa,** CARTER (**33**); 1886, **Esperia plumosa,** CARTER (**20**).

Sponge irregularly frondose or digitate; clathrous. Surface irregularly cactiform or conulose, covered by a very well-developed, stellately reticulate dermal membrane. Vents not seen; pores scattered in the meshes of the dermal reticulation. Texture (in spirit) coarsely fibrous, compressible, resilient, fragile. Colour grey. The largest fragment measures about 62 millims. in height by 41 millims. in greatest breadth.

The main skeleton is an irregular reticulation of coarse, stout, multispicular fibre without visible spongin; the main fibres running lengthwise and branching and

* Possibly young forms of the anisochelæ.

anastomosing with one another. The fibres are not very sharply defined and numerous megascleres occur scattered between them. The dermal skeleton is a very well-developed, triangular-meshed, stellate reticulation of stout, multispicular fibre (about 0·05 millim. in diameter).

Spicules.—(1.) Styli; fairly stout, often slightly crooked, with fairly well-developed oval heads and slightly constricted necks; sharply and rather abruptly pointed at the apex; size about 0·3 millim. by 0·009 millim.

(2.) Broad palmate anisochelæ, very similar to those of *Esperella simonis*;* about 0·048 millim. long; frequently in rosettes.

(3.) Minute palmate isochelæ; numerous, about 0·012 millim. long.

(4.) Large, stout sigmata, C-shaped and contort, with abruptly recurved and very sharply pointed ends; size about 0·08 millim. from bend to bend by 0·006 millim. thick in the middle.

(5.) Slender toxa with gently rounded curves; up to about 0·08 millim. long by 0·002 millim. thick in the middle; often in sheaves (toxodragmata) when young.

I have been able to satisfy myself by personal examination of Mr. CARTER'S type preparation of his *Esperia plumosa* (now in my possession) of the specific identity of the Ceylon form with the sponge recorded by CARTER from Mauritius, and subsequently from the Mergui Archipelago also. As Mr. CARTER'S descriptions are very scanty, I have thought it desirable to give the above details concerning what is evidently a widely distributed and characteristic species in the Indian Ocean, distinguished by an exceptionally varied and beautiful spiculation.

R.N. 298, 328, 361 (three fragments amongst a large number; all from Ceylon seas).

Esperella crassissima, n. sp.—Plate XI., fig. 6.

The single specimen is rounded, cushion-shaped, attached by the base to a mass of calcareous débris. The upper surface is strongly convex and bears a single large prominent vent about 3 millims. in diameter. Surface with a more or less strongly marked reticulate appearance, due to the coarse sub-dermal network of very stout spicular fibre, the oval meshes of which are normally covered over by a thin pore-bearing membrane, now mostly rubbed off. Pores scattered in the meshes of the dermal skeleton. Texture (in spirit) rather hard but slightly compressible and resilient; coarsely fibrous. Colour pale grey. Maximum diameter of specimen about 24 millims.

The main skeleton is a very well-developed reticulation of very stout, compact spicular fibre up to about 0·33 millim. in diameter, composed of very numerous closely packed spicules and without visible spongin. The meshes of this reticulation vary greatly in size and shape; perhaps 1·3 millims. would be a fair average diameter. Immediately beneath the surface the main skeleton passes into the more compact

* *Vide* (1), Plate XV., fig. 16.

sub-dermal reticulation, with rounded meshes averaging about 0·5 millim. in diameter, separated by fibres of about the same diameter (more or less). Over this lies a true dermal reticulation composed mostly of loosely scattered spicules (sometimes aggregated in slender fibres) lying tangentially in the pore-bearing dermal membrane.

Spicules.—(1.) Tylostyli (Plate XI., fig. 6, *a*); slightly curved, rather stout; with well developed oval heads narrower than the middle of the shaft, from which they are separated by a well marked constriction; gradually or rather abruptly sharp pointed at the apex. Size about 0·49 millim. by 0·016 millim.

(2.) Large palmate anisochelæ of the ordinary form (Plate XI., fig. 6, *b*, *c*), measuring about 0·06 millim. by 0·024 millim. Very numerous, mostly in groups which look like disorganised rosettes; found chiefly just beneath the surface. In the dermal membrane numerous small palmate isochelæ occur scattered singly; these are about 0·012 millim. long and are probably young forms.

(3.) Sigmata (Plate XI., fig. 6, *d*); slender, C-shaped and contort, up to about 0·036 millim. long; numerous.

(4.) Trichodragmata (Plate XI., fig. 6, *e*); short, compact; about 0·02 millim. by 0·006 millim. Very abundant.

This species is very closely related to *Esperella fusca*, Ridley and Dendy (1), obtained by the "Challenger" off Bahia; it differs, however, in the more strongly developed main skeleton and consequently greater hardness of texture, and in the sharply pointed character of the tylostyles; possibly also in colour.

R.N. 240 (Ceylon seas).

Esperella tenuispiculata, n. sp.

Sponge irregularly massive, with a tendency to grow out into rounded lobes or short, thick branches. Surface very uneven, covered over by a soft dermal membrane. Vents few, small, scattered. Pores scattered (perhaps in irregular groups) in the dermal membrane. Texture (in spirit) soft and spongy, but intensely gritty from the presence of an immense quantity of coarse sand, chiefly in the interior of the sponge. Colour varying from grey to brown. The largest specimen is about 63 millims. long by 36 millims. in greatest breadth.

The skeleton is to a large extent replaced by the abundant sand-grains, which may be held together in very irregular bands by spongin cement. Between and in association with these we have loose, wispy bands of styli running towards the surface, or simply scattered styli. There is no dermal skeleton.

Spicules.—(1.) Tylostyli, very much reduced; straight, slender; with distinct oval heads, constricted necks and fairly gradually sharp-pointed apices; size about 0·21 millim. by 0·004 millim., but often more slender.

(2.) Small palmate anisochelæ, about 0·02 millim. long; rather scarce but constant.

(3.) Slender sigmata, C-shaped and contort, about 0·036 millim. from bend to bend; sometimes very abundant.

In its intensely arenaceous habit and the consequent reduction of the proper skeleton, this species resembles *Esperella arenicola*, RIDLEY and DENDY (**1**), and *E. crassa*, DENDY (**10**), both from Bass Straits. It differs from the former, however, in the absence of trichodragmata, and from the latter in the presence of sigmata.

R.N. 293; 305; 334; 344 (Ceylon seas).

Paresperella, n. gen.

Encrusting or massive Esperellinæ, with megascleres in the form of tylostyli or styli; with microscleres in the form of palmate anisochelæ and serrated sigmata, to which others (such as toxa) may be added.

The existence of several esperelline species with serrated sigmata justifies the erection of a new genus, of which the type will be CARTER'S *Esperia serratohamata*, I am not aware that this very extraordinary form of spicule has hitherto been met with in any other genus.

There are probably at least three species of the genus *Paresperella* in the neighbourhood of Ceylon, for in an indeterminable sponge encrusting a calcareous nodule from "Deep water off Galle and onwards" I have found (as a foreign body) a huge serrated sigma (Plate XI., fig. 3) like those of *Paresperella serratohamata*, but far too large to be referred to that species. It measures 0·3936 millim. from bend to bend and 0·0146 millim. thick in the middle of the shaft, while, according to Mr. CARTER'S measurements, the corresponding spicule in *P. serratohamata*, though large, measures only 0·1 millim. by 0·0052 millim. Curiously enough, *P. serratohamata* was also first known from a single spicule.

LINDGREN (**86**) has described, under the name *Esperella macrosigma*, a species of *Paresperella* in which the serrated sigmata attain still more enormous dimensions, measuring 0·48 millim. in length by 0·024 millim. in diameter. This species comes from the straits of Korea, and it is quite likely that it occurs also in Ceylon waters and may be represented by the single spicule above described.

The genus is, of course, very closely related to *Esperella*, from which it has evidently been derived.

Paresperella serratohamata (CARTER)—Plate XI., fig. 2.

1880, **Esperia serratohamata**, CARTER (**4**).

A minute specimen of this remarkable sponge occurs on a calcareous nodule in association with *Hymedesmia stellivarians* and *Esperella parishii*. The spiculation agrees very well with Mr. CARTER'S description, but the apices of the tylostyles are uniformly mucronate (Plate XI., fig. 2, *a*). This character is not mentioned in Mr. CARTER'S description, and the figure which he gives of the tylostyle is on too small a scale to afford satisfactory evidence.

LAMBE (**85**) records this species from Vancouver, but I am doubtful, from the measurements which he gives of the spicules, whether his identification is correct; we have probably here yet another species of the genus.

R.N. 220c (deep water off Galle and onwards up the West Coast of Ceylon).

Paresperella bidentata, n. sp.—Plate XI., fig. 1.

Sponge intensely arenaceous, the single specimen consisting of a friable mass of coarse yellow sand, held together and permeated by the soft sponge-tissues. Somewhat cavernous internally. Surface uneven, with a soft dermal membrane visible in places. The single specimen is an irregular massive fragment about 25 millims. in maximum diameter.

The main skeleton of the sponge, between the closely aggregated sand-grains, consists of slender megascleres, mostly loosely scattered, but occasionally collected in fairly stout multispicular fibres. In the dermal membrane there is a distinct but very loose and wide-meshed reticulation of slender spicular fibre, three or four spicules wide, supported here and there on very loose sub-dermal brushes belonging to the main skeleton.

Spicules.—(1.) Tylostyli (Plate XI., fig. 1, *a*); long, slender, straight or nearly so, with oval heads, about equal in diameter to the middle of the shaft, and slightly constricted necks; typically with the apex slightly enlarged, truncated, and provided with two (sometimes three ?) minute conical teeth placed side by side on the truncated end (with their long axes parallel with the long axis of the spicule). The enlargement from which these teeth project contains a diverticulum of the central canal of the spicule. These spicules are best developed in the dermal membrane (and in the lining membrane of the large canals ?). In the dermal membrane they form the reticulation of spicular fibre mentioned above, and measure about 0·27 millim. by 0·0053 millim. In the deeper parts of the sponge, between the sand-grains, they are more slender and their apices sometimes appear to end in simple, long-drawn-out points.

(2.) Palmate anisochelæ (Plate XI., fig. 1, *c*, *d*), about 0·028 millim. long; mostly in rosettes near the surface, very abundant and similar to those of *P. serratohamata*.

(3.) Sigmata (Plate XI., fig. 1, *b*, *b*); long and slender, usually contort, with sharply incurved apices and (? always) with more or less distinct teeth on the outer side of each bend, similar to those on the sigmata of *P. serratohamata*, but much less strongly developed. Size about 0·052 millim. from bend to bend by 0·002 millim. thick in the middle.

This species differs from *P. serratohamata* in the presence of two teeth, instead of one, at the apex of the tylostyle; in the much more slender and less distinctly toothed or serrate character of the sigmata, and in the absence of toxa; as well as in the arenaceous habit, which has doubtless caused considerable reduction in the proper skeleton. I know of no other case where one can trace such a close and evident relationship between an arenaceous sponge with reduced skeleton and a non-arenaceous congener. The bidentate character of the apex of the tylostyle is very remarkable, especially in comparison with the mucronate character of the corresponding spicule in *P. serratohamata*.

R.N. 263A (Gulf of Manaar).

Iotrochota, Ridley.

Esperellinæ of massive, ramose, or flabellate form, and usually of dark purple or brown colour. Skeleton reticulate. Megascleres styli, to which diactinal forms may be added, especially in the more superficial parts of the sponge. Typical microscleres birotulate (apparently modified isochelæ).

In previous papers I have used the term "Amphiaster" for the birotulate spicules of this and certain other genera of Esperellinæ. There can, however, be little doubt that these microscleres are modified isochelæ, and do not belong to the astrose series at all. They are connected with the more typical isochelæ by the peculiar isochelæ of the genera *Chondrocladia* and *Axoniderma*, and may conveniently be termed "birotulate isochelæ."

Iotrochota purpurea (Bowerbank), Ridley.

1875, **Halichondria purpurea**, Bowerbank (**49**); 1884, **Iotrochota purpurea**, Ridley (**16**).

The Ceylon variety of this species is characterized by its dark brown instead of purple colour in spirit.* It is also easily distinguished from *Iotrochota baculifera* by this character as well as by the replacement of the tylote megascleres by slender styli, commonly arranged in radiating tufts at the surface.

The specimens are for the most part irregularly cylindrical in shape, may be much branched; and the surface is covered irregularly with small, sharp conuli. The styli of the main skeleton are usually sharp-pointed and very variable in size. The birotulate isochelæ are numerous and about 0·02 millim. long. Not infrequently, the straight, slender styli in the radiating tufts at the surface of the sponge exhibit an inflation not far from the middle of the shaft, causing them to resemble a pipette. The fibres of the main skeleton reticulation are stout and contain much spongin as well as very many spicules.

The original type of the species was described by Bowerbank from the Straits of Malacca. Ridley recorded it from Torres Straits, Albany Island, Port Molle, and the Amirante Group. The West Indian *Iotrochota birotulata* (Higgin) (**53**) and the Southern Australian *Iotrochota coccinea* (Carter)† are very possibly identical with this species, or only varietally distinct.

R.N. 258; 297; 309; 343; 354; 366 (Stat. V., off Chilaw, 10 fathoms, and elsewhere in Ceylon seas. Some are mere fragments).

* It should, however, be noted, that a portion of the collection was preserved in formalin and transferred to spirit afterwards. I do not know which specimens were treated in this way, nor do I know what effect such treatment may have had upon the colour.

† *Vide* Dendy (**10**).

Iotrochota baculifera, Ridley.

1884, **Iotrochota baculifera,** Ridley (**16**); 1887, **Iotrochota baculifera,** Ridley, var. **flabellata,** Dendy (**2**).

There are in the collection a number of dark purple-coloured specimens, mostly small or mere fragments, which I identify with this species. The flabellate habit, characterizing my variety *flabellata*, is not recognisable in most of them, and it seems hardly worth while to retain a special varietal name for the Ceylon form. In a boiled-out preparation of R.N. 164 I find the styli frequently much stouter than the measurements which I gave from Mr. Thurston's specimens, often measuring about 0·2 millim. by 0·012 millim., but very variable in diameter, while the tylota measure about 0·246 millim. by 0·007 millim., and the birotulate isochelæ about 0·02 millim. long. It will be seen that these measurements agree very closely with those given by Ridley for the type specimen from Port Darwin.

Thiele (**39**) has recorded the species also from Celebes.

R.N. 47 (Gulf of Manaar); 164; 317; 322; 331 (all from Ceylon seas).

Sub-family: PHLŒODICTYINÆ.

Desmacidonidæ in which the sponge body is provided with fistular outgrowths, and, usually at any rate, with a spicular rind or cortex.

In this sub-family I include the genera *Phlœodictyon*, *Oceanapia*, *Histoderma*, *Sideroderma* and *Amphiastrella*, which appear to me to form a very natural group.

The microscleres are usually more or less completely suppressed.

Phlœodictyon, Carter.

Phlœodictyinæ with oxeote or strongylote megascleres and no microscleres at all.

Lundbeck (**88**) has shown pretty conclusively that Carter's name "*Phlœodictyon*" must be revived for this genus, the type species of "*Rhizochalina*," described by Schmidt, being true Chalininæ.

Phlœodictyon fistulosum (Bowerbank).

1873, **Desmacidon fistulosa,** Bowerbank (**22**); 1880, **Desmacidon Jeffreysii,** Carter (**4**); 1884, **Rhizochalina fistulosa,** Ridley (**16**); 1888, **Rhizochalina fistulosa,** Ridley and Dendy (**1**); 1897, **Oceanapia fistulosa,** Topsent (**83**); 1904, **Phlœodictyon fistulosum,** Topsent (**62**).

Mr. Carter recorded this species from the Gulf of Manaar under the name *Desmacidon Jeffreysii.* It differs, however, from the British *Oceanapia jeffreysi*, as Mr. Carter himself pointed out, in the absence of sigmata. In this respect it agrees with the Australian *Phlœodictyon fistulosum*, with which I have no hesitation in identifying it.

In a footnote to the account of this species in the Report on the "Challenger"

Monaxonida, Mr. RIDLEY and I suggested that *Rhizochalina* and *Oceanapia* should be united in one genus, and in a subsequent paper **(10)** I have carried out this suggestion. Our reason for this proposal was that at one of the "Challenger" stations (188, off New Guinea) specimens with and without sigmata appear to occur together, and are so closely similar in external appearance that they cannot be distinguished otherwise than microscopically. It seems equally reasonable, however, to suppose that the two genera actually occur together in this locality, or that there has been some confusion in the sorting out of the specimens. We can hardly suppose that the same species sometimes occurs with, and sometimes without, sigmata. I therefore propose to return to the arrangement originally adopted in the "Challenger" Report, substituting, for the reason above given, the name "*Phlœodictyon*" for "*Rhizochalina*."

Neither Mr. CARTER nor I have been able to find sigmata in the Ceylon specimens, though I have myself examined about half-a-dozen microscopically.

One of Professor HERDMAN'S specimens has the body, which varies much in shape and is often very irregular, up to 48 millims. in maximum diameter. As pointed out by Mr. CARTER, the fistular processes are long and may be ramified. They sometimes appear to be naturally closed at the extremity (except, perhaps, for small pores), and sometimes open. In nearly all cases they have been broken off short.

R.N. 81, 90, 237 (all from deep water off Galle and onwards up West Coast of Ceylon); 260; 363 (fistulæ only, Stat. I., hauls 1–4, January 31, 1902, Colombo to Negombo, 12 to 20 fathoms). Also other unnumbered specimens and loose fistulæ.

Histoderma, CARTER.

Phlœodictyinæ with usually diactinal megascleres and microscleres in the form of isochelæ, to which others may be added.

An examination of Mr. CARTER'S own preparations of his *Phlœodictyon singaporense* **(54)** has revealed the presence of small palmate isochelæ. I therefore propose to place this species, together with a closely related Ceylonese form, in the genus *Histoderma.*

The presence of isochelæ in this genus is of great interest and necessitates the inclusion of the Phlœodictyinæ amongst the Desmacidonidæ, the two species referred to forming an important connecting link between *Phlœodictyon* and *Oceanapia* on the one hand and *Desmacidon* on the other.

Histoderma vesiculatum, n. sp.—Plate XI., figs. 8, 9.

This remarkable sponge is represented in the collection by two fragments of about equal size and closely similar appearance. Each consists of an elongated cylindrical body inflated at irregular intervals to form oval vesicles. In one specimen there are two distinct vesicles connected by a short cylindrical piece, and from the larger of the two, which is broken across at the end, another short cylindrical piece is given off as a branch. The slender cylindrical portions, and the vesicles too, are now more or less hollow, but they contain the remains of the coarse skeleton network and a certain amount of decomposed soft tissue. Thus, in the present condition of the specimens, the outer wall of the sponge forms a thin but firm shell enclosing a wide cavity in which lie the remains of the choanosome. How far the sponge was hollow in life cannot now be ascertained. The colour (in spirit) is dark brown throughout, with a slight purplish tinge on the surface. The surface is smooth, but has a very characteristic tessellated appearance, caused by the very stout sub-dermal reticulation of spicular fibre showing through the thin dermal layer. Each specimen has a total length of about 27 millims. The largest vesicle measures about 11 millims. by 9 millims., and the slender cylindrical portions are about 4 millims. in diameter (sometimes rather less).

The main skeleton forms a very wide-meshed reticulation of very stout spicular fibre, occupying the interior of the sponge; the meshes being very irregular in shape and size. The diameter of the fibre, which appears to be composed entirely of very closely packed megascleres, is about 0·165 millim. There is a sub-dermal reticulation of similar fibre with roundedly polygonal meshes, the meshes being about 1 millim. in diameter. This supports the dermal skeleton (Plate XI., fig. 8), which is very well developed and extremely beautiful, consisting of a single layer of strongyla of various lengths lying tangentially side by side as closely packed together as possible, with a few much larger oxea, or sometimes styli, intermingled with them.

Spicules.—(1.) Oxea (Plate XI., fig. 8, *o*, *o*, *o*); rather long and only moderately stout; slightly curved, usually sharply but sometimes rather abruptly pointed at each end; size about 0·3 millim. by 0·009 millim., but variable. Abundant in the fibres of the skeleton and scattered in the soft tissues between, where numerous very slender, hair-like forms, possibly young, also occur.

(2.) Strongyla (Plate XI., fig. 8, *s*, *s*); cylindrical, more or less curved, and evenly rounded off at each end; size extremely variable, from 0·04 millim. by 0·005 millim. to 0·1 millim. by 0·007 millim., or perhaps more. Characteristic of the dermal skeleton, but also found in the spicular fibres and soft tissues of the choanosome.

(3.) Palmate isochelæ (Plate XI., fig. 9), about 0·016 millim. long; very similar to those of *Desmacidon conulosa*, as figured in the Report on the "Challenger" Monaxonida; numerous.

(4.) I have also seen one "birotulate" of about the same length as the ordinary isochelæ; with very slender and apparently straight shaft and short umbrella-like ends with minutely dentate margins. Whether or not this forms a constant element in the spiculation I am not prepared to say, but its presence is very interesting in view of the normal occurrence of such spicules in the genus *Amphiastrella*.

This species differs from *Histoderma singaporense* (Carter) chiefly in external form, but also in the more slender character of the oxea.

Lindgren, however, has described (**86**), under the name *Rhizochalina singaporensis*

(CARTER), a sponge from the China Sea, in which he also discovered isochelæ. This specimen seems to resemble the Ceylon form very closely, and it is possible that future investigations may show them all to be specifically identical.

R.N. 212 (deep water outside pearl banks, Gulf of Manaar).

SUB-FAMILY: ECTYONINÆ.

Desmacidonidæ in which some of the megascleres take the form of spined styli, originally developed as echinating spicules of the skeleton fibre or projecting at right angles from the substratum.

The members of this sub-family are usually easily recognised by their spined styli, but, as in the case of perhaps every type of spicule, the spined styli may be lost again by degeneration. Such degeneration has obviously taken place in the genus *Raspailia*, which, until recently, has been confounded with the Axinellidæ. As a rule, microscleres are present in the form of isochelæ (to which toxa are frequently added), but these also may be lost.

Myxilla, SCHMIDT.

Ectyoninæ, usually of massive, irregular form, in which the megascleres are spined styli, which may or may not be echinating, and variously ended diactinal forms which typically belong to the dermal skeleton. The typical microscleres are tridentate isochelæ, to which other forms may be added.

This genus in a certain sense occupies, as pointed out by Mr. RIDLEY and myself in the Report on the "Challenger" Monaxonida, a position intermediate between the sub-families Esperellinæ and Ectyoninæ, including both species with definite echinating spicules and species in which such spicules cannot be distinguished from those of the ordinary skeleton reticulation. It appears probable, from their form, that the spined styli originated in the first instance as echinating spicules, *i.e.*, spicules in which the growth of one end (the base) became arrested by pressure against a firm substratum, while the apex projected freely into the surrounding soft tissues and thus formed an internal defence against the attacks of parasites. In some species these echinating spicules appear to have passed into the main skeleton and form a reticulation with one another.* It appears desirable, therefore, to regard the presence of spined styli (or tylostyli) as constituting the leading feature of the Ectyoninæ, without insisting too strongly upon their actual arrangement.

In the genus *Myxilla* itself it is sometimes impossible, owing to the irregular character of the skeleton reticulation, to distinguish sharply between echinating and non-echinating styli, and, as I have pointed out before (**10**), I cannot, therefore, agree with TOPSENT (**62**, &c.) and HANITSCH (**46**) in retaining GRAY'S genus *Dendoryx* for species in which no special echinating spicules are recognisable.

* Compare *Rhabderemia indica* and its relationship to the thin encrusting forms of the same genus. See also below, under *Myxilla tenuissima*.

This important genus is represented in the present collection by only two species, but both of these are of exceptional interest owing to their unusual habit, the one being a typical sand-sponge and the other a very thinly encrusting form.

Myxilla arenaria, n. sp.

Sponge massive, irregular; intensely and coarsely sandy, with a distinct translucent dermal membrane visible in places. Pores and vents (?). Greatest diameter of type (R.N. 263) 30 millims. Colour (in spirit) light brown (the colour of the sand) or grey; texture very friable.

Main skeleton composed almost entirely of sand, with slender strongyla scattered between the sand-grains and also collected in loose, wispy fibres; and with small spined tylostyli or styli very sparsely echinating the sand-grains. Dermal skeleton composed of slender strongyla scattered irregularly in the dermal membrane.

Spicules.—(1.) Strongyla, perhaps sometimes faintly tylote; straight, slender, smooth; measuring about 0·146 millim. by 0·002 millim.

(2.) Spined tylostyli or styli; straight; gradually and very sharply pointed at the apex; rather sparsely and irregularly spined, chiefly at and near the base, which is generally distinctly tylote. Size variable, say about 0·056 millim. by 0·004 millim. (near the head, including spines).

(3.) Tridentate isochelæ, with small teeth and fairly stout, strongly curved shaft; length about 0·014 millim.; not very abundant.

(4.) Slender sigmata; C-shaped and contort; measuring about 0·032 millim. from bend to bend, but rather variable in size.

As usual in sand-sponges, the proper skeleton is reduced in accordance with the arenaceous habit. In external appearance the sponge closely resembles *Paresperella bidentata*, and might easily be mistaken for that species.

R.N. 263 (Gulf of Manaar); 266 (pearl banks off Aripu).

Myxilla tenuissima, n. sp.—Plate XI., fig. 5.

Sponge extremely thin, encrusting. The single specimen forms a small crust of a pale yellowish colour growing on a mass of calcareous worm-tubes in association with *Discodermia emarginata*. Vents and pores not seen.

The skeleton consists partly of slender tylota, scattered irregularly and in loose wisps, and partly of spined tylostyles projecting vertically from the substratum, upon which their bases rest while their apices point outwards.

Spicules:—(1.) Tylota (Plate XI., fig. 5, *a*); smooth, slender, straight or nearly so, with rather feebly developed oval heads and commonly with the shaft slightly inflated (tylote) in many places at irregular intervals. Size about 0·148 millim. by 0·002 millim.

(2.) Spined tylostyli (Plate XI., fig. 5, *b*); quite straight and abundantly spined all over; with spherical head not much wider than the shaft, which tapers gradually from the head to a fine, sharp apex. Spines rather small, conical and sharp pointed; on the head rather longer than elsewhere and arranged in a radiating manner, so that the head, when viewed end on, resembles a spheraster. Size variable, up to about 0·08 millim. in length by 0·008 millim. in thickness where the shaft joins the head (exclusive of spines). These spicules are very numerous and, though quite separate from one another, are placed pretty close together.

(3.) Stout tridentate isochelæ (Plate XI., fig. 5, *c*, *d*) of the usual *Myxilla* type, with rather strongly curved shaft; length about 0·032 millim.; very numerous.

This is a *Myxilla* with the encrusting habit of a *Hymedesmia*, and with correspondingly arranged skeleton. In spiculation it closely resembles TOPSENT'S *Dendoryx certa* (**48**), but differs in skeleton arrangement, the spined styli forming a network in the latter species. In fact, *Myxilla tenuissima* bears much the same relationship to *Myxilla* (*Dendoryx*) *certa* that *Rhabderemia pusilla* does to *Rhabderemia indica.*

R.N. 234A (on same mass as R.N. 234, "deep water off Galle and onwards").

Clathria, SCHMIDT.

Ectyoninæ of various habit, frequently clathrous; skeleton a reticulation of fibre, usually with much spongin, containing smooth styli and echinated by spined styli. Typical microscleres small palmate isochelæ, to which toxa are frequently added.

I have already (**10**) indicated the necessity for abandoning the genus *Rhaphidophlus* of EHLERS, which differs from *Clathria* only in the possession of a dermal crust of radially disposed styli. The degree of development of this crust varies to such an extent, however, that it is quite impossible to base a generic distinction on this character alone.

Clathria frondifera (BOWERBANK).

1875, **Halichondria frondifera,** BOWERBANK (**49**); 1884, **Clathria frondifera,** RIDLEY (**16**); 1889, **Clathria corallitincta,** DENDY (**3**).

I do not think it is possible to keep the Ceylonese form, described by me under the name *Clathria corallitincta*, separate from the common Australian and Indian Ocean species, originally described by BOWERBANK from the Straits of Malacca and Gaspar Straits under the name *Halichondria frondifera* and subsequently re-investigated by RIDLEY.

The external form of the sponge is very characteristic, and one of Professor HERDMAN'S specimens (R.N. 44) bears a remarkably close resemblance to a specimen from the Mascarene group figured by RIDLEY (*loc. cit.*, Plate liii., fig. j). The spiculation, however, seems to be somewhat variable, and I must add to the description which I gave of Mr. THURSTON'S specimens the following particulars concerning those in the present collection.

The palmate isochelæ may be abundant. Smooth, slender toxa of very various length are also met with. These are best developed in R.N. 85 and 281, where they attain a length of about 0·184 millim., being almost straight from end to end except for a small bow in the middle. The stout styli of the main skeleton vary greatly in thickness. The slender styli or tylostyli may form a fairly distinct dermal skeleton, in which they are either irregularly scattered or arranged in more or less definite radiating brushes. The bases of these spicules are sometimes minutely spined (R.N. 169).

One of the specimens (R.N. 97) is attached to a pearl oyster (*Margaritifera vulgaris*).

R.N. 44, 97, 268 (all Gulf of Manaar); 85, 169, 281 (all deep water off Galle and onwards up West Coast of Ceylon).

Clathria indica, Dendy.

This common species (Dendy, **3**) is represented in the collection by four specimens.

R.N. 27, 106 (both from Gulf of Manaar, Stat. IX., &c.); 166; 291 (Ceylon seas).

Clathria spiculosa (Dendy).

1889, **Rhaphidophlus spiculosus**, Dendy (**3**).

There is one small specimen of this sponge which makes a close approach to the original types both in external form and spiculation.

R.N. 335 (Ceylon seas).

Clathria spiculosa, var. **ramosa**, nov.

This variety agrees closely with the types of the species in skeleton arrangement and spiculation, but differs conspicuously in its elongated, slender, sub-cylindrical, irregularly branching external form. It thus makes a very close approach to Ridley's *Echinonema gracilis* from the Mascarene Islands (**16**), but the megascleres in the Mascarene species are much stouter.

R.N. 168; 308; 310; 333; 368 (deep water outside pearl banks, Gulf of Manaar).

Clathria spiculosa, var. **tessellata**, nov.—Plate VIII., fig. 2.

This variety again differs from the types of the species only in external features, which are, however, very characteristic. The sponge consists of more or less erect, thick, irregular lamellæ, with the margin rising up here and there into short, digitiform processes. The vents are minute and few, marginal or on the ends of the processes. The most striking character of the variety, however, is the tessellated appearance of the surface, due to the presence of a close, polygonal-meshed reticulation of (presumably) pore-bearing grooves; the meshes of the reticulation are about 1 millim. to 1·5 millims. in diameter. The general appearance of the sponge is well shown in the figure. One specimen (R.N. 92a) measures about 70 millims. in greatest breadth and the same in height. The colour (in spirit) is dark grey, and the texture characteristically firm and fleshy, and very tough.

R.N. 92; 92A (Gulf of Manaar).

Raspailia, NARDO.

Ectyoninæ of elongated, slender, branching habit. Skeleton composed of a dense central axis of spicular fibre containing much spongin, from which bundles or tufts of spicules radiate to the surface. Smooth monactinal (sometimes diactinal) megascleres are present, and also (normally) spined echinating styli. No microscleres.

As already indicated, the members of this genus bear a strong superficial resemblance to Axinellidæ, but it is evident from the presence of the spined echinating styli (though these may be vestigial) that they are really highly modified Ectyoninæ.

Raspailia thurstoni, DENDY.

There is one specimen of this sponge (DENDY, 2, 1887) in the collection.

R.N. 39 (Stat. LX., outside Muttuvaratu Paar, 30 fathoms)

Raspailia fruticosa, DENDY, var. **tenuiramosa**, nov.—Plate VIII., fig. 5.

1887, **Raspailia fruticosa**, DENDY (2).

There are in the collection two specimens, one dry and one in spirit, which differ from the type of the species only in the much more slender and much shorter branches, and in the greater density of the skeleton, which is less distinctly reticulate. The branches are usually only from 2 millims. to 3 millims. in diameter, and very numerous, so that the whole sponge is even more fruticose than the type. The largest specimen (dry) is about 55 millims. in total height and 78 millims. in greatest breadth; it is represented in Plate VIII., fig. 5.

R.N. 100 (dry, Gulf of Manaar); 173.

Raspailia hornelli, n. sp.—Plate XI., fig. 7.

The single specimen is erect, arborescent, branching in one plane. The branching at first sight appears to be dichotomous, but in reality the two branches present are both given off from the same side of a main axis which in no way differs from them in appearance, except that the part below the first branch, which we may consider as representing the stalk, is more rounded in transverse section and slightly expanded below at the attachment, while the branches themselves are slightly flattened. Each branch is very much narrowed at the end to form a slender, elongated apex. The surface is rather coarsely granular, with numerous minute apertures between the granules; slightly hispid in places. Colour (in spirit) dark brown. Texture tough, compressible, resilient. Total height about 99 millims. Length of stem below the first branch 33 millims., diameter about 5 millims. Length of longest (lowest) branch about 64 millims.; greater transverse diameter of branches when fully developed about 6 millims.

The skeleton consists of a network of stout horny fibre, irregularly cored by smooth megascleres and fairly abundantly echinated by spined styli. There is a well marked axial condensation of the reticulation, in which most of the larger spicules are to be found densely packed together lengthwise in the stout horny fibre. From this axial portion more slender fibres run obliquely outwards to the surface, where each one ends (typically) in a projecting brush composed of a very few long, stout styli, surrounded at the base by numerous much shorter and very slender styli (these often appear to be absent). The outwardly-directed horny fibres are irregularly cored by usually slender megascleres and abundantly echinated towards their outer ends by spined styli. They are connected together to form a network by short secondary fibres of similar structure, but more slender. There are also many of the smooth megascleres scattered through the soft tissues apparently without any relation to the fibres at all

Spicules.—(1.) Smooth styli (Plate XI., fig. 7, *a*); long and comparatively stout, evenly rounded off at the base, gradually and sharply pointed at the apex; usually slightly curved towards the base; size about 0·65 millim. by 0·018 millim.; found chiefly in the axial condensation (but also scattered in the soft tissues outside it) and in the surface brushes.

(2.) Smooth styli (Plate XI., fig. 7, *b*, *c*); very slender, straight or nearly so, evenly rounded off at the base and very finely and gradually pointed at the apex; size, say about 0·24 millim. by 0·0027 millim., but sometimes longer; characteristic of the surface brushes, but also occurring frequently between the axis and the surface; perhaps sometimes oxeote.

(3.) Smooth oxea (Plate XI., fig. 7, *d*, *e*, *f*, *g*); rather short and fairly stout, fusiform, more or less curved or angulated in the middle, gradually sharp pointed at each end; size very variable, commonly about 0·2 millim. by 0·012 millim., but may be as much as 0·46 millim. by 0·014 millim.; abundant, scattered irregularly outside the horny fibres, and within them.

(4.) Strongyla (Plate XI., fig. 7, *h*, *h*); very short and comparatively stout, straight, equal-ended and broadly rounded off at each end; size very variable, say about 0·2 millim. by 0·024 millim.; sometimes pretty numerous in the axial condensation and occasionally met with outside it, but very erratic in occurrence.

(5.) Spined styli or sub-tylostyli (Plate XI., fig. 7, *k*, *l*, *m*); rather short, straight, tapering gradually from base to apex, which, though narrow, is bluntly pointed; covered all over with very minute, sharp spines, which are most abundant at the base and apex; size about 0·08 millim. by 0·008 millim. (at the base, including spines).

Numerous small, spherical, granular, brown pigment cells, about 0·01 millim. in diameter, are scattered through the outer part of the soft tissues.

This species, though evidently closely related to the European *Raspailia* (*Dictyo-*

cylindrus) *hispida*, is readily distinguished by the details of its spiculation. I have much pleasure in naming it after Mr. HORNELL, to whose energy this collection owes, I am told, so much of its value.

R.N. 59 (Stat. IV., off Karkopani, Gulf of Manaar).

Agelas, DUCHASSAING and MICHELOTTI.

Ectyoninæ in which the skeleton is composed of horny fibre echinated by verticillately spined styli; with no other spicules.

For synonymy and references I must refer to the Report on the "Challenger" Monaxonida (p. 163).

Agelas mauritiana (CARTER).

1883, **Ectyon mauritianus**, CARTER (**54**); 1887, **Agelas mauritianus**, RIDLEY and DENDY (**1**); 1903, **Agelas cavernosa**, THIELE (**87**).

This species is represented by a tubular fragment 31 millims. long and up to about 16 millims. in diameter; widely open at both ends and with the wall of the tube only about 3·5 millims. thick. It is of rather dark brown colour and firm, resilient consistence.

The skeleton is a close, irregular network of stout, amber-coloured horny fibre echinated very abundantly by the characteristic verticillately spined styli, which measure about 0·176 millim. by 0·016 millim. (including spines).

This beautiful species has hitherto been recorded from Mauritius (CARTER), off Tristan da Cunha (?) ("Challenger"), and from Ternate (THIELE).

R.N. 358 (Ceylon seas).

Agelas ceylonica, n. sp.—Plate XII., fig. 9.

The type specimen* consists of a few slender, anastomosing, sub-cylindrical branches, arising from an irregular, proliferous basal crust attached to a calcareous nodule. The branches are only about 2 millims. in diameter, and their surface is irregular and sometimes minutely hispid. Texture (in spirit) compressible, resilient, fibrous and fairly tough. Colour brown. Vents minute and scattered on the branches.

The skeleton is an irregular network of pale-coloured horny fibre about 0·03 millim. in diameter, abundantly echinated by the spined styli, which are occasionally also found embedded lengthwise in the fibre, two or three side by side.

Spicules.—Verticillately spined styli (Plate XII., fig. 9), straight or slightly curved; the spines mostly small and conical, especially about the middle of the spicule; those at the base irregularly arranged, larger, and often hook-shaped, with the sharp points curved towards the apex of the spicule; apex sharp-pointed and free from spines for a short distance. Size variable, but characteristically long, say about 0·24 millim. by

* A second specimen closely resembles the type.

0·02 millim. at the base (including spines). Although they are verticillately spined, the annulation of these spicules is not nearly so distinct as in *Agelas mauritiana*.

R.N. 304; 312 (type). (Both from Ceylon seas.)

Echinodictyum, Ridley.

Ectyoninæ with reticulate main skeleton composed of spicular fibre containing smooth oxea and echinated by spined styli. Smooth styli may also be present. Microscleres usually absent.

Echinodictyum clathratum, n. sp.—Plate XI., fig. 4.

The single specimen forms a sub-spherical, clathrous mass of rather thin, short, flattened trabeculæ, echinated on the outer surface by slender conuli. Vents and pores not seen. Colour (in spirit) pale greyish-yellow; texture soft and resilient, fairly tough. Total diameter about 20 millims.

The main skeleton is a very irregular network of fairly stout spicular fibre; the size and shape of the meshes and the thickness of the fibres varying greatly. The fibres contain a very large number of oxeote megascleres closely packed together side by side, while the spongin cement which unites them is inconspicuous on account of its very pale colour. The fibres are echinated more or less abundantly by spined styli which project from them almost or quite at right angles. Numerous loose megascleres (oxea and styli) are scattered between the fibres. There is a dermal skeleton of well developed brushes of very slender styli; the brushes are well separated from one another, and each exhibits a beautiful radiate arrangement of its component spicules. These brushes appear to be confined to the outer surface of the sponge as a whole, and are absent from the surfaces of the inner trabeculæ.

Spicules.—(1.) Oxea (Plate XI., fig. 4, *c*, *d*); smooth, slender, usually more or less sharply bent at or near the middle, gradually and sharply pointed at each end; size very variable, commonly about 0·25 millim. by 0·006 millim. In the fibres and scattered between them, forming the greater part of the skeleton.

(2.) Smooth styli (Plate XI., fig. 4, *a*, *a*); very long and fairly stout, tapering gradually from the evenly rounded base (which may be very faintly tylote) to the sharply pointed apex; nearly straight but generally slightly curved towards the base; size variable, say about 1·26 millims. by 0·012 millim. These spicules lie parallel to the surface in the thickness of the sponge-lamella, without any definite arrangement.

(3.) Smooth styli (Plate XI., fig. 4, *b*); very slender, almost hair-like; straight or gently curved; evenly rounded at the base, very gradually and finely pointed at the apex; size about 0·34 millim. by 0·002 millim. In the dermal brushes.

(4.) Spined tylostyli (Plate XI., fig. 4, *e*, *f*); rather long and slender, straight, tapering gradually from the slightly developed head to the narrow, fairly sharp-pointed apex. Spines small but abundant all over, especially on the head. Size about 0·1 millim. by 0·006 millim. where the shaft joins the head.

I have also seen three small isochelæ about 0·018 millim. long, and two or three sigmata, one of which measured about 0·05 millim. from bend to bend; but these spicules are so scarce that I am doubtful whether they are proper to the sponge.

This is an interesting species, having (if we leave out of account the doubtful microscleres) the spiculation of an *Echinodictyum* combined with the habit of an *Echinoclathria*. It is evidently nearly related to THIELE'S *Echinodictyum cavernosum* from Celebes (**39**), but differs in its pale colour and in the presence of the large styli.

R.N. 325 (Ceylon seas).

Aulospongus, NORMAN.

Massive Ectyoninæ with plumose columnar skeleton, comprising both smooth and spined styli in the spiculation. Without microscleres.

In my 'Report on a Second Collection of Sponges from the Gulf of Manaar' (**3**) I expressed the opinion that NORMAN'S genus *Aulospongus* (**55**) was unnecessary, and that the species for which it was established might be included in the genus *Axinella*. Further consideration has, however, induced me to alter my views on this question, and to consider the presence of the spined styli as constituting a sufficient generic distinction from *Axinella*, and, indeed, necessitating the removal of the genus to the Ectyoninæ.

This genus is evidently closely related to *Raspailia*, and constitutes one of the apparent connecting links between the Ectyoninæ and Axinellidæ. THIELE (**39**) has referred to the genus *Raspailia* two or three Japanese species, one, at least, of which (*Raspailia* (?) *villosa*) should perhaps be included in *Aulospongus*. The Australian *Raspailia cacticutis* (*vide* DENDY, **10**) may also possibly belong here, and likewise Mr. CARTER'S *Dictyocylindrus sessilis* from the Gulf of Manaar (**4**).

Aulospongus tubulatus (BOWERBANK).

1873, **Haliphysema tubulatum**, BOWERBANK (**8**); 1878, **Aulospongus tubulatus**, NORMAN (**55**); 1889, **Axinella tubulata**, DENDY (**3**).

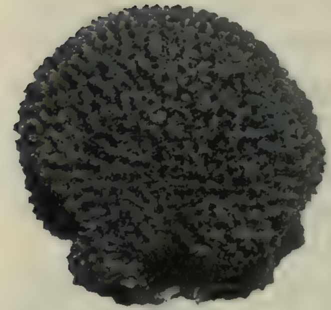


Fig. 3. *Aulospongus tubulatus* (BOWERB.); from Gulf of Manaar; nat. size.

There are a number of specimens of this sponge in Professor HERDMAN'S collection. The species (fig. 3) forms one of the most characteristic elements in the Sponge-Fauna of Ceylon, and is of especial biological interest as affording an example of symbiosis, or perhaps commensalism, between a Sponge and an Annelid. I have nothing to add to the account which I gave in my 'Report on a Second Collection of Sponges from the Gulf of Manaar' (**3**).

R.N. 1, 2, 3 (and others not numbered; all from Gulf of Manaar (Stats. V., IX., XV., LV., LXI., LXVIII.).

Acarnus, Gray.

Ectyoninæ in which the megascleres may be stylote, oxeote, tylote and cladotylote, the latter forming the characteristic "grapnel-spicules" which typically echinate the skeleton fibre. Microscleres may be present in the form of palmate isochelæ and toxa.

Acarnus ternatus, Ridley.—Plate VIII., fig. 4.

There is in the collection a remarkably fine dry specimen of this species (R.N. 105, Plate VIII., fig. 4), of proliferous and thickly flabellate habit, with rather large vents (about 8 millims. in diameter) on the summits of the lobes. The specimen measures 270 millims. in greatest breadth by 150 millims. in height, and its colour is brown. There are also a couple of small specimens in spirit, the best of which is sub-cylindrical in form and irregularly branched.

The spongin of the skeleton fibres is very strongly developed but very pale-coloured.

Spicules.—(1.) Styli, measuring about 0·3 millim. by 0·0164 millim.

(2.) Cladotylota (grapnels), with usually three large, strongly recurved, sharp teeth; shaft about 0·21 millim. by 0·012 millim.

(3.) Slender tylota with slightly spined heads; about 0·22 millim. by 0·0035 millim. in the middle.

(4.) Oxea; long and very slender, gradually sharp-pointed at each end, may be angulated at or near the middle; say about 0·74 millim. by 0·004 millim.

(5.) Toxa; say about 0·152 millim. by 0·008 millim., but often more slender.

(6.) Palmate isochelæ, about 0·02 millim. long.

The slender oxea occur irregularly distributed outside the horny fibres. Ridley (**16**) makes no mention of them in his description, but they might be overlooked or regarded as accidental. Keller, on the other hand, describes and figures similar spicules in his *Acarnus wolffgangi* from the Red Sea (**61**). The latter species may possibly prove to be a mere synonym of *A. ternatus*.

The species has hitherto been recorded from Torres Straits (Ridley), Bombay (?) (Ridley), Amirante Islands (Ridley), and Tahiti ("Challenger").

R.N. 105 (dry, Gulf of Manaar); 313; 329 (Ceylon seas).

Cyamon, Gray (*emend.*).

Ectyoninæ in which the principal megascleres are smooth styli and tylostyli; the echinating spicules have a radiate form, and there are no microscleres.

In 1867, Gray (**31**) proposed this genus for Bowerbank's *Dictyocylindrus vickersii*, of which a single spicule was figured and described in the 'Monograph of British Spongiadæ.'* It was not until 1879 that this species was first really described by

* Vol. i., p. 267, fig. 234.

CARTER (**56**), who, however, did not adopt GRAY'S genus, but adhered to BOWERBANK'S original name.

In 1880, CARTER (**4**) also described two species from the Gulf of Manaar, which he named *Microciona quadriradiata* and *M. quinqueradiata* respectively, and called attention to the resemblance of the echinating spicules in these species to those of "*Dictyocylindrus vickersii.*" It appears to me that all these three species must be included in one genus, distinguished as in the diagnosis given above, for which we may retain GRAY'S name *Cyamon.*

This genus appears to be nearly related to *Trikentrion*, but is distinguished from it by the absence of oxeote megascleres (compare CARTER, **56**).

The peculiar radiate echinating spicule is probably derived from a spined echinating stylus by great enlargement of three or four of the basal spines. In this way it may come to resemble a tetractinellid spicule or an aster. It is extremely interesting to compare with these forms the equally peculiar echinating "grapnel" spicule of *Acarnus*, in which a tetractinellid form may also be arrived at secondarily, but by enlargement of spines at the apex instead of at the base of the spicule.

Cyamon quinqueradiatum (CARTER).

1880, **Microciona quinqueradiata,** CARTER (**4**).

The single specimen in the collection forms a sub-circular crust, about 11 millims. in diameter and 3 millims. thick in the middle, attached to a mass of nullipore.* The surface is uneven and irregularly conulose, and there is in parts a distinct, thin dermal membrane. In parts also the surface is sparsely hispid from the projection of some of the large spicules. The texture is soft and compressible, internally somewhat cavernous, and the colour (in spirit) is pale yellowish-brown.

The skeleton consists chiefly of tylostyles and styles of various sizes, the latter (at any rate usually) longer than the former. These spicules sometimes have their bases resting on the substratum and sometimes they are arranged in short plumose columns; some have their apices projecting for a considerable distance beyond the surface. The echinating spicules are rather scarce and local in their distribution, mostly to be found amongst the bases of the other spicules; though plentiful here and there, they might easily be overlooked except in fortunate preparations.

The spiculation agrees fairly closely with CARTER'S description, but I think he has laid too much stress upon the distinction of the various forms of styli and tylostyli. In our specimen these pass gradually into one another; the slender "acuate" is not recognisable as a distinct type (it may be simply a young form), while the tylostyli have larger heads than appears from CARTER'S description and figure. There may be either three or four smooth rays in the echinating spicule (in addition to the spined ray), but it agrees very closely with CARTER'S description and figure.

R.N. 270 (deep water off Galle and onwards up West Coast).

* In association with a small specimen of *Petromica massalis*, R.N. 269.

Plocamia, SCHMIDT.*

Ectyoninæ of varying form; may be encrusting or erect and branched. The characteristic spicules are dumb-bell-shaped or sausage-shaped megascleres, in addition to which styli or tylostyli of various forms (some of which are typically echinating) may be present. The microscleres are isochelæ and (at any rate usually) toxa.

Plocamia manaarensis (CARTER)—Plate VIII., fig. 1.

1880, **Dictyocylindrus manaarensis,** CARTER (**4**); 1881, **Dirrhopalum manaarense,** RIDLEY (**60**).

There are several specimens of this curious sponge in the collection. Mr. CARTER figured and described both external form and spiculation, and Mr. RIDLEY added valuable information on the latter point and on the question of systematic position. It is therefore unnecessary for me to do much more than refer to Plate VIII., fig. 1, which represents a much finer specimen than any hitherto obtained. The colour of the sponge (in spirit) varies from pale yellowish-grey to almost black,† and the branching is extremely irregular. One specimen (R.N. 367) shows very clearly how the main stem may be attached to the substratum by an expanded base.

LAMBE (**85**) has recorded this species from California, but I think that his identification is probably erroneous.

R.N. 41 (Gulf of Manaar); 76 (Stat. XXXIII., 18 fathoms); 107 (off Galle, February 13, 1902); 278 (deep water off Galle and onwards up West Coast of Ceylon); 367 (deep water outside pearl banks); 374 (Stat. LX., 20–30 fathoms, Gulf of Manaar).

Bubaris, GRAY.

Ectyoninæ of usually encrusting habit. Skeleton consisting of an inner mass of diactinal (vermicular) spicules, from which large styli or tylostyli project vertically outwards. Without microscleres.

This genus was founded by GRAY (**31**) for BOWERBANK'S *Hymeraphia vermiculata*, the type of the genus *Hymeraphia* (*H. stellifera*) being a totally different sponge. TOPSENT (**59**, **62**) has already adopted the genus.

It is probable that there are a large number of encrusting sponges, with skeleton arrangement very similar to that of *Bubaris*, which are in reality not closely related to one another, but derived from several groups by adaptation to an encrusting habit (compare *Hymedesmia* amongst Astromonaxonellida). In such cases we must judge of their systematic position rather by the form of the spicules than by the mere arrangement of the skeleton.

The possible relationship of the genus *Bubaris* to the Axinellidæ is indicated in the Report of the "Challenger" Monaxonida (p. 182).

* For literature, &c., *vide* RIDLEY and DENDY (**1**).

† See footnote under *Iotrochota purpurea*.

Bubaris eruca (CARTER).

1880, **Hymerhaphia eruca**, CARTER (**4**); 1894, **Rhabderemia eruca**, TOPSENT (**59**).

There are three specimens of this very curious encrusting sponge in the collection; it has been well described and figured by CARTER (*loc. cit.*), who himself pointed out its close resemblance to BOWERBANK'S *Hymeraphia vermiculata*, which is the type species of the genus *Bubaris*.

TOPSENT (**62**) has recently proposed to include this species in his genus *Monocrepidium*, distinguished from *Bubaris* by the tuberculation of the diactinal megascleres. In *Bubaris eruca* the spicules in question are annulated rather than tuberculated.

R.N. 183 (Stat. XLIII., off Kaltura, February 19, 1902, depth 22 fathoms); 239A, 240A (both from deep water off Galle and onwards up West Coast).

Rhabderemia, TOPSENT.

Encrusting or massive Ectyoninæ in which the principal megascleres are styli with strongly curved base, shaped like a hockey stick, and the principal microscleres are contorted sigmata. There are no chelæ and the echinating spicules appear to be greatly reduced or absent.

TOPSENT (**48**) established this genus in 1892, originally for the reception of CARTER'S *Microciona pusilla* and *M. intexta* (**57**), and a new species described by himself under the name *Rhabderemia guernei*. *R. pusilla*, being mentioned first, may be taken as the type of the genus. *R. guernei* and the new species which I am about to describe under the name *Rhabderemia indica*, agree so closely with *R. pusilla* that there can be no reasonable doubt of their generic identity. *R. intexta* differs more from the typical species, but may still, I think, be included in the genus. It is distinguished from the others by the possession of spined megascleres and the absence of small slender styli. There is in Mr. CARTER'S cabinet, however, a preparation labelled by him "*Microciona minutula,*" which is intermediate in spiculation, having large bent styli minutely spined at the apex and also very slender styli slightly roughened at the base. It is further characterized by having toxa amongst the microscleres, and is evidently quite distinct from *Rhabderemia* (*Microciona*) *pusilla*, with which Mr. CARTER has apparently confounded it.*

It is probable that some other species hitherto referred to the genus *Microciona* will also have to be included under *Rhabderemia*; on the other hand, as I have shown in dealing with *Bubaris eruca*, this species has been erroneously included in the genus *Rhabderemia* by TOPSENT.

Rhabderemia indica, n. sp.—Plate XII., fig. 10.

The specimen encrusts and almost completely envelopes some large fragments of shell, and attains on one side of the shell a thickness of 7 or 8 millims. The shape of the entire specimen with its enclosed shell-fragments is massive and irregular.

* The name *pusilla* was intended by CARTER to be *minutula*, *vide* CARTER (**57** and **4**).

The surface is uneven but fairly smooth; granular; with a distinct, translucent dermal membrane in places. Vents probably small and scattered. Texture rather soft, spongy and friable. Colour (in spirit) dull grey. Greatest diameter of the entire mass about 48 millims.

The skeleton is a close-meshed, very irregular reticulation of megascleres, many of which are collected together into loose multi-spicular bands running perpendicularly to the surface. These primary fibres, if we may so call them, are connected together by still looser and more irregular secondary bands, and the whole is confused by immense numbers of irregularly scattered megascleres. There is no special dermal skeleton and I have detected no spongin.

Spicules.—(1.) Styli, "rhabdostyles" of Topsent (Plate XII., fig. 10, *a*, *b*, *c*); base evenly rounded off, not tylote; basal part of shaft sharply bent at an angle to the remainder, like the end of a hockey stick, occasionally somewhat spirally curved; remainder of shaft straight or nearly so; gradually or somewhat hastately pointed at the apex; size fairly uniform, about 0·24 millim. by 0·006 millim., the bent basal portion being about 0·018 millim. long. These make up the main skeleton.

(2.) Very small, slender styli (Plate XII., fig. 10, *d*); straight or nearly so; tapering gradually from rounded base to finely pointed apex; with very slightly roughened surface; size about 0·044 millim. by 0·002 millim. at the base. Scattered very abundantly through the soft tissues as microscleres, and very uniform in size. I am inclined to think that these spicules are vestigial echinating styli.

(3.) Sigmata (Plate XII., fig. 10, *e*); very much contort, slender, often twisted into a kind of half-knot in the middle, sharply pointed at each end (when one end appears bluntly rounded, or even knobbed, it is probably due either to its having been broken short or to fore-shortening in perspective). The greatest length, measured in a straight line from bend to bend, is only about 0·012 millim., but if the spicule were straightened out it would measure at least twice as much. Very abundant.

This species is distinguished from *Rhabderemia pusilla* by the greater length of the bent styli and the much smaller size and roughened surface of the minute styli; from *R. guernei* by the absence of the peculiar microscleres which Topsent terms "thraustoxes," and by the smaller size of the megascleres and the roughening of the minute styli; from *R. intexta* by the presence of the minute styli, the smoothness of the large megascleres and the form of the sigmata. It differs from all in its much more robust growth, which constitutes perhaps its most noteworthy feature.

R.N. 341 (Ceylon seas).

Family: AXINELLIDÆ.

Sigmatomonaxonellida in which the microscleres have usually been entirely lost by degeneration; the megascleres are usually, in part or entirely, stylote; the skeleton arrangement is usually, but not always, plumose; and there are no spined echinating styli.

Owing to their loss of microscleres and want of other well-marked characters, this family is one of the most unsatisfactory with which we have to deal. The plumose arrangement of the megascleres in the main skeleton cannot be regarded as exclusively diagnostic, for it is met with also in Ectyoninæ and even in Chalininæ, and too great reliance upon this character has led to the inclusion of forms amongst the Axinellidæ which certainly should not be included in that family. I have already indicated that those so-called Axinellids in which true asters have been observed (*e.g.*, *Vibulinus*) should be placed amongst the Astromonaxonellida. The genus *Raspailia*, similarly, has been removed from the Axinellidæ to the Ectyoninæ, but we are still left with a somewhat heterogeneous collection of sponges which it is extremely difficult to define, and which will probably be subjected to considerable re-arrangement in the future. A curiously constant feature in this group is the irregularity exhibited by the ends of the megascleres and the manner in which the stylote and oxeote forms tend to pass into one another.

It is highly probable that the group, even as here restricted, is of polyphyletic origin.

Spongosorites, Topsent (*emend.*).

Axinellidæ with the main skeleton composed of an irregular but dense reticulation of large oxea or styli, and dermal skeleton composed of a thin layer of very much smaller oxea lying tangentially, and in close contact with the main skeleton; oxea typically biangulate.

Topsent (**14**, &c.) places the genus *Spongosorites* in his family Coppatiidæ, assuming that it has lost the characteristic microscleres, and calling attention to the apparent tetractinellid affinity indicated by the biangulate oxea. It appears to me, on the other hand, to come more naturally amongst the Axinellids, being not distantly removed from *Leucophlœus* and *Ciocalypta*, as indicated by the new species described below, in one of which we perhaps find a clue to the evolution of the curious finger-shaped "processes" of the latter genus. In *Ciocalypta tyleri*, var. *aberrans*, we also sometimes find biangulate oxea.

The genus *Spongosorites* may also be nearly related to Thiele's *Dactylella* (**39**).

Spongosorites topsenti, n. sp.—Plate XII., fig. 1.

There are six specimens of this curious sponge in the collection, differing so mucn amongst themselves in external form that it seems desirable to give a short account of each.

R.N. 152 is a depressed cake-shaped sponge of nearly circular outline, with convex upper and almost flat lower surface, the latter having been evidently attached to the substratum all over. Greatest diameter 36 millims., thickness in the middle 13 millims. The upper surface is somewhat corrugated, with shallow grooves (indicating underlying canals) radiating in a stellate manner from low, mound-like projections, one at least of which bears at its summit a small group of vents through which the radiating canals open, while another bears no visible apertures at all. The upper surface also bears one very small digitiform process, about 5 millims. long and 2 millims. in diameter, with no visible opening, and there may have been more of these processes, now broken off. The texture is hard and compact, almost stony, and the colour (in spirit) is dull brownish-grey.

R.N. 68 is similar in general features, but the upper surface is much more strongly convex; the broad, mound-like projections are rather better developed, but still few in number (about three, grouped in the middle of the upper surface), and one bears a conspicuous vent. The slender digitiform processes without visible openings are more numerous than in R.N. 152. Greatest diameter of specimen 34 millims.

R.N. 182 is a small hemispherical specimen only about 15 millims. in diameter, with the convex upper surface produced in the middle into a single stout digitiform process, about 11 millims. long by 6 millims. thick, but of irregular shape. This process contains wide canals which enter it from the body of the sponge. There are apparently none of the slender digitiform processes. I have seen no vents, but the specimen is somewhat damaged.

R.N. 202 is closely similar to the last, but rather larger, with a single stout digitiform process in the middle, containing longitudinal canals, but now broken short.

R.N. 134 is a small specimen about 26 millims. in diameter, with slightly conulose surface and two very short but stout finger-like processes.

R.N. 77 is much larger than any of the preceding, and the base, instead of being flat below, has grown partially round several loose calcareous nodules. It is strongly convex and more or less conulose and corrugated above, and the upper surface also bears two or three well-developed, stout, erect digitiform processes, very irregularly distributed. These processes contain more or less well-developed longitudinal canals, but there are no visible vents. On the general surface of the sponge the usually low conuli are in places elongated to form slender projections about 4 millims. long, and with strongly hispid surface. The base of this specimen is about 78 millims. long by 35 millims. in greatest breadth. One of the larger processes is about 26 millims. high by 15 millims. broad at the base, tapering upwards almost to a point.

From the above descriptions it would appear that the sponge is normally cushion- or cake-shaped, with the upper surface conulose or rugose, and sometimes bearing processes of two kinds, viz., (1) large processes which appear to contain the exhalant canals and to be produced by elongation of low, mammiform, vent-bearing projections, with the conspicuous vents probably replaced by a cribriform dermal membrane; and (2) small slender processes produced by elongation of the surface conuli, and apparently bearing no special relation to the canal system.

The main skeleton in the body of the sponge consists of a very dense and confused reticulation of scattered spicules lying in all directions and varying greatly in form and size, stout and slender mixed up together. At the surface, lying immediately on the main skeleton, there is a thin dermal layer of short and rather slender oxea, through which the apices of the large underlying spicules frequently project. In the processes of both kinds, large and small, the spicules of the main skeleton for the most part run lengthwise, and there is the same irregular dermal reticulation of small oxea. There are none of those characteristic radiating pillars of spicules, supporting the dermal membrane over large sub-dermal cavities, which we find in a typical *Ciocalypta*.

Spicules.—(1.) Large and very stout (Plate XII., fig. 1, *a–k*), typically fusiform oxea, but variously ended, sometimes stylote or strongylote, always more or less curved, sometimes biangulate, sometimes very crooked and irregular; size about 1·1 millims. by 0·065 millim., but variable.

(2.) Short, slender oxea (Plate XII., fig. 1, *l*); usually biangulate, gradually and sharply pointed at each end, symmetrical; measuring about 0·18 millim. by 0·008 millim., but variable. These forms occur chiefly, but not entirely, in the dermal skeleton; while between these and the largest spicules numerous intermediate forms (Plate XII., fig. 1, *m*) may be observed.

The above account of the spiculation is taken from R.N. 152, but the spiculation of the other specimens does not differ in any important respect.

The species may be distinguished from its European congener, *S. placenta* (the type of the genus), by the development of the finger-like outgrowths (which, however, may be not always present) and by details of spiculation, such as the absence of the central inflation of the oxea.

R.N. 68 (Gulf of Manaar); 77 (Stat. XLV., off Pantura, 25 fathoms); 134, 202 (deep water off Galle and onwards up West Coast); 152; 182 (Stat. XLIII., off Kaltura, February 19, 1902).

Spongosorites (?) **lamellata**, n. sp.—Plate XII., fig. 2.

Sponge irregular, compressed, lamello-digitate; only 3 millims. or 4 millims. in average thickness, with a maximum length of about 45 millims. ? Erect. Surface granular in appearance and minutely hispid, fairly smooth but uneven; margins rounded. Colour (in spirit) pale greyish-yellow.

The main skeleton consists of a dense and very irregular reticulation of styli, mostly scattered singly, but occasionally collected in loose strands. The dermal skeleton is formed of a thin layer of small slender oxea, lying tangentially to the surface and very irregularly scattered.

Spicules.—(1.) Styli (Plate XII., fig. 2, *a*, *b*, *c*); usually fairly stout and slightly curved or crooked (especially towards the base), narrowing slightly to the base, which is evenly rounded, and tapering gradually to the apex, which is sharply pointed; size, when fully grown, about 0·95 millim. by 0·02 millim., but numerous smaller and more slender forms occur which are apparently young.

(2.) Oxea (Plate XII., fig. 2, *d*, *e*); slender, sub-fusiform, slightly curved or angulated once or twice, sharply pointed at each end; size very variable, averaging, say, about 0·2 millim. by 0·0055 millim. These spicules occur chiefly at the surface of the sponge, but are also found in the interior.

This species differs widely from *Spongosorites topsenti*, not only in external form but also in the (? invariably) stylote character of the larger spicules.

R.N. 236 (deep water off Galle and onwards up West Coast of Ceylon).

Spongosorites (?) **lapidiformis**, n. sp.—Plate XII., fig. 3.

The three specimens by which this species is represented in the collection are quite irregular in shape; massive, and everywhere evenly rounded off, like water-worn pebbles, with no recognisable points of attachment or differentiation of surfaces. The surface is granular and very shortly hispid; harsh to the touch; occasionally veined by underlying ramifying canals. Vents few, small, sometimes hardly recognisable. Texture hard and compact, without separable dermal membrane. Colour (in spirit) pale wax-yellow. The largest specimen measures about 29 millims. in maximum diameter.

The skeleton is a very dense, irregular reticulation of megascleres, partly collected together in ill-defined bands. This reticulation extends right up to the surface of the sponge, and there is no special dermal skeleton, and apparently no spongin.

Spicules.—(1.) Very stout, fusiform oxea (Plate XII., fig. 3, *a*, *b*); slightly curved and gradually and sharply pointed at each end; measuring, say, about 0·87 millim. by 0·0495 millim.; pretty frequently becoming stylote (Plate XII., fig. 3, *c*) by rounding off of one end, and rarely even strongylote. These oxea are connected by intermediate forms (Plate XII., fig. 3, *d*) with

(2.) Slender oxea (Plate XII., fig. 3, *e*); slightly curved, gradually sharp-pointed at each end; measuring, say, about 0·54 millim. by 0·012 millim.; irregularly intermingled with the large oxea, and perhaps only young forms thereof.

This species is of very doubtful systematic position. Had it not been for the presence of so many stylote spicules, I should probably have referred it to *Halichondria*. It differs from typical species of *Spongosorites* in the absence of a special dermal layer of small oxea.

R.N. 143, 144, 145 (all from deep water off Galle and onwards up West Coast).

Hymeniacidon, Bowerbank (*emend.*).

Axinellidæ of massive habit. Skeleton reticulate, composed of spicular fibre usually containing a good deal of spongin; with no special dermal skeleton. Megascleres styli or sub-tylostyli; no microscleres.

I have pointed out on a previous occasion (**10**) that Lendenfeld's genus *Stylotella* (with which Topsent's *Stylinos* is admittedly synonymous) is not distinguishable from *Hymeniacidon*. The position of the genus amongst the Axinellidæ is, of course, open to question, but it seems to come at least as naturally here as anywhere else.

Hymeniacidon petrosioides, n. sp.—Plate XII., fig. 4.

The type specimen (R.N. 151) is massive, cushion-shaped, strongly convex above and irregularly concave below, having evidently been attached to the substratum at a few points only. Upper surface fairly even but coarsely granular. Vents (probably) few, small and scattered. Texture very hard and compact; surface harsh to the touch. Colour (in spirit) dull grey, with a purplish tinge here and there. Greatest breadth about 47 millims.; maximum thickness about 19 millims. There is another much smaller specimen of irregularly massive form.

The skeleton is a dense, close-meshed reticulation of short, stout styli, in which one can readily distinguish stout, multispiculous main fibres running at right angles to the surface at distances of about one spicule's length from one another, and connected crosswise by isolated spicules and bundles of spicules, with other similar spicules irregularly scattered in the soft tissues.

Spicules.—Short, stout, more or less curved or bent styli (Plate XII., fig. 4), broadly rounded off at the base (occasionally slightly tylote) and gradually sharp pointed at the apex; fairly uniform in size, measuring about 0·39 millim. by 0·022 millim. (There are apparently no oxea.)

This species appears to be nearly related to Topsent's *Stylinos jullieni* from the Atlantic (**48**), but the spicules are much larger. In external appearance it bears a very close resemblance to *Thrinacophora durissima*, with which it may easily be confounded until microscopically examined, and, indeed, I am inclined to think that these species of *Hymeniacidon* are really closely related to the massive species of *Thrinacophora*. We may also have here, so to speak, a point of contact between the Axinellidæ and Desmacidonidæ, indicated both by the form and arrangement of the megascleres and the presence of trichodragmata in the last-named genus. The spicular fibre in *Hymeniacidon* is not plumose, or, at most, very feebly so, but it is impossible to draw a hard and fast line between the plumose type of fibre characteristic of the Axinellidæ and the non-plumose type characteristic of the Desmacidonidæ, &c.

R.N. 151; 316 (Ceylon seas).

Thrinacophora, Ridley and Dendy.

Axinellidæ with typically plumose skeleton and with microscleres in the form of trichodragmata.

Thrinacophora agariciformis, n. sp.—Plate XII., fig. 6.

Sponge consisting (usually, at any rate) of a short, thick stalk (which has evidently been attached below), supporting a thick, rounded, cushion-shaped body which is irregularly depressed above so as to form a more or less shallow, very thick-walled cup; or the top of the sponge-body may be flattened, with several irregular, shallow depressions. Surface minutely and uniformly conulose; the conuli barely 0·5 millim. in diameter and separated from one another by deep but narrow, meandering grooves. In the depression at the top the conuli may be covered over by a thin translucent membrane containing small circular vents. Consistence compressible, resilient. Colour (in spirit) pale yellowish-grey. A typical specimen (R.N. 163, not quite the largest) gave the following measurements: total height 25 millims.; length of stalk 8 millims.; diameter of stalk 13 millims.; longer diameter of body 31 millims.; shorter diameter 21 millims.

The skeleton is arranged in a typical axinellid manner, consisting chiefly of plumose columns of spicules running at right angles to the surface and ending in the conuli. These columns lie pretty close together and are connected with one another crosswise by occasional groups of spicules, or by single spicules, running across at right angles from one to the other; there are also numerous irregularly scattered spicules in the interspaces. The spicules are cemented together in the columns, and sometimes also in the cross connections, by a large amount of very pale-coloured spongin. There is no special dermal skeleton, but the surface may be rendered slightly hispid by the projection of the terminal spicules of the columns.

Spicules.—(1.) Short styli (Plate XII., fig. 6, *b*, *c*); fairly stout and more or less curved, especially towards the base, which is broadly rounded off; with gradually and finely pointed apex; size about 0·268 millim. by 0·01 millim., but variable.

(2.) Oxea (Plate XII., fig. 6, *d*, *e*); usually gently and evenly curved and sharply pointed, but often irregularly ended; of about the same size as the short styli, and very numerous.

(3.) Very long and slender, setaceous styli (Plate XII., fig. 6, *a*) (sometimes oxea), measuring, say, about 0·75 millim. by 0·008 millim., but variable. These spicules are found lying lengthwise in the interspaces between the plumose columns.

(4.) Trichodragmata (Plate XII., fig. 6, *f*); bundles of short and very slender, hair-like microscleres, slightly curved, the whole bundle measuring, say, about 0·032 millim. by 0·005 millim., but variable. These occur scattered quite irregularly between the spicular columns.

This beautiful and well-characterised little sponge is represented in the collection by seven specimens. It differs widely from any of its known congeners in external form, and spirit specimens are easily mistaken, at first sight, for young examples of *Phakellia donnani*, though readily distinguished on closer inspection by their paler colour, more finely conulose surface, &c. It is apparently common and may be looked upon as one of the most characteristic species of the Ceylon Sponge-Fauna.

R.N. 160A; 160B; 163; 163A; 314; 332; 356 (all from Ceylon seas).

Thrinacophora durissima, n. sp.—Plate XII., fig. 5.

Sponge sessile, cushion-shaped, very strongly convex above and somewhat contracted below, but attached by a broad base. Surface even, but granular or minutely conulose, the conuli being in part covered over by a translucent dermal membrane; very minutely hispid. Vents small, few, scattered; surrounded by feebly developed grooves arranged in a somewhat stellate fashion. Colour (in spirit) pale yellowish-grey. Texture compact, very hard; surface harsh to the touch; internal structure radially columnar. Greatest diameter about 23 millims.

The skeleton is composed chiefly of close-set, rather irregular, plumose columns of megascleres, running at right angles to the surface and ending in the small conuli or granules. These columns are connected by numerous spicules, isolated or in loose bands, which run across at right angles from one to another, while numerous megascleres are also scattered irregularly in the soft tissues.

Spicules.—(1.) Oxea (Plate XII., fig. 5, *b*); short, fairly stout, fusiform, gently and symmetrically curved, gradually sharp-pointed at each end; size up to about 0·39 millim. by 0·024 millim., but usually somewhat less, especially in diameter.

(2.) Styli (Plate XII., fig. 5, *a*); with broadly rounded base and gradually sharp-pointed apex; usually more or less curved towards the base; dimensions about the same as those of the oxea. Perhaps not quite so abundant as the oxea.

(3.) Trichodragmata (Plate XII., fig. 5, *c*, *d*); short, stout bundles of very slender, hair-like spicules, the whole bundle having, as usual, a faint brownish colour; dimensions of the entire bundle about 0·02 millim. by 0·008 millim.; abundant towards the surface of the sponge.

This curious little sponge is evidently closely related to Topsent's *Thrinacophora spissa* (**48**) from the North Atlantic, and forms an interesting connecting link between that species (which has only oxeote megascleres, apparently arranged in a halichondrioid rather than an axinellid fashion) and the more typical species of the genus.

R.N. 355 (Ceylon seas).

Axinella, Schmidt.

Axinellidæ of varying habit, but not flabellate. With plumose skeleton composed of smooth styli or oxea and no microscleres.

Axinella labyrinthica, Dendy.

There are three specimens of this sponge in the collection. The species is easily recognisable by its external appearance, and I have nothing to add to my former description, Dendy (**3**), 1889.

R.N. 33, 103 (both from Gulf of Manaar); 357 (Ceylon seas).

Axinella manus, n. sp.—Plate XII., fig. 8.

Sponge erect, stipitate, branched in a somewhat palmate manner, but with the branches coming off at different levels and curving slightly towards one another (so as to suggest a hand holding a ball). Stem cylindrical, slightly expanded below, about 25 millims. long and 9 millims. in diameter. Branches about as thick as the stem, slightly flattened, short (usually about 30 millims. long), rather few in number, terminating in abrupt, conical apices. The vents are small openings in the floors of stellately arranged or longitudinal grooves, which give a characteristic appearance to the sponge, and are chiefly placed on the inner surface of the branches, but also occasionally on the outer surface and on the stem. Surface between the vent-bearing grooves granular or minutely conulose. Texture compressible, resilient but tough, with the stem a good deal harder than the branches. Colour (in spirit) rather light grey. Total height of specimen 84 millims.

The skeleton is rather loose and irregular, consisting (in the branches) of plumose columns radiating outwards to the surface and with many spicules irregularly scattered between; the whole becoming quite confused towards the middle of the branch, but without any special axial condensation.

Spicules.—(1.) Rather short and fairly stout styli (Plate XII., fig. 8); more or less curved towards the base, which is broadly rounded off; gradually and sharply pointed at the apex; size about 0·295 millim. by 0·016 millim., but often more slender.

(2.) Oxea; almost symmetrically curved and gradually sharp pointed at each end; of about the same dimensions as the styli; abundant.

This species, in the arrangement of the vents and in the skeletal characters, makes a close approach to *Phakellia donnani* and *P. symmetrica*, and demonstrates very clearly the impossibility of distinguishing sharply between the genera *Phakellia* and *Axinella*.

R.N. 53 (Gulf of Manaar).

Axinella tenuidigitata, n. sp.—Plate XIII., fig. 4.

The single specimen is a small massive sponge of short, thick, irregularly cylindrical form, attached by a broad base below and strongly convex on the upper surface, from which a number of slender, elongated, finger-like processes are given off. Surface uneven and irregularly hispid, especially on the digitiform processes; in part minutely and irregularly conulose and in part covered by a distinct, sub-glabrous, translucent dermal membrane. The digitiform processes are solid and they may unite with one another. Vents apparently small and scattered between the processes. Colour (in spirit) pale wax-yellow; texture hard and compact. Height of body about 20 millims., diameter about 15 millims.; length of processes, of which there are about half a dozen, about 11 millims., with a diameter of not much more than 1 millim.

The skeleton in the body of the sponge consists of an irregular reticulation of long styli, which, as they approach the surface, arrange themselves in loose, irregular, plumose columns. The digitiform processes are composed each almost entirely of a dense axis of similar spicules closely crowded together and placed longitudinally, with a few spicules projecting outwards beyond the surface, so as to give rise to its hispid character.

Spicules.—Apparently all stylote and all long (Plate XIII., fig. 4), but varying much in thickness; usually only very slightly curved (towards the base), but sometimes crooked; broadly rounded off at the base, which may be somewhat narrower than the middle part of the spicule, and gradually and sharply pointed at the apex. The stouter forms measure about 1·18 millim. by 0·0328 millim. In the digitiform processes they are a good deal more slender, and slender forms also occur intermingled with the stout ones in the body of the sponge.

R.N. 202A (deep water off Galle and onwards up West Coast of Ceylon).

Axinella halichondrioides, n. sp.—Plate XII., fig. 7.

Sponge encrusting, extended horizontally. Upper surface somewhat convex and rather uneven, with small monticular elevations, each bearing a single vent, scattered at fairly regular intervals; granular (minutely conulose) between the elevations, the conuli being normally covered over by a thin, transparent dermal membrane. Colour (in spirit) light brown; texture firm and compact, columnar in vertical section. Greatest breadth of specimen about 64 millims.; thickness in the middle about 16 millims. Height of vent-bearing projections up to about 2 millims. Diameter of vents about 1 millim. Distance between vents about 9 millims.

The skeleton consists chiefly of very stout but rather loose and irregular and only slightly plumose columns of spicules running vertically to the surface and ending in loose brushes in the small surface conuli. These columns contain a very large number of spicules and are connected together by short, loose bands of spicules running across the interspaces at right angles. There are also a large number of spicules irregularly and loosely scattered through the soft tissues.

Spicules.—Mostly oxeote (Plate XII., fig. 7, *a*); gently and uniformly curved, gradually and sharply pointed at each end; size about 0·31 millim. by 0·01 millim. A few styli of about the same size also occur (Plate XII., fig. 7, *b*, *c*).

This species resembles pretty closely THIELE'S *Axinella incrustans* (**39**) from Japan, but its spiculation shows it to be distinct.

R.N. 75 (outside pearl banks, Gulf of Manaar).

Phakellia, BOWERBANK.

Axinellidæ of compressed, flabellate (or cup-like) form, usually with vents on one of the flat surfaces and inhalant pores on the other. Without microscleres.

Phakellia donnani (BOWERBANK).

1873, **Isodictya donnani**, BOWERBANK (**8**); 1887, **Axinella donnani**, DENDY (**2**).

There are a dozen specimens of this characteristic species in the collection, in various stages of growth. The spiculation, as usual in the Axinellidæ, is somewhat variable, and oxeote as well as stylote spicules occur. In view of the cup-shaped (or sometimes flabellate) form (see fig. 4) it seems desirable to remove the species from the genus

Axinella and put it in *Phakellia*, if indeed the distinction between these two genera is to be maintained.

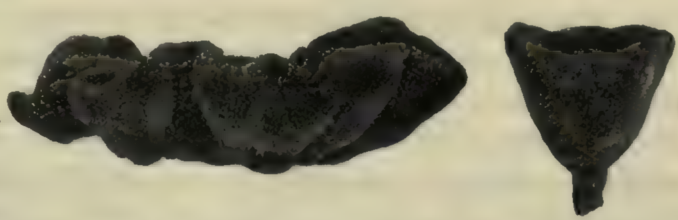
A  B

Fig. 4. *Phakellia donnani* (BOWERB.), from Gulf of Manaar, nat. size. A, flabellate; B, cup-shaped form.

R.N. 10, 15, 20, 21, 22, 23 (all from Gulf of Manaar); 160; 160A; 160B; 160C; 181, 181A (the last two from Stat. XLIII., off Kaltura, depth 22 fathoms, February 19, 1902).

Phakellia symmetrica, n. sp.—Plate XIII., fig. 3.

The single specimen is a short-stalked, flabellate sponge, the somewhat compressed stalk widening out not very suddenly into a single vertical expansion with evenly rounded margin and without any proliferation. The two surfaces are exactly alike; minutely conulose with small circular openings (? inhalant pores) everywhere between the conuli, and with numerous stellate vents scattered at moderately wide intervals. Towards the margin the surface becomes longitudinally grooved rather than conulose, and there are also a few marginal vents. Colour (in spirit) dull yellowish-grey; texture compressible, resilient, tough. Total height of specimen about 55 millims.; length of stalk about 16 millims.; greatest breadth of frond about 41 millims.; thickness of frond in the middle about 8 millims.

The skeleton is composed of moderately stout, slightly plumose fibres curving upwards and outwards to the surface (where they terminate in the small conuli) and connected together by short, irregular cross fibres, so as to form an ill-defined reticulation with many spicules scattered irregularly in the interspaces. The skeleton fibres contain much spongin, not very conspicuous, however, on account of its pale colour.

Spicules.—Styli (occasionally oxeote) of two principal varieties: (*a.*) Comparatively short and stout (Plate XIII., fig. 3, *a*, *b*); more or less curved towards the base, which is evenly rounded off, and gradually and sharply pointed at the apex; size about 0·23 millim. by 0·009 millim. (*b.*) Comparatively long and slender (Plate XIII., fig. 3, *d*), slightly curved towards the base, which is evenly rounded off, and gradually and finely pointed at the apex; size about 0·5 millim. by 0·008 millim.

This pretty little sponge may prove to be merely a variety of *Phakellia donnani*, connected with the typical form by the flabellate variety figured in my paper on the Sponge-Fauna of Madras (**2**). For the present, however, it is perhaps better to keep the two distinct.

R.N. 159 (Muttuvaratu Paar, 8 fathoms).

Phakellia ceylonensis, n. sp.—Plate VIII., fig. 3 ; Plate XIII., fig. 5.

The single specimen (Plate VIII., fig. 3) is shortly stipitate, erect, thinly flabellate and very proliferous. The branching and anastomosing vertical lamellæ of which it is composed all terminate at about the same level in thin, sinuous margins. The lamellæ are scarcely 3 millims. in thickness and have a tendency to become perforated by larger and smaller apertures. The two surfaces of the lamella are not distinguishable; each is finely conulose (granular) and minutely and slightly hispid. Vents not recognisable. Texture tough and resilient; colour (in spirit) greyish-brown. Total height only about 41 millims., but with a maximum breadth of about 90 millims.

The skeleton is dense, composed of plumose columns radiating upwards and outwards into the small surface conuli, and merging internally into an irregular but fairly dense reticulation of spicules. There is a large development of very pale-coloured spongin.

Spicules.—(1.) Styli; slightly curved or bent, evenly rounded off at the base, usually very gradually and finely pointed at the apex; of two principal sizes, but very variable : (*a.*) Comparatively short and stout (Plate XIII., fig. 5, *a*), say about 0·2 millim. by 0·008 millim. (*b.*) Long and slender (Plate XIII., fig. 5, *b*), say about 0·44 millim. by 0·005 millim.

(2.) Oxea (Plate XIII., fig. 5, *c*, *d*, *e*) ; subject to much the same variations in size as the styli, and variously ended.

This species is nearly related to CARTER'S *Phakellia flabellata* from Australia (*vide* DENDY, **10**), but for the present at any rate it may be regarded as specifically distinct.

R.N. 34 (Gulf of Manaar).

Phakellia crassistylifera, n. sp.—Plate XIII., fig. 6.

The single specimen is a small, irregular, proliferously lamellar and slightly clathrous sponge, without recognisable point of attachment. The surface is granular and minutely hispid, and there are no visible vents. Texture hard, tough, resilient. Colour (in spirit) pale wax-yellow. Height (?) 31 millims. ; greatest breadth about 19 millims. ; thickness of lamellæ variable, say about 2 millims.

The skeleton is a very dense, close and irregular reticulation of very stout fibre, composed of a large quantity of almost colourless spongin, in which numerous usually stout styli are more or less completely embedded. The primary fibres are stouter than the secondaries, and may have a somewhat plumose character ; but the whole reticulation is so confused, and the spongin, though very abundant, so pale in colour, that at first sight the entire skeleton looks like a dense, irregular network of thickly scattered styli.

Spicules.—Styli (Plate XIII., fig. 6) ; usually stout and comparatively short and more or less curved ; broadly rounded off at the base, which is not narrowed, and usually sharply and gradually pointed at the apex ; but the apex is occasionally bluntly rounded off, so that the spicule becomes strongylote with unequal ends. Size commonly about 0·46 millim. by 0·0285 millim., but very variable in diameter; often much more slender than the measurement given, and occasionally a good deal stouter; sometimes rather longer.

R.N. 256 (Ceylon seas).

Acanthella, Schmidt.

Axinellidæ of usually flabellate form and more or less cartilaginous consistence. With more or less strongly aculeate or conulose surface. With no microscleres.

Acanthella carteri, Dendy.—Plate VIII., fig. 6.

There are several specimens of this sponge in the collection, and as the external form has not yet been figured, Professor Herdman has kindly had one of them photographed for this report (Plate VIII., fig. 6). There is a strong development of very pale-coloured spongin fibre associated with the spicules, which I omitted to mention in my original description, Dendy, **3** (1889).

Keller's *Acanthella aurantiaca* (**61**), from the Red Sea, comes very near to this species, if it be not identical with it.

R.N. 11, 36, 49 (all from Gulf of Manaar, Stats. II., IV., V.); ? 301 (perhaps young); ? 336 (perhaps young).

Acanthella flabelliformis, Keller.

The single specimen is thinly flabellate; ? stipitate (the stalk may have been broken off, the specimen being somewhat damaged and worn); both surfaces beset with rather sharp longitudinal ridges, showing a tendency to break up into conuli; with deep, semi-cylindrical, longitudinal grooves between the ridges. The floor of the grooves is formed by a rather thick, translucent dermal membrane, containing no spicules and easily stripping off; in this membrane are scattered numerous small vents. Colour (in spirit) dark greyish-brown. Texture tough, compressible, resilient. Height of the single lamella of which the specimen consists 37 millims.; breadth 51 millims.; thickness (including ridges) about 5 millims.

The skeleton is a reticulation of stout spicular fibre, containing much spongin and comparatively few, though still very numerous, spicules. The main fibres curve upwards and outwards to the surface, and are united by irregular cross-fibres. The arrangement of the spicules, both in the fibres and between them, is very irregular and confused. The main fibres are often somewhat plumose.

Spicules.—Oxea; straight or curved, slender, gradually and sharply pointed at each end; size fairly uniform, up to about 0·3 millim. by 0·0065 millim.; occasionally stylote.

The soft tissues are densely charged with small, round, granular brown cells, probably pigment cells.

This species is chiefly characterised by its oxeote spicules and by the distinctly reticulate skeleton with its strong development of spongin. It appears to form a connecting link between the genera *Acanthella* and *Phakellia*.

I have little doubt of the specific identity of the Ceylon form with that from the Red Sea, where it is, according to KELLER, one of the most abundant and characteristic forms on the reefs. Such slight differences as I have observed will be sufficiently evident by comparison of the description given above with that given by KELLER (**61**), in 1889. KELLER tells us that the colour in life is blue.

R.N. 31 (Gulf of Manaar).

Auletta, SCHMIDT.

Axinellidæ of tubular form; without microscleres.

Auletta lyrata (ESPER).

1798–1806, **Spongia lyrata**, ESPER (**6**); 1870, **Raspaigella lyrata**, EHLERS (**58**); 1889, **Auletta aurantiaca**, DENDY (**3**).

There are a number of specimens of this species in the collection, which show it to be an extremely variable one, both as regards external form and spiculation. The re-discovery of the typical flabellate form, agreeing closely with ESPER'S figs. 1 and 2 (Plate 67), enables me to identify my *Auletta aurantiaca* with ESPER'S *Spongia lyrata*, which was also obtained from Ceylon.

Typical examples may be described as follows:—

Sponge erect, flabellate, shortly stalked. Lamella thick, slightly proliferous, with broadly rounded margin bearing a row of small, sometimes sphinctrate vents, which are the outlets of vertical oscular tubes. Surfaces of lamella rather minutely conulose or rugose, and slightly hispid. Texture (in spirit) compressible and resilient, but tough; colour yellowish-grey. One specimen (R.N. 345) has a total height of about 31 millims., the lamella is about 42 millims. in breadth, and 7 millims. in thickness. The vents are rather less than 1 millim. in diameter.

The main skeleton consists of wispy bands of long, slender spicules united together by abundant very pale-coloured spongin, running upwards and outwards to the surface conuli (from which their terminal spicules project more or less) and connected with one another by occasional short cross-fibres of one spicule's length, forming an ill-defined, rectangular-meshed network of spicular fibre. In these fibres the spicules lie approximately parallel to one another, there being none of the typical axinellid arrangement except in the surface brushes. Between the fibres, which have a very loose, irregular appearance, numerous isolated spicules are scattered.

Spicules.—(1.) Styli; long and very slender, nearly straight; evenly rounded off at the base and fairly sharply pointed at the apex; size about 0·41 millim. by 0·005 millim., but variable.

(2.) Slender oxea; variously ended; mostly a good deal shorter than the styli.

A second specimen (R.N. 174) differs in having the margin of the sponge thinner, the vents fewer and somewhat larger (with a tendency to occupy separate prominences of the margin), and the spicules somewhat stouter.

In the arrangement of the vents, this typical form of the species resembles *Phakellia tumida*, from Australia (**10**), but the genus *Phakellia*, if retained, should probably be restricted to species with the vents arranged on one or both of the flat surfaces of the lamella. It differs from my "*Auletta aurantiaca*" in the more slender form of the spicules, as well as in the distinctly flabellate character of the sponge, which may be regarded as formed from a number of *Auletta* tubes fused together side by side.

R.N. 174; 345 (Stat. LXVIII., Gulf of Manaar, 10 fathoms).

Auletta lyrata, var. **glomerata**, nov.

In this variety the sponge consists of an irregular agglomeration of short, finger-like processes, more or less united together laterally, and each containing a longitudinal oscular tube terminating at the apex of the process in a sphinctrate vent. In other respects, including spiculation, this variety resembles the preceding, and the whole mass is attached to the substratum by a short stalk.

This variety makes a near approach to THIELE'S *Auletta halichondrioides*, from Japan (**39**), while in external form it closely resembles fig. 3 of ESPER'S Plate 67.

R.N. 170 (pearl banks off Aripu); 194 (south of Dutch Modragam Paar); 303.

Auletta lyrata, var. **crassispiculata**, nov.

I propose this name for three irregularly branched, loosely bushy specimens, characterised mainly by the large size of the spicules, which, however, vary so much that it is almost impossible to express the difference by measurements. The tubular branches of which the sponge is composed are short and rather slender.

R.N. 43, 60 (both from Gulf of Manaar); 161 (deep water off Galle and onwards up West Coast).

Auletta lyrata, var. **brevispiculata**, nov.

This variety is represented in the collection by one very fine specimen of much larger size than usual and consisting of a great mass of branching and anastomosing tubes, each ending in a sphinctrate vent now more or less completely closed by the membranous sphincter. The whole mass is attached to a very short, stout stem, and the shape and size of the individual branches do not differ from those of the specimens of "*Auletta aurantiaca*" originally described by me. The total height of the specimen, however, is 122 millims., and the greatest breadth about 73 millims. The branching is very irregular.

The spicules commonly measure about 0·35 millim. by 0·0164 millim.

R.N. 45 (Gulf of Manaar).

Auletta elongata, n. sp.—Plate XIII., fig. 7.

The type specimen (R.N. 73) consists of a bunch of seven elongated, sub-cylindrical tubes, branching out from each other and from the short, thick stem by which they are attached to the substratum. All the tubes grow vertically upwards, close together and parallel with one another, and they do not vary greatly in length. Each terminates in a wide vent, which may be more or less closed by a membranous sphincter. Colour in spirit, dull yellowish-grey. Texture of tubes compressible, resilient, stiff; stem hard and tough. Total height of specimen 90 millims.; length of stem about 18 millims.; diameter of stem about 10 millims.; length of longest unbranched tube about 52 millims.; diameter of tube about 8 millims. The thickness of the wall of the tube is about 2 millims., and the inner surface of the wall bears the numerous small apertures of the exhalant canals, while the outer surface is granular and porous in appearance and minutely hispid.

The skeleton consists chiefly of very stout bands of spicular fibre, which run longitudinally through the inner half of the tube-wall, branching and anastomosing with one another in a quite irregular manner. From these stout fibres very short, irregular, loose, somewhat plumose columns of long, slender spicules run almost vertically outwards to the surface of the sponge, beyond which the apices of some of them project; the distance between the longitudinal fibres and the outer surface being only about one spicule's length. No spongin is recognisable in ordinary unstained sections.

Spicules.—Very variable in form and thickness, the stoutest being found for the most part in the coarse longitudinal fibres, while more slender ones radiate thence to the surface. The following may be regarded as the chief varieties:—

(1.) Styli (Plate XIII., fig. 7, *a*, *b*); fairly stout or slender, slightly curved, evenly rounded off at the base, bluntly or sharply pointed at the apex; size about 0·83 millim. by 0·022 millim.; passing into

(2.) Oxea (Plate XIII., fig. 7, *c*), of about the same dimensions, but more or less sharply pointed at each end.

(3.) Strongyla (Plate XIII., fig. 7, *d*, *e*); more or less crooked, often very much so; size, say, about 1·2 millims. by 0·022 millim.

More slender forms of all occur, and the slenderer styli may be nearly as long as the strongyla or much shorter than the stout styli whose measurement is above given.

This species is evidently nearly related to *Auletta lyrata*, differing chiefly in the arrangement of the skeleton and the length of the tubes.

R.N. 73 (outside pearl banks, Gulf of Manaar); 148, 283 (fragment, both from deep water oft Galle and onwards up West Coast of Ceylon).

Leucophlœus, Carter.*

Axinellidæ of massive habit, often clathrous. Skeleton reticulate, composed of stout multispicular fibres with little if any spongin; with a well-developed dermal skeleton composed of a reticulation of spicule-bundles or a crust of tangentially placed spicules. Megascleres typically stylote, sometimes oxeote. No microscleres.

* *Vide* Carter (**54**), p. 323.

This genus, which was never diagnosed by its author, is an extremely difficult one to deal with. In our Report on the "Challenger" Monaxonida, Mr. RIDLEY and I decided to suppress it as a synonym of *Hymeniacidon*, but it has lately been revived by THIELE (39) as a distinct genus, and I am prepared to follow him in this respect. I cannot quite see, however, why THIELE should, in the same work, have established another genus (*Amorphilla*) for the reception of closely similar forms (especially as he gives no definite generic diagnoses), unless it be on account of the comparatively small size of the spicules.

If we decide to separate *Leucophlœus* from *Hymeniacidon*, as I think we must, it must be mainly on the ground of the presence in the former of a strongly developed dermal skeleton (composed, mostly at any rate, of tangentially placed spicules) which often forms a white crust in dry specimens.

Our knowledge of these sponges, however, is still very deficient, and their systematic position very doubtful. I retain the genus amongst the Axinellidæ on account of the presence of stylote megascleres and the apparent relationship to *Ciocalypta* as pointed out by Mr. CARTER. *Leucophlœus fœtidus*, with its long oxeote megascleres, perhaps comes nearer to *Halichondria* than any other species, and may indicate a close relationship with the Renierinæ.

Leucophlœus fœtidus (DENDY).

1889, **Hymeniacidon** (?) **fœtida,** DENDY (**3**); 1897, **Amorphinopsis fœtida,** TOPSENT (**83**); 1898, **Ciocalypta fœtida,** LINDGREN (**86**).

There is one good specimen of this sponge in the collection, differing from the type as originally described in its partially trabecular and clathrous external form, and in the pale yellowish (not blackish) grey colour of the surface (in spirit).

I have already pointed out the resemblance which this species bears to RIDLEY and DENDY'S *Hymeniacidon* (?) *subacerata*, and it is not impossible that the presence of the small projecting styli in the dermal membrane of both these species may ultimately prove to be of generic import.

R.N. 63 (Gulf of Manaar).

Ciocalypta, BOWERBANK.

Axinellidæ provided with elongated, digitiform processes springing from a massive body. In the processes the skeleton is arranged in a plumose manner with a dense central axis. There is a thin dermal membrane supported on spicular columns and usually strengthened by a reticulation of tangentially placed spicules, overlying extensive sub-dermal cavities. There are no microscleres.

Ciocalypta tyleri, BOWERBANK.

There is in the collection one specimen which I must refer to the typical form of this species (**22**). This specimen (R.N. 29), which I examined hastily in Liverpool, has unfortunately not been sent out to me, as it appeared to be identical with another which was sent instead (R.N. 29A), and the only preparation which I have of it (made in Liverpool) shows none of the very large spicules characteristic of the variety *manaarensis* previously described by me (**3**), though it is not impossible that such may occur in other parts of the sponge.

R.N. 29 (Gulf of Manaar).

Ciocalypta tyleri, var. **aberrans,** nov.

The single specimen consists of a flattened, cushion-shaped body of oval outline, with a number (now four, but apparently one at least has been broken off) of slender, upright, digitiform processes springing from the upper surface. These processes are long and conical, tapering gradually almost to a point, and with no visible vents; their walls, however, are pierced by numerous small dermal pores. The surface of the sponge between the roots of the processes is rather uneven and somewhat rugose, with branching canals radiating from the roots of the processes beneath the surface, through which they are plainly visible; these canals are continuous with the large canals which run lengthwise through the digitiform processes, about four in each. The general surface of the sponge is very minutely hispid; the walls of the processes have a minutely reticulate appearance and may also be very slightly hispid. The texture of the basal part of the sponge (which has been cut off below) is fairly compact, except for the numerous cylindrical canals, some of which run almost vertically downwards from the bases of the digitiform processes. The colour of the sponge (in spirit) is dull brownish-grey. The longer diameter of the base measures about 45 millims., the shorter diameter about 24 millims.; the thickness in the middle of the base (now) is about 13 millims. The digitiform processes are about 29 millims. long and 6 millims. in diameter at the base, from which they taper gradually to the narrow, blunt apex.

The skeleton in the body of the sponge is a dense, irregular reticulation of loosely scattered spicules, chiefly oxeote, of various sizes. There is no special dermal skeleton and no extensive sub-dermal cavities, and the spicules at the surface do not differ in size, form, or arrangement, from those below. In the digitiform processes there is a central axis surrounded by about four longitudinal canals, separated from one another by rather thin longitudinal septa radiating from the central axis. Both axis and septa are crowded with spicules similar to those in the body of the sponge, but mostly arranged lengthwise. From the more peripheral portions of the septa radiate loose brushes of, for the most part, more slender and shorter oxea, which spread out beneath the dermal membrane and support it on their apices, which may project slightly beyond the surface. Although the more peripherally placed spicules of each brush are inclined very obliquely to the surface, there is no true dermal reticulation, but the dermal membrane may contain irregularly scattered spicules of various sizes.

Spicules.—Oxea of various dimensions; usually gently curved, symmetrical, gradually and fairly sharply pointed at each end; sometimes biangulate instead of simply curved; occasionally stylote with broadly rounded base. Size varying up to about 0·69 millim. by 0·025 millim.; sizes indiscriminately mixed in the body of the sponge, partially sorted out as described above in the digitiform processes, measuring in the surface brushes usually only about 0·377 millim. by 0·0082 millim.

This variety differs from the typical form of the species in the absence of the special dermal skeleton of slender oxea placed tangentially.

R.N. 29A (Stat. XLIII., off Kaltura, 22 fathoms).

Collocalypta, n. gen.

Axinellidæ consisting of a basal crust, from which isolated digitiform processes spring vertically upwards. With a thick, collenchymatous ectosome which, in the digitiform processes, is penetrated by wide longitudinal canals communicating with the exterior by groups of small canals ending in dermal pores. Skeleton consisting in the basal portion of erect plumose columns of megascleres; in the digitiform processes of an axial core of spicular fibre from which loose bands of spicules radiate outwards between the longitudinal canals to surface conuli. Spicules more or less cemented together by spongin. Without microscleres.

This remarkable genus bears a very striking superficial resemblance to *Ciocalypta*, from which, however, it differs widely in the presence of the thick, collenchymatous ectosome and the typically axinellid (plumose) character of the main skeleton, as well as in the total absence of dermal skeleton (compare, however, *Ciocalypta tyleri*, var. *aberrans*), and the presence of abundant spongin cement.

Collocalypta digitata, n. sp.—Plate VII., fig. 6; Plate XIII., figs. 1, 2.

Sponge (Plate VII., fig. 6) consisting of a flat, wide-spreading, encrusting base, about 8 millims. thick, from which arise erect digitiform processes widely separated from one another by irregular intervals. These processes vary much in size, the largest in my possession is about 53 millims. high by 8 millims. in diameter in the middle. They usually taper to a sharp apex and are, as a rule at any rate, unbranched. The surface of the basal crust, between the processes, is smooth or nearly so, but it may be slightly hispid, and it is covered by a good deal of foreign matter in places. The digitiform processes have a distinctly conulose and, at the same time, longitudinally corrugated surface. They bear no visible vents, but numerous minute pores (now all closed). The colour of the sponge (in spirit) is pale grey; the consistence tough and fleshy.

The skeleton in the basal crust consists of stout, erect, plumose columns of spicular fibre, closely crowded together. The spicules are arranged in the typical axinellid manner, with their outer ends projecting obliquely upwards and outwards, while their inner portions are cemented together by a considerable amount of spongin. Each column is continued through the ectosome as a loose tuft of more slender and longer spicules than those which compose its deeper portion, and the apices of these spicules commonly project beyond the surface. There is no dermal skeleton. In the digitiform processes we find a very dense, stout axial core of spicules more or less cemented together by spongin, from which numerous loose bundles of spicules radiate obliquely outwards and upwards into the surface conuli, beyond which their apices may project. Here, again, there is no dermal skeleton.

Spicules.—Oxea (Plate XIII., fig. 1), of various shapes and sizes according to situation; (*a.*) in the columns of the basal skeleton, stout, sub-fusiform, slightly curved, irregularly ended, variable in size, say about 0·56 millim. by 0·03 millim.; (*b.*) in the ectosome of the base, comparatively long and slender, slightly curved, irregularly ended, measuring, say, about 0·88 millim. by 0·02 millim.; (*c.*) in the digitiform processes the spicules are mostly of the long and slender type just described, but occasionally stout and comparatively short forms occur.

One of the most characteristic features of this sponge is the thick gelatinous ectosome (Plate XIII., fig. 2, *ect.*), composed of collenchyma, with a hyaline, or sometimes finely granular, matrix containing an immense number of large, stellate, connective-tissue cells. In the basal crust this ectosome is about 0·65 millim. thick. In the digitiform processes it forms an even thicker layer around the dense central axis of spicular fibre (Plate XIII., fig. 2), but it is penetrated by large longitudinal canals (*l.c.*), about half a dozen in number, and varying in diameter up to about 2·25 millims. These canals are separated from one another by radially arranged longitudinal septa (*sept.*), in which the bundles of spicules run out from the central axis to the surface conuli. The ectosome on the outer sides of the longitudinal canals is reduced to a membrane of varying thickness, containing no spicules and penetrated by short, narrow canals which place the great longitudinal canals in communication with the exterior. These short canals are arranged in groups at wide intervals, and those of each group unite together into a single larger canal before opening into the longitudinal canal. The dermal pores are doubtless arranged in corresponding groups, probably with one pore at the end of each of the smaller canals, but they are now all closed (their position is shown in Plate XIII., fig. 2, *d.p.*). The fact that the smaller canals unite together as they pass inwards to the great longitudinal canals seems to indicate that this is an inhalant system. The arrangement of the exhalant system I have not succeeded in making out, and the choanosome is not sufficiently well preserved to enable me to give any details with regard to the flagellate chambers.

The digitiform processes may contain a good deal of sand outside the spicular axis.

R.N. 74, 74A (outside pearl banks, Gulf of Manaar).

ORDER 4: EUCERATOSA.

Non-calcareous sponges without siliceous spicules, but with a skeleton consisting of horny fibres developed independently, *i.e.*, not in relation to any pre-existing spicular skeleton. (The skeleton is sometimes replaced or supplemented to a greater or less extent by foreign bodies.)

The study of the very interesting series of twenty-two species, by which the horny sponges are represented in the present collection, has caused me greatly to modify my views as to the phylogeny of this group. Hitherto I have, in common with certain other writers on the subject, been in the habit of regarding it as a group of polyphyletic origin, derived probably from several distinct groups of monaxonellid sponges by substitution of spongin for spicules. This view I now believe to be true only for a very limited number of horny sponges, which might be distinguished from the true Ceratosa (or "Euceratosa," as I propose to term them) under the name "Pseudoceratosa," until such time as our increased knowledge shall enable us to assign them to their proper systematic positions. This is already possible in some cases, as, for example, in certain species of the Chalinine genus *Siphonochalina* (*Spinosella*), concerning which I observed as far back as 1887, in my memoir on the West Indian Chalinine Sponges (**75**) :—

"Here we can trace in different species of the same genus the gradual degeneration and disappearance of the spicules until we come down to forms like *Spinosella maxima*, mihi (Plate LXI.), and *Spinosella plicifera*, D. and M. (Plate LVIII., fig. 5; Plate LX., fig. 1), which sometimes still contain traces of the spicules imbedded in the horny fibre, and apparently on the verge of disappearance, while at other times they contain no spicules whatever; and yet the specimens with spicules and those without are specifically indistinguishable."

As regards the great majority of the horny sponges, however, I feel convinced that they form a natural and compact group, in which it is almost impossible to separate even the genera from one another by hard and fast lines. Thus I am in close agreement with POLÉJAEFF, who summarizes (**74**) his own observations on the classification of the group as follows :—"*With the exception of the genera Darwinella, Ianthella, and Psammopemma, all genera are devoid of any properties separating them absolutely from one another.*"

LENDENFELD (**66**) has endeavoured to show that the Ceratosa are divisible into two great groups of very different phylogenetic origin, viz., "Monoceratina" and "Hexaceratina." It would not be difficult to expend a very large amount of criticism upon his system, but, without going into detail, I must remark that this main sub-division appears to me to be wholly erroneous, and that the connection between these two groups is so close that it is quite impossible to separate them from one another; while, instead of the "Hexaceratina" being derived from the Hexactinellida and the "Monoceratina" from the Monaxonellida, as LENDENFELD would have us believe, it appears to me tolerably certain that the majority of the "Monoceratina"* are descended from ancestral "Hexaceratina," and the latter in turn from Myxospongida.

Some justification of my views concerning the phylogeny of the Euceratosa will,

* It must be remembered that LENDENFELD'S "Monoceratina" include both Pseudoceratosa and Euceratosa; the latter alone are here referred to.

I hope, appear in the course of the subsequent pages; in the meantime I may give the following summary of the conclusions at which I have arrived :—

In the first place it is pretty obvious that the Aplysillidæ (constituting a large part of the so-called "Hexaceratina") form the starting point of the evolutionary series within the order. The primitive character of such genera as *Aplysilla* and *Darwinella* is clearly indicated by the simple canal-system, the large sac-shaped flagellate chambers, and the very simple skeleton of branched spongin-fibres, supplemented in *Darwinella* by detached spicules of spongin. The presence of these so-called spicules at first sight seems to lend colour to LENDENFELD's views as to the relationship between the Aplysillidæ and Hexactinellida. It is very difficult to see, however, how the horny spicules in question can have anything to do with the siliceous spicules of the Hexactinellida; their shape is extremely variable and they are probably best regarded simply as isolated portions of the general spongin skeleton, secreted by groups of spongoblasts which, for some unknown reason, have become isolated from their fellows.

Altogether the Aplysillidæ agree very closely in structure with the Myxospongida, especially with the genera *Halisarca* and *Hexadella*, and it is not impossible that the curious fibres of *Halisarca* may represent a rudiment of a horny skeleton. That the spongin skeleton in the Aplysillidæ has been developed quite independently of that of the Monaxonellida, and with no relation to a pre-existing siliceous skeleton, admits, I think, of little doubt. The character of the skeleton, consisting in the simplest cases of a thin basal lamina of spongin, from which slightly branched fibres spring vertically upwards and end in surface conuli, without anastomosing with one another to form a network, is quite different from what we find in typical horny Monaxonellida, in which the spongin is originally deposited as a cement which binds together the spicules of a reticulate skeleton, and in which, consequently, when the spicules disappear, the spongin is left in the form of a network of horny fibres. A very similar network of horny fibres appears, however, to have been independently evolved in the higher Euceratosa.

This difference in the arrangement of the horny skeleton—in the one case in the form of a network and in the other case in the form of separate tree-like fibres—has given occasion to MINCHIN (**12**) to divide his "Grade" Keratosa into two orders, viz., "Dictyoceratina (= Monoceratina, LDF.)" and "Dendroceratina (= Hexaceratina, LDF., *pars*)," the latter group including only the family Aplysillidæ. MINCHIN's distinction cannot, however, be maintained as a basis of classification, for, as LENDENFELD himself recognised, there are undoubted Aplysillids (*e.g.*, *Dendrilla elegans*, LENDENFELD) which possess a reticulate skeleton, and in the present report I propose the new genus *Megalopastas* for such forms, of which two species occur in Ceylon waters.

The importance of the genus *Megalopastas* lies in the fact that it forms a connecting link between the Aplysillidæ and Spongeliidæ, and thus completely breaks down the distinction between "Monoceratina" and "Hexaceratina," or "Dictyoceratina" and "Dendroceratina." The Spongeliidæ, like the Aplysillidæ, have large sac-shaped flagellate chambers, simple canal-system, and clear transparent ground-substance. In fact, they differ from the Aplysillidæ only in their reticulate skeleton and in their habit of taking foreign bodies into the fibre. The so-called "pith" in the fibre is also less obvious, but this is an extremely variable character, and one upon which we cannot place very much reliance for purposes of classification. In *Megalopastas pulvillus*, for example, one and the same section may show great differences in this respect, some fibres showing a strongly marked pith, differentiated by its darker colour, and others apparently having no pith at all (Plate XV., fig. 3), the difference apparently depending upon differences in local conditions at the time when the fibre is growing, which give rise to a more or less distinct lamination analogous to the annual rings in a tree trunk.

Moreover, when we remember that SCHULZE has described (**71**), under the name *Spongelia spinifera*, a species in which the arenaceous fibres do not form a network at all, but are arranged in a tree-like manner, as in the genus *Aplysilla*, we see at once that the distinction between the Spongeliidæ and Aplysillidæ is purely arbitrary, though, as a matter of convenience, it may, perhaps, still be maintained. From the Spongeliidæ the transition to the Spongiidæ, by complication of the canal-system, reduction in the size of the flagellate chambers and granulation of the ground substance between them, is very simple.

I therefore conclude that the Euceratosa are a natural group descended from the Myxospongidæ, that their evolution starts with the Aplysillidæ and ends with the Spongiidæ, between which the Spongeliidæ occupy an intermediate position, and that the reticulate skeleton of the higher types has been independently evolved from a more primitive dendritic skeleton.

FAMILY: APLYSILLIDÆ.

Euceratosa with a dendritic or reticulate skeleton composed of spongin-fibres containing a more or less distinct pith, but usually without foreign inclusions; sometimes also with isolated spicules of spongin; with a lacunar canal-system and large sac-shaped flagellate chambers opening by wide mouths direct into wide exhalant lacunæ.

Darwinella, MÜLLER.

Aplysillidæ with a dendritic skeleton and with isolated spicules of spongin.

Four species of this remarkable genus have been described, viz., *D. aurea*, MÜLLER (**67**); *D. australiensis*, CARTER (**18**); *D. joyeuxi*, TOPSENT (**89**); and *D. simplex*, TOPSENT (**84**); but it appears to me somewhat doubtful whether they should all be regarded as specifically distinct from one another.

Darwinella simplex, Topsent, 1892 (**84**, *vide* also **62**)—Plate XV., figs. 1, 2.

The single specimen forms a thin crust extending over a considerable area on the surface of a branching tube which has apparently belonged to some annelid worm. The surface of the sponge is glabrous and covered with sharp-pointed conuli, about 1 to 1·5 millims. in height and some 2 to 3 millims. distant from one another. The maximum thickness of the crust is only about 2 millims. The dermal membrane is minutely reticulate and lifted up in a tent-like manner on the ends of the vertical skeleton fibres to form the surface conuli. The colour (in spirit) is dark purple,* and the texture very soft and tender. The vents are inconspicuous, only one small one having been detected. The inhalant pores are abundantly grouped in pore-sieves, which occupy the oval or rounded meshes of the dermal reticulation.

The skeleton consists, in the first place, of sparingly and irregularly branched, pithed horny fibres (Plate XV., figs. 1, 2) of the usual *Darwinella* type, which rise more or less vertically from the base of the sponge and terminate in rounded apices in the surface conuli. These fibres have a diameter of about 0·165 millim. near the base, diminishing to about half as much in the conuli. The base of the fibre is expanded into a thin plate of spongin, doubtless attached to the substratum; the fibres themselves do not appear to form any anastomoses. The wall of the fibre is only about 0·01 millim. thick, and the interior is generally occupied by a much-branched filamentous fungus (?), composed of rows of short cells, which more or less completely replaces the pith in the older parts of the fibre (Plate XV., fig 2). In the younger parts of the fibre (Plate XV., fig. 1) the pith exhibits the characteristic thimble-shaped layers described and figured by Lendenfeld in *D. aurea*.

In the second place we have horny spicules of the usual *Darwinella* type, but rather sparingly developed and, so far as I have been able to ascertain, all of the triradiate form. They are irregularly scattered through the soft tissues, and I have seen no union between them. The rays are long, slender and tapering; say about 0·5 millim. long by about 0·025 millim. thick near the base.

The canal-system and general anatomy agree very closely with the description and figures given by Lendenfeld (**66**) for *D. aurea.*

The Ceylon specimen agrees very well with Topsent's descriptions of the species, but the horny spicules (in the single specimen available) do not appear to attain so large a size. The species has hitherto been recorded only from the Mediterranean and the Azores.

R.N. 302 (Ceylon seas).

Megalopastas, n. gen.

Aplysillidæ with an entirely reticulate skeleton and without spongin spicules.

As I have already pointed out, Lendenfeld (**66**) includes in his genus *Dendrilla* both species (*e.g.*, *D. rosea*) without and species (*e.g.*, *D. elegans*) with a reticulate

* *Vide* footnote under *Iotrochota purpurea.*

skeleton. It is very doubtful, however, whether the genus, as constituted by LENDENFELD, is separable from the older *Aplysilla.* The type species of *Dendrilla* appears to be a form with a dendritic skeleton, viz., *D. rosea*, and if we are to separate the species with reticulate skeleton, we can, for etymological reasons, hardly employ the name *Dendrilla* for them.

In my report on Mr. THURSTON'S Second Collection of Sponges from the Gulf of Manaar (**3**) I attempted to avoid the necessity for erecting a new genus by employing BOWERBANK'S old name *Spongionella* for what must now be regarded as the type of the genus *Megalopastas*, viz., *Megalopastas nigra.* I must admit, however, that BOWERBANK'S type of the genus *Spongionella*, viz., *S. pulchella*, is probably not an Aplysillid at all (according to LENDENFELD it is a "*Leiosella*"), while, on the other hand, BOWERBANK (**8**) also applied the name *Spongionella* to another totally different sponge, viz., *Phyllospongia* (*Spongionella*) *holdsworthi*, and *Spongionella* is retained by LENDENFELD (**66**) as a sub-genus of *Phyllospongia.* I therefore now revert to what was my original intention in 1889, and propose the new genus *Megalopastas*, the name being chosen in allusion to the large size of the flagellate chambers.

The anatomical characters of the genus are shown in Plate XV., fig. 4, which represents, somewhat diagrammatically, a vertical section of an Australian species, *M. elegans* (LENDENFELD'S *Dendrilla elegans*), of which I happen to have much better preserved material than of the Ceylon species. Excepting that in *M. elegans* the ectosome is thicker and the outermost secondary fibres of the skeleton do not lie so near the surface, so that there is no "dermal skeleton," the figure would serve almost equally well for either of the Ceylon species. My preparations of *M. elegans* contain numerous embryos, enclosed in spherical endothelial capsules, and mostly in the stage represented in the figure, consisting of a solid inner mass of cells surrounded by an outer layer modified near one end to form a pigment ring. This embryo agrees pretty closely with those described by SCHULZE in *Spongelia* (**71**) and *Euspongia* (**72**), and its occurrence perhaps tends to show the correctness of my views as to the close relationship of the so-called "Hexaceratina" to the other Euceratosa.

Megalopastas nigra (DENDY).—Plate XIV., fig. 7 ; Plate XV., figs. 5–8.

1889, **Spongionella nigra**, DENDY (**3**).

This very remarkable species was originally discovered by Mr. THURSTON and is represented in Professor HERDMAN'S collection by two specimens. The sponge (Plate XIV., fig. 7) is sessile, and consists of a number of vertical lamellæ, branching and anastomosing with one another, often in a very complex manner. The largest specimen I have seen was about 250 millims. high and the same in breadth, with lamellæ about 5 millims. thick. The colour of the living sponge is black (THURSTON), when dry, dull black, and in spirit rather lighter, blackish-grey. Texture (in spirit) very compressible and resilient ; moderately tough. Surface granulated, the granules being really minute, close-set conuli. Vents abundantly scattered, but almost or quite confined to one surface of each lamella. The vents are compound, each consisting of an aggregation of several smaller ones, the entire group only from 1 millim. to 2 millims. in diameter.

The main skeleton (Plate XV., fig. 5) is a rectangularly meshed network of very distinct primary and secondary fibres, the primaries running vertically to the surface and the secondaries crossing them more or less at right angles. The primary fibres average about 0·049 millim. in diameter, and the secondaries about half as much. The outermost secondary fibres form a well-developed dermal or sub-dermal skeleton (Plate XV., fig. 5, *d.s.*; fig. 6), in the form of an irregular network with fairly wide polygonal meshes, the fibres averaging about 0·02 millim. in diameter.

There are many more minute conuli on the surface than there are of the stout primary fibres, and those which do not contain the apices of such fibres are supported by short fibres which spring vertically from the tangential fibres of the dermal skeleton (Plate XV., figs. 5, 8).

All the fibres of the skeleton are composed of pale-coloured spongin without any foreign enclosures. They are not distinctly "pithed" except at the growing apices (Plate XV., fig. 7), where the usual thimble-shaped layers of spongin are added one on top of the other, as in other Aplysillidæ, but even here the "pith" is not distinctly differentiated.

The ectosome forms a thin dermal membrane containing the inhalant pores, and the choanosome is very delicate and gelatinous. The canal-system agrees closely with that of *Aplysilla*, as described and figured by SCHULZE (70). It is lacunar, and the flagellate chambers are sac-shaped and large, averaging when full-grown about 0·07 millim. in diameter. They are not placed very close together and they open directly into the excurrent lacunæ, without special exhalant canaliculi.

R.N. 71, 161A (Pearl banks, Gulf of Manaar—not uncommon).

Megalopastas pulvillus, n. sp.—Plate XV., fig. 3.

The single specimen has the form of a small flattened cushion, slightly convex above and (has been) attached by a broad flat base below. The outline of the specimen is irregularly rounded. The upper surface bears several small, compound vents, each about 2 millims. in total diameter; it also appears granular from the presence of numerous minute, slender, sharp-pointed conuli containing the ends of the primary fibres. The inhalant pores are conspicuous under the microscope in small groups in the thin, translucent dermal membrane. Texture (in spirit) firm, but compressible and resilient; colour, pale yellowish-grey. Diameter of specimen about 18 millims.; thickness in the middle about 5 millims.

The skeleton (Plate XV., fig. 3) is a partly rectangular- and partly polygonal-meshed network of pale amber-coloured horny fibre, in which the primary fibres are very clearly differentiated, radiating towards the surface and terminating in long, slender apices in the surface conuli. The primary fibres not infrequently branch, while at the base of the sponge they are seen to originate in a thin horizontal spongin-lamella, which evidently forms the means of attachment to the substratum. The primary fibres are about 0·096 millim. in diameter, the secondaries are usually a good deal more slender, say about 0·04 millim. in diameter, but variable. Both primary and secondary fibres frequently exhibit a very distinct pith of variable thickness, which evidently simply represents the older part of the fibre surrounded by fresh accretions of spongin. Even in old parts of the primary fibres the old slender apices may frequently be observed thus imbedded in the new growth (Plate XV., fig. 3, *ap.*). The principal secondary fibres run across at right angles between the primaries, but numerous others run in various directions. The outermost secondary fibres form a pretty definite dermal skeleton with polygonal meshes of very variable size. Here and there short, vertical, gradually tapering branches arise from this network and enter some of the surface conuli. These branches evidently form the commencements of new primary fibres, as in *M. nigra.*

The ectosome is feebly developed, forming a thin dermal membrane containing the inhalant pores and overlying the sub-dermal cavities. The canal-system is lacunar. The flagellate chambers are large and sac-shaped, about 0·088 millim. in longer diameter; they open by wide mouths direct into wide exhalant lacunæ. The ground substance between them is very feebly developed, gelatinous-looking and broken up into trabeculæ by the smaller inhalant lacunæ in the characteristic aplysillid fashion. The larger exhalant canals converge towards the compound vents, where they open to the exterior.

It will be seen from the above description that this species agrees closely in skeletal characters and canal-system with *M. nigra*, but it differs widely in external form and colour (in spirit). The fact that the specimen contains large ova and embryos in endothelial capsules likewise seems to indicate that it is not merely a young form of *M. nigra.* Owing to the much greater distinctness of the pith in the horny fibres the species is a more typical aplysillid than its congener.

R.N. 191 (Muttuvaratu Paar, Gulf of Manaar).

Family: SPONGELIIDÆ.

Euceratosa with a (usually) reticulate skeleton of horny fibres without distinct pith, but containing foreign bodies; or with a skeleton composed of foreign bodies united together by little if any spongin. With lacunar canal-system and large, sac-shaped flagellate chambers opening directly by wide mouths into wide exhalant lacunæ.

This family may be retained as a matter of convenience, but it is, as I have already indicated, logically impossible to separate it sharply from the Aplysillidæ, for the genus *Megalopastas*, on the one hand, and Schulze's *Spongelia spinifera*, on the other, are strictly intermediate between the two groups.

Spongelia, NARDO.

Spongeliidæ with a skeleton composed of distinct, but more or less areniferous, horny fibres.

Spongelia fragilis, MONTAGU, var. **ramosa,** SCHULZE.

1879, **Spongelia pallescens,** sub-species **fragilis,** var. **ramosa,** SCHULZE **(71)**; 1889, **Spongelia fragilis,** var. **irregularis,** LENDENFELD **(66)**, *pars.*

There is a single, partly macerated specimen of this variety in the collection. The external form appears to have been loboso-digitate. The skeleton network is very coarse, with rectangular meshes, and densely charged throughout with sand. The soft tissues are very densely charged with chains of algæ, probably *Oscillaria spongeliæ.* The large sac-shaped flagellate chambers measure up to about 0·1 millim. in longer diameter.

Under the name *Spongelia fragilis,* var. *irregularis,* LENDENFELD has already **(66)** recorded a sponge from Ceylon which probably belongs to this variety, as he himself admits that his var. *irregularis* partly corresponds with SCHULZE'S var. *ramosa.* The species, at any rate, appears to be cosmopolitan, if not the variety also.

R.N. 307 (Ceylon seas).

Spongelia elastica, var. **lobosa,** SCHULZE.

1879, **Spongelia pallescens,** sub-species **elastica,** var. **lobosa,** SCHULZE **(71)**; 1889, **Spongelia elastica,** var. **lobosa,** LENDENFELD **(66)**.

There is one specimen of this variety in the collection, consisting of a massive, columnar and slightly clathrous basal portion, giving off numerous short, irregular, digitiform processes above. The surface is covered with acute conuli, larger and further apart on the lower than on the upper portions of the sponge, varying from about 0·5 millim. to 2·5 millims. in height. Between the conuli is stretched the usual reticulate dermal membrane, and the lines of the dermal reticulation are areniferous. The texture (in spirit) is soft and elastic and the colour pale greyish-yellow. The specimen measures about 58 millims. in height by 40 millims. in maximum diameter. The apices of the branches are commonly occupied by parasitic barnacles, each enclosed in a cavity which opens to the exterior by a small terminal aperture resembling a vent.

The primary fibres of the skeleton, ending in the conuli, are abundantly charged with foreign matter, chiefly sponge-spicules, while the connecting fibres are almost free from foreign matter, and form a moderately close network. The canal-system and histology agree closely with SCHULZE'S classical description. The large, sac-shaped flagellate chambers, about 0·08 millim. in maximum diameter, are imbedded in a sparsely developed gelatinous ground substance. They have numerous prosopyles and open directly by wide mouths into the exhalant canals.

This variety is well known in the Mediterranean and, according to LENDENFELD, occurs also in the North Atlantic and in Australian seas.

R.N. 165 (deep water off Galle and onwards up West Coast of Ceylon).

Spongelia elastica, var. **crassa,** nov.—Plate XIV., fig. 4.

This variety differs from var. *lobosa* in the much coarser main fibres, filled with much larger foreign particles (sand grains), and in the more areniferous character of the connecting fibres, which, however, are still occasionally quite free from sand. In external appearance (Plate XIV., fig. 4) the single specimen closely resembles the specimen of var. *lobosa* described above, but it may readily be distinguished by its much more rigid and coarsely arenaceous character. The very stout main fibres contain sand grains of extremely various size. The network of connecting fibres is very irregularly developed and sometimes is absent over wide areas. The sponge is infested by numerous small chætopod worms imbedded in the soft tissues.

R.N. 35 (Gulf of Manaar).

Spongelia incrustata, n. sp.

Sponge compressed, irregularly lobose, proliferous. Surface with small acute conuli irregularly scattered over it at varying intervals, and only about 1 millim. in height; minutely reticulate over large areas, while over areas quite as large the dermal reticulation is completely obliterated by the sand cortex. Vents rather small and mostly on the margins of the lobes. Texture (in spirit) rather soft, compressible, flaccid, cavernous internally. Colour yellowish-grey throughout. The largest specimen is about 100 millims. in maximum diameter, and the lobes are generally not more than 5 millims. or 6 millims. thick, though variable.

The skeleton consists in the first place of the dense arenaceous cortex, which is well developed everywhere, except in the thin dermal membrane of the pore-areas which lie between the meshes of the dermal reticulation (where present). This cortex is about 0·5 millim. thick. Internally the skeleton also consists chiefly of sand-grains, arranged in irregular tracts rather than in well-defined fibres, but often held together by spongin cement. Between these tracts are wide areas free from sand.

The canal-system is that of a typical *Spongelia*. The sub-dermal cavities, underlying the pore-sieves, are large, and the whole canal-system is lacunar in a high degree. The flagellate chambers are sac-shaped and up to about 0·08 millim. in longer diameter, opening by wide mouths into the exhalant canals and provided with numerous prosopyles. The mesoglœa between them is very scantily developed, clear and gelatinous, but with numerous stellate connective-tissue cells. The walls of the larger exhalant canals contain numerous elongated muscle-cells.

This species appears to be nearly related to LENDENFELD'S *Spongelia laxa* from the South Coast of Australia (**66**), but the surface conuli are more or less acute instead of rounded, the skeleton fibres are apparently much less well-defined, and the sand cortex is apparently much thicker.

R.N. 72 (outside pearl banks, Gulf of Manaar); 279 (deep water off Galle and onwards up West Coast of Ceylon).

Psammopemma, MARSHALL.

Spongeliidæ in which the skeleton is composed of densely aggregated sand-grains which are more or less connected together by spongin.

Psammopemma crassum (CARTER), var. **clathrata,** nov.

1885, **Holopsamma crassa,** CARTER (**18**); 1889, **Psammopemma crassum,** LENDENFELD (**66**).

The specimens differ from the types as described by Mr. CARTER in their clathrous form and in the absence of large conspicuous vents. They are extremely irregular and friable, and densely charged with coarse sand, over which a distinct pellucid dermal membrane, free from sand, is frequently stretched. The surface is very uneven, sometimes ribbed and sometimes conulose; the texture incompressible but fragile, and the colour (in spirit) pale brown.

The sand grains are not arranged in distinct fibres, but in ill-defined bands forming an irregular reticulation. They are connected at the points of contact by a very small quantity of spongin cement.

The flagellate chambers are large (about 0·08 millim. in longer diameter) and sac-shaped, and open direct into the exhalant canals by wide mouths. The ground substance between them is clear and transparent and very sparsely developed, except in the neighbourhood of the larger canals, which are surrounded by an abundant gelatinous collenchyma, with numerous stellate or fibrous connective-tissue cells.

The types of the species came from Australia, and LENDENFELD also records it from New Zealand.

R.N. 64 (type of variety, Gulf of Manaar); 330 (Ceylon seas).

FAMILY: SPONGIIDÆ.

Euceratosa with a reticulate horny skeleton and with small, more or less spherical flagellate chambers, commonly provided with special narrow exhalant canaliculi. The ground-substance between the chambers is compact and densely charged with fine granules.

Cacospongia, SCHMIDT.

Spongiidæ with a very wide-meshed skeleton network, and with distinctly lamellated horny fibres which are usually of a brown colour and of very variable diameter.

Cacospongia scalaris, SCHMIDT.

1862, **Cacospongia scalaris,** SCHMIDT (**47**); 1879, **Cacospongia scalaris,** SCHULZE (**72**); 1889, **Stelospongia scalaris,** LENDENFELD (**66**).

There are several rather small specimens in the collection which agree closely with the Mediterranean form as described and figured by SCHULZE. The connecting fibres are often very irregular in arrangement and very variable in diameter. The histological features are not very well preserved, but the flagellate chambers probably have elongated exhalant canaliculi, as described by SCHULZE.

The main fibres may contain many foreign bodies. What can LENDENFELD mean by saying that the fibres are all of uniform diameter and never contain foreign bodies, in direct opposition to the observations of SCHMIDT and SCHULZE?

R.N. 18 (Gulf of Manaar); 162 (three specimens); 347 (all Ceylon seas).

Euspongia, BRONN.

Spongiidæ of compact structure and with a very fine-meshed skeletal network of slender and fairly uniform horny fibre. Primary fibres, usually containing foreign bodies, radiate towards the surface and are connected together by a close but very irregular-meshed network of more slender connecting fibres free from foreign bodies.

LENDENFELD (**66**) has already recorded several species of *Euspongia* from Ceylon, viz.:—

E. trincomaliensis, which he identifies with one of HYATT'S American varieties of "*Spongia officinalis*";

E. irregularis, var. *pertusa*, which is also recorded from North America, Australia, and the tropical Pacific; and

E. irregularis, var. *dura*, also recorded from Madagascar and Australia.

There are two forms in Professor HERDMAN'S collection which appear to be quite distinct from all these.

Euspongia officinalis, AUCTORUM, var. **ceylonensis,** nov.—Plate XIV., fig. 3; Plate XVI., fig. 5.

There are in the collection several nice specimens of a bath sponge which obviously belong to a variety of *Euspongia officinalis*, closely resembling *E. officinalis*, var. *rotunda*, of HYATT (**69**) and LENDENFELD (**66**). The latter is one of the American varieties, and there is probably sufficient difference in the Ceylon sponge to merit recognition under a new varietal name.

The sponge is massive and compact, without vestibules. Of the two specimens which I now have before me, the one (in spirit) is slightly elongated vertically and at the same time slightly compressed laterally and slightly flattened on the top, while the base is somewhat constricted and charged with pebbles and other foreign matter. The vents are rather large and conspicuous, scattered on the top and sides of the sponge, from 2·5 millims. to 5 millims. in diameter, sometimes more or less prominent. Each vent forms the termination of a long vertical oscular tube, of the same diameter as itself. The surface is thickly and uniformly covered with minute, low conuli (about 0·8 millim. apart, from apex to apex), from the summits of which fine ridges radiate into the intervening valleys, where they branch and anastomose with one another, so as to give rise to a delicate reticulation which is scarcely visible to the naked eye, and in the meshes of which the dermal pores are situate in small groups.

The colour of the surface in spirit is black, paling to grey below and internally, and the texture compact, but compressible and very elastic. The specimen thus described measures about 90 millims. in height by 73 millims. in greatest breadth. Another somewhat similar spirit specimen has been photographed for me by Professor HERDMAN, and is represented, about two-thirds natural size, in Plate XIV., fig. 3.

Professor HERDMAN has also sent me part of the macerated skeleton of a much larger specimen. The piece sent is a segment of what appears to have been a massive, hemispherical sponge, with very strongly convex upper surface and broad flattened base. Numerous large vents, up to 8 millims. in diameter, are scattered singly over the upper surface, each at the end of a long, vertical oscular tube. Between these vents the surface is rather uneven (but not channelled or grooved) and honeycombed by close-set narrow vertical canals (inhalant) about 0·5 millim. in diameter, which reduce the skeleton reticulation to a mesh-work of thin trabeculæ which terminate at the surface in small, slightly projecting villi. The texture, after soaking in water, is very soft and elastic and not very tough, and the colour is pale greyish-yellow. The specimen from which this piece was taken must have been about 200 millims. in diameter by 100 millims. in height.

The primary fibres of the skeleton (Plate XVI., fig. 5) run parallel with one another (at distances of about 0·8 millim.) towards the surface, where they end singly in the conuli. They rarely branch, and apparently never anastomose. They are about 0·04 millim. in diameter and composed chiefly of broken sponge spicules, with comparatively little spongin cementing them together. They are connected with one another by a polygonal-meshed network of secondary fibres, in which the meshes vary greatly in size and shape, while the fibres are of fairly uniform diameter and only rarely contain foreign matter. Average diameter of meshes, say, about 0·17 millim. ; diameter of the secondary fibres themselves, when fully developed, about 0·02 millim., but often less.

Owing to the quantity of broken spicules which they contain, the primary fibres are distinctly visible to the naked eye in the macerated sponge, appearing as very fine threads of a paler colour than the rest of the skeleton, and thus constituting what is perhaps the most obvious distinctive feature of the variety.

The dermal membrane contains numerous broken sponge-spicules scattered through it.

In internal anatomy this variety agrees minutely with SCHULZE's classical account of the bath sponge (**72**), so that it is unnecessary to describe the canal-system and histology in this place. One point perhaps deserves mention, and that is the very strong development of long bands or cords of granular fibrous cells, running through the sponge in various directions (but mostly more or less at right angles to the surface), and not by any means confined to the neighbourhood of the larger canals. These bands are, as already suggested by SCHULZE for closely similar structures in the Adriatic bath sponge, probably muscular, and their function appears to me to be to effect the contraction of the sponge as a whole and thus squeeze the water out very thoroughly when necessary.

This Ceylon bath sponge appears to differ from most of the varieties of *Euspongia officinalis* in the greater slenderness of the very pale-coloured secondary or connecting fibres of the skeleton. SCHULZE gives the average thickness of these fibres in *Euspongia officinalis* as 0·03 millim. to 0·035 millim., while in our variety they attain only a thickness of about 0·02 millim., and are often less.

Owing to this character the sponge acquires a remarkable softness, but at the same time loses somewhat in durability. This want of durability may impair its value as an article of commerce, but in view of its softness and elasticity and its great absorbent power, combined with its good shape and size, I am inclined to think that it would be worth while to experiment in the way of placing it upon the market if it can be obtained in sufficient quantity.

R.N. 37 (several specimens in spirit); 101 (dry). All from Trincomalee.

Euspongia tenuiramosa, n. sp.

Sponge consisting of irregular, slender branches, usually only about 5 millims. or 6 millims. in diameter and apparently repent. The branches are more or less angular or nodose, and usually very crooked. The surface is more or less concealed by coarse, calcareous débris, such as the shells of large Foraminifera, &c. Where free from foreign matter, it is covered with small, sharp conuli, scattered at very various intervals. Vents small and few; pores not observed. Colour (in spirit) purplish-brown or nearly black. Texture, where free from foreign matter, which occurs internally as well as at the surface of the sponge, compressible and resilient. The longest branch is about 60 millims. in length by 5 millims. in diameter, but the diameter varies much.

The skeleton is an irregular but fairly close, polygonal- or sometimes quadrangular-meshed network of rather dark-coloured fibre varying much in diameter. Here and there primary fibres can be recognised running into the surface conuli, and these may contain a rather slender core of broken sponge-spicules. The primary fibres have a diameter of about 0·05 millim. The connecting fibres vary from about the same diameter downwards to about 0·008 millim. The diameter of the meshes varies so much that it is useless to give measurements.

The material is not very well preserved for histological investigation, but, so far as I have been able to make out, the internal anatomy offers no features of special interest and agrees closely with that of other species of the genus. The flagellate chambers are small, about 0·024 millim. in diameter, and nearly spherical, and the ground-substance between them is finely granular. I have not been able to make out the nature of their openings. The usual cylindrical cords of elongated fibre-cells are present, and there is a collenchymatous ectosome. There appears also to be a thin cuticle similar to that of various species of *Hippospongia*.

As regards skeletal characters this species agrees closely with LENDENFELD'S very comprehensive *Euspongia irregularis*, but the external appearance is so characteristic that it seems to deserve a distinct specific name.

R.N. 311; 339 (Yard Cove, Trincomalee, shallow water).

Hippospongia, SCHULZE.

Spongiidæ of clathrous structure, but otherwise resembling *Euspongia*, except that the skeleton fibre may be much coarser and the whole sponge harder.

Except in its harder and more incompressible character, I cannot see that LENDENFELD'S genus *Hyatella* differs from SCHULZE'S *Hippospongia*, yet LENDENFELD himself describes a *Hippospongia dura* which is, perhaps, as hard as any *Hyatella*.

Hippospongia intestinalis (LAMARCK).

1813, **Spongia intestinalis**, LAMARCK (**73**); 1877, **Spongelia velata**, HYATT (**69**); 1884, **Hippospongia intestinalis**, RIDLEY (**16**); 1889, **Hyatella intestinalis**, LENDENFELD (**66**).

This species is represented in the collection by several specimens of elongated tubular form, very intestinal in appearance and of a light brown colour, with their walls perforated here and there at irregular intervals, and the surface slightly conulose. The tubes may branch and anastomose, but are for the most part well separated from one another and usually about 10 millims. in diameter, but variable. The characteristic surface reticulation of slender horny fibre is very well developed, and the surface appears to be covered by a remarkable continuous but separable cuticle, which possibly has some connection with the dermal skeleton, but I have not been able to elucidate its true nature. The main skeleton is very irregular and composed of mostly stout amber-coloured horny fibre. Primary fibres cored with foreign bodies are visible here and there.

The flagellate chambers are small (about 0·03 millim. in diameter) and approximately spherical, and the ground-substance between them is finely granular. The special exhalant canaliculi, if present, are short. Stout bands of elongated fibres, presumably muscular and mostly longitudinal in direction, are developed as in other Spongidæ, and there may be a good deal of collenchyma around some of the larger canals.

The species has been recorded from the Mediterranean, Zanzibar, the Mascarene Islands, and the Amirante Group (**66**), and from Porto Rico (**29**).

R.N. 65 (Gulf of Manaar); 83 (deep water off Galle and onwards up West Coast); 337 (Ceylon seas).

Hippospongia clathrata (CARTER)—Plate XIV., fig. 2.

1881, **Hircinia clathrata,** CARTER **(5)**; 1887, **Hircinia clathrata,** DENDY **(2)**; 1889, **Hircinia clathrata,** DENDY **(3)**; 1889, **Hyatella clathrata,** LENDENFELD **(66).**

There is a single specimen of this well-characterised sponge in the collection. LENDENFELD **(66)** has added particulars as to the canal-system to our previous knowledge. The sponge contains no filaments, but the bands or cords of fibrous tissue in the choanosome, so characteristic of many other Spongidæ, are very well developed. The species was recorded by CARTER from the Gulf of Manaar and the Red Sea, and it also occurs in Australia (DENDY, LENDENFELD) and on the American coast of the North Atlantic (LENDENFELD).

The figure represents the characteristic appearance of a spirit specimen, no good illustration of the external form having yet been published.

R.N. 24 (Gulf of Manaar).

Hippospongia anomala, POLÉJAEFF.

1884, **Hippospongia anomala,** POLÉJAEFF **(74)**; 1889, **Hippospongia anomala,** LENDENFELD **(66).**

There is one specimen in the collection which, although of smaller size, agrees very well in nearly all respects with POLÉJAEFF'S description and figure of the type specimen from Torres Straits. Our specimen consists of an erect, sub-cylindrical cavernous body, expanding gradually below and giving off two short digitiform processes on one side. The interior, especially in the lower portion, is sub-divided by trabeculæ, and the surface is covered over by a thin, parchment-like dermal membrane pierced by numerous larger and smaller circular apertures, especially abundant towards the extremity. These apertures lead into the large vestibular spaces in the interior of the sponge. The end of the main body and those of the two processes taper suddenly to rather sharp apices, and are covered with fairly numerous small conuli, elsewhere the surface is nearly smooth and glabrous and provided with a delicate cuticle, like that of *Hippospongia intestinalis.* POLÉJAEFF'S expression "shagreen-like" may refer to the same character. The colour (in spirit) is pale grey, the texture compressible and very resilient. The height of the specimen is about 120 millims. and the maximum diameter at the base about 50 millims.

The skeleton is a pretty close but irregular polygonal-meshed network of fibres of very uniform diameter, about 0·02 millim. to 0·03 millim. thick, and free from foreign bodies. Occasionally only one observes much stouter primary fibres, composed principally of broken sponge spicules, running towards the surface and sometimes branching. Occasionally also one sees very slender connecting fibres amongst the ordinary ones; these are probably young. There is no specially differentiated dermal skeleton, but the main skeleton reticulation comes close to the surface. A good many broken spicules are scattered in the dermal membrane.

The canal system is remarkable for the unusual length of the exhalant canaliculi of the flagellate chambers, reminding one of the similar condition described by

SCHULZE (72) in *Cacospongia scalaris.* POLÉJAEFF (74) has already called attention to variability in the development of the cameral canaliculi in this species, so that we can hardly consider the presence of long exhalant canaliculi as a character of specific value.

R.N. 56 (Gulf of Manaar).

Hippospongia dura, LENDENFELD (66).

The single specimen consists of an irregular massive body tapering gradually upwards (?) or on one side (?) into a sub-cylindrical fistular process, the conical extremity of which is perforated by numerous small, round apertures leading into the internal vestibular space. Similar apertures are scattered more sparsely on other parts of the sponge. Internally the sponge is cavernous, with wide, sub-cylindrical, vestibular spaces, more or less sub-divided by trabeculæ of smaller diameter than the vestibules. The vestibular spaces are covered in at the surface partly by a somewhat parchment-like dermal membrane and partly by superficial extensions of the trabeculæ themselves. The surface is rather uneven, but not distinctly conulose ; a considerable amount of calcareous and other foreign matter is attached to it. The texture, in spirit, is hard and only slightly compressible, and the colour rather dark brown throughout. The specimen measures about 110 millims. in greatest length (height ?) and 60 millims. in greatest breadth at right angles to the length.

The skeleton is an unusually close and fairly uniform network of rather stout, amber-coloured horny fibre. There is no distinction between primary and secondary fibres, except at wide intervals, where the network becomes somewhat closer and forms stout columns radiating towards the surface. In these columns many primary fibres run side by side and nearly parallel with one another, connected at frequent intervals by short, transverse secondaries to form a very stout, but ill-defined, compound, trellis-like fibre. Elsewhere the stouter fibres frequently run parallel with the surface of the sponge and are connected together by more slender fibres which run transverse to the stouter ones. In other places again the network is quite irregular. The stouter fibres, forming the bulk of the skeleton, are about 0·04 millim. or 0·05 millim. in diameter; the more slender ones are very variable. Usually the fibres are quite free from foreign bodies, but broken spicules may be found occasionally in fibres of the trellis-like groups. There is no special dermal skeleton, but the ordinary reticulation of fibres comes close to the surface, which is covered by a thin cuticle like that of *Hippospongia intestinalis* and *H. anomala.* A remarkable feature of the skeleton fibre is the brilliant yellow colour which it assumes in sections stained with picro-carmine. The superficial cuticle stains in the same way, and sometimes appears to be continuous with the more superficial skeleton fibres, but this is a point which requires further investigation.

The flagellate chambers are nearly spherical, only about 0·024 millim. in diameter, and the ground-substance between them is finely granular. There is a rather thin, collenchymatous ectosome, containing a good many brown pigment cells. Cylindrical bands or cords of elongated fibrous cells are developed as usual.

LENDENFELD describes the species, apparently from a dry specimen, from the American coast of the North Atlantic. Under these circumstances the identification may seem somewhat hazardous, but the species is so well characterised by its general form, its colour and texture, and its peculiar skeleton arrangement, that I do not think there can be much doubt about it. Of course, it is possible that there has been a mistake about the locality of the type specimen, which is in the British Museum Collection.

R.N. 57 (Gulf of Manaar).

Phyllospongia, EHLERS.

Spongiidæ of thin, lamellar form, often cup-shaped. With a close-meshed skeleton network of slender horny fibre.

Phyllospongia papyracea (ESPER), var.—Plate XIV., fig. 6.

1798–1806, **Spongia papyracea**, ESPER (**6**); 1870, **Phyllospongia papyracea**, EHLERS (**58**); 1877, **Phyllospongia papyracea**, HYATT (**69**); 1884, **Phyllospongia papyracea**, RIDLEY (**16**); 1889, **Phyllospongia papyracea**, *pars*, LENDENFELD (**66**).

This variety is represented in the collection by a fine dry specimen, of which a photograph is reproduced in Plate XIV., fig. 6. The specimen is frondose, proliferous and decumbent, and has apparently been attached to the substratum at many points. The thickness of the fronds is about 1·25 millims. The consistence (when perfectly dry) is stiff and rather fragile, the colour light brownish-yellow. The upper surfaces of the fronds are marked with feebly developed concentric and radiating ridges, and also by numerous narrow grooves, frequently arranged in a branching or stellate manner and probably containing minute exhalant apertures. The lower surface is entirely free from such grooves. Both surfaces appear minutely reticulate under a lens, and neither possesses a continuous sand-cortex, though there is a good deal of sand scattered on the upper surface.

The skeleton is a close network of very pale-coloured horny fibres usually about 0·02 millim. in diameter. The fibres are mostly free from foreign matter, but the primary lines, radiating to the surface, contain many comparatively large sand-grains.

Except for the presence of the stellate or branching grooves on the upper surface and the sand-grains in the primary fibres, this species agrees very closely with the figures and description of the type given by ESPER and EHLERS. As the type came from Southern India (Tranquebar), it is not likely that the Ceylon form is more than varietally distinct.

The species has been previously recorded from Tranquebar (ESPER); Cape of Good Hope (HYATT); and Mozambique (RIDLEY). LENDENFELD also records it from

Australia and New Zealand, but his identifications are not always trustworthy, and he appears to me to have got a wrong conception of the species. Thus he states that "in every case the sponge is attached by a short peduncle." He also includes (perhaps rightly) the cup-shaped *Phyllospongia holdsworthi* in the species.

R.N. 104A (Gulf of Manaar).

Phyllospongia holdsworthi (BOWERBANK).

1873, **Spongionella holdsworthii**, BOWERBANK (**8**); 1889, **Phyllospongia papyracea**, *pars*, LENDENFELD (**66**).

There are several exquisitely cup-shaped specimens of this sponge in the collection. BOWERBANK'S figures and descriptions do not appear to me to be very typical, and it seems not impossible that he had also before him, when writing, specimens of *Phyllospongia papyracea*. The specimens which I have examined are regularly cup-

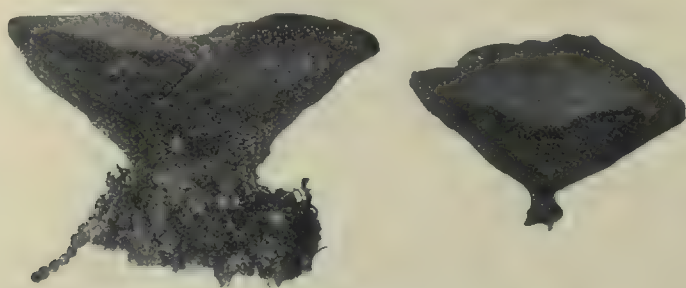


Fig. 5. *Phyllospongia holdsworthi*, half nat. size.

shaped (see text-fig. 5), with an entire margin and a very well developed peduncle branching out into root-like processes below. The wall of the cup is only about 1·5 millims. thick, stiff and tough and slightly flexible in the perfectly dry state. Both surfaces are smooth or nearly so, but show feebly developed concentric and sometimes radiating ridges. The vents are minute, usually circular in outline, and abundantly scattered over the inner surface only of the cup, which is covered by a thin sand-cortex not sufficiently developed to conceal the minutely reticulate character of the dermal skeleton. There is no sand-cortex on the outer surface, which is also minutely reticulate. Professor HERDMAN informs me that the colour of the sponge in life is purplish-brown, and my dry specimens still retain a distinctly purple tinge in places.

The skeleton is a close-meshed but very irregular network of horny fibre, mostly about 0·02 millim. in diameter and free from sand, but with stouter primary lines radiating to the surface and containing numerous comparatively large sand-grains, especially towards the inner surface of the sponge.

Bowerbank's figures certainly represent a form which is intermediate in external appearance between what I regard as the typical cup-shaped *P. holdsworthi* and the foliaceous *P. papyracea*, and it is quite possible that the two are not more than varietally distinct.

Bowerbank quotes from a letter of Mr. Holdsworth the following interesting particulars:—"Spongionella is only found on the 9-fathom line of the large pearl-bank. It is attached to pieces of dead coral or stones. When alive it is of a dark brown; and when taken out of the water it looks exactly like dirty wet leather. If you soak a bit of one of the dark specimens* you will see it with as nearly as possible the original appearance. This sponge is so strictly confined to the locality above mentioned, that its discovery by the divers is considered the strongest evidence that the outer part of the bank has been reached."

Professor Herdman adds, as the result of his much more extended examination of the Gulf of Manaar, that "although very characteristic of the Periya Paar and other deeper grounds west of the Cheval Paar, still it is not absolutely confined to these, but may be found elsewhere, as on the Muttuvaratu Paar."

R.N. 30; and other specimens (dry). (Periya Paar, Muttuvaratu Paar, &c., Gulf of Manaar.)

Hircinia, Nardo.

Spongiidæ with a coarse-meshed skeleton network usually containing much foreign matter. Denser aggregations of the network along the primary lines frequently form trellis-like compound fibres. Filaments are usually present in the ground-substance.

Hircinia fusca, Carter—Plate XIV., fig. 1.

1880, **Hircinia fusca**, Carter (4), not **Hircinia fusca**, Ridley (16) and Lendenfeld (66).

This is a very remarkable and well-characterised species. It was originally described by Carter in less than four lines, and the species was styled "provisional." It is, therefore, little wonder that Ridley and Lendenfeld have erred in identifying certain slender branching sponges from other localities with the Ceylon species. Carter's description of the external form should, however, have been sufficient to prevent any such misconception, for a slender, branched, cylindrical sponge, narrower at the base, and with conuli only 1 millim. high, can hardly be identical with one which is described as "massive, digitate, branched lobate, cactiform on the surface." In addition to these characters, the dark brown colour and the resemblance to *Aplysina fusca*, noted by Mr. Carter, leave no doubt in my mind that Professor Herdman's specimens really belong to the species in question, an opinion which is rendered almost

* Professor Herdman's dry specimens are very pale in colour.

certainly correct by the fact of their coming from the same locality. Under the circumstances it seems desirable to give some details with regard to the species.

There are two good specimens in the collection, one in spirit (R.N. 48) and one dry (R.N. 99). The former (figured) is massive, irregular, attached by a broad spreading base, from which compressed digitate or flabellate processes rise vertically upwards, bearing small vents at their apices (vents about 1·5 millims. in diameter). The surface is cactiform, with usually sharp-pointed but broad conuli, up to about 3 millims. in height, but usually less. The distance between the conuli varies greatly, but they are usually widely separated from one another by intervals of about 8 millims. The surface between the conuli is smooth or wrinkled, finely granular, under a lens very minutely reticulate and porous. The colour on the surface (in spirit) is warm brown, internally it is much paler, yellowish. The texture is compressible and resilient, but extraordinarily tough and leathery, so that it is very difficult to cut sections. This leathery character is obviously due to the enormous quantity of "filaments" which the sponge contains. Internally it is somewhat cavernous, owing to the presence of numerous cylindrical canals running vertically upwards towards the vents. This specimen measures about 190 millims. in greatest breadth of base and 56 millims. in greatest height.

The dry specimen is strongly compressed, flabellate, and only very slightly proliferous, with a narrow margin bearing a row of vents. It contains much more sand than the spirit specimen, but in other respects agrees closely. It measures about 135 millims. in height by 120 millims. in greatest breadth.

The skeleton is composed principally of large sand-grains, with a comparatively small quantity of spongin; arranged as follows:—(1) Very stout columns or tracts of sand-grains run vertically through the sponge and end in the surface conuli. These columns are compound structures, in which the sand-grains are held together by numerous short, slender spongin threads running from one to the other, in much the same way as LENDENFELD (**66**) has figured for *Psammopemma marshalli*. They apparently represent an exaggerated condition of the trellis-like main fibres of certain other Hirciniæ. (2) A very irregular network of more slender secondary fibres, composed of sand-grains held together by spongin threads as in the main columns, but the large sand-grains often only in single series. (3) In the dermal membrane there is a thin layer of broken sponge-spicules and large sand-grains, the former lying somewhat more superficially than the latter. Numerous broken spicules also occur along with the sand in the deeper parts of the sponge.

The canal-system appears to be that of a typical *Hircinia*, but, owing to the large quantity of sand and "filaments," it is impossible to get satisfactory sections. The flagellate chambers are not well preserved, but they appear to be about 0·04 millim. in diameter and approximately spherical, and the ground-substance between them is finely granular. The soft tissues are very densely charged with filaments. These have a maximum thickness of about 0·004 millim. between the heads. The heads, which stain deeply with picro-carmine, are about 0·008 millim. in diameter and somewhat variable in shape, sometimes nearly spherical and sometimes more or less pointed at the end.

Ridley's *Dysidea fusca*, which that author (**16**) supposed might be identical with Carter's *Hircinia fusca*, appears to be quite a different sponge.

R.N. 48, 99 (pearl banks, Gulf of Manaar); 271 (small specimen with fewer filaments. "Deep water off Galle and onwards up West Coast of Ceylon").

Hircinia tuberosa, n. sp.—Plate XVI., fig. 2.

The sponge consists of a very irregular, somewhat tuber-like body, from which irregular, finger-like processes are given off in various directions, the whole much mixed up and partially coated with calcareous débris. In the largest specimen the central portion of the sponge measures about 60 millims. in diameter, and the two larger processes each about 44 millims. in length by 18 millims. in diameter. The surface is very uneven, but sub-glabrous (not reticulate) between the foreign adhesions, and only slightly conulose, the conuli being low, irregular, and widely separated from one another. Internally the sponge is cavernous, being permeated by wide, cylindrical, meandering vestibules, which are covered in at the surface of the sponge by a thin, parchment-like dermal membrane, pierced here and there by rounded apertures. These apertures are evidently vents. They vary from about 0·5 millim. to 4 millims. in diameter, and are frequently arranged in groups. They are found sometimes on the central portion of the sponge, but more frequently on the more or less fistular, finger-like processes. Texture extremely coarse and gritty throughout, but tough. Colour (in spirit) pale yellowish-grey throughout. There is a distinct but thin sand-cortex in the parchment-like dermal membrane.

The skeleton (Plate XVI., fig. 2) is an extremely irregular network of more or less trellis-like horny fibre, partly enclosing and partly connecting together the very numerous sand-grains and other foreign bodies with which the sponge is filled. Main fibres are recognisable, but not very well defined, and the whole is so irregular that it is useless to give measurements.

The flagellate chambers are about 0·03 millim. in diameter and approximately spherical, and the ground-substance between them is finely granular.

Filaments are present in enormous numbers and usually collected together in more or less dense bundles. They measure about 0·006 millim. in maximum diameter between the heads, and their heads are approximately spherical and about 0·008 millim. in diameter.

R.N. 86, 88, 88a (all from deep water off Galle and onwards up West Coast).

Hircinia schulzei, n. sp.—Plate XVI., fig. 3.

Sponge slender, cylindrical, irregularly branched, and attached at many points to fragments of calcareous débris, amongst which it appears to creep. A few rather short and somewhat club-shaped branches, about 25 millims. in length and 3 millims. in maximum diameter, probably rose vertically upwards from repent stems of about the same diameter. The surface is pretty uniformly covered with low conuli, between which narrow longitudinal canals may be seen running beneath a thin membrane, which is occasionally broken through by a single small vent or by a sieve-like group of very small vents. The colour (in spirit) is very pale yellow and the texture pretty stiff, but compressible and resilient.

The skeleton (Plate XVI., fig. 3) consists of widely distant, longitudinal main fibres curving outwards towards the surface and connected at irregular intervals by a round-meshed lattice work of secondaries. The main fibres are pretty regularly cylindrical and about 0·12 millim. in diameter, not fascicled, and containing a good many fragments of sponge-spicules. The connecting fibres are entirely free from foreign matter; they vary much in diameter, but are usually pretty stout.

The canal-system is of the type usually met with amongst the Spongiidæ. The small flagellate chambers are approximately spherical and up to about 0·04 millim. in diameter, with short, wide, exhalant canaliculi. The ground-substance between them is finely granular. A very conspicuous histological feature is the presence of numerous long, cylindrical cords of fibrous tissue running longitudinally through the sponge. These cords are composed each of a compact mass of elongated, finely granular cells, each with a very distinct, darkly staining nucleus. They closely resemble the similar fibrous bands found in *Euspongia*, &c., and are probably contractile. The characteristic *Hircinia* filaments are abundantly scattered through the soft tissues. They are, however, very slender, and I have not succeeded in making out the nature of their terminations.

This appears to be a very distinct and well-characterised species, differing from *Hircinia dendroides*, SCHMIDT, which is, perhaps, its nearest ally, in its much more slender branches and much more regular main fibres. I have much pleasure in dedicating it to the zoologist to whom we chiefly owe our accurate knowledge of the Spongiidæ.

R.N. 277 (deep water off Galle and onwards up West Coast of Ceylon).

Hircinia anomala, n. sp.—Plate XIV., fig. 5; Plate XVI., fig. 1.

Sponge massive, irregular, with a tendency to become lobose or digitate. Surface uniformly covered with small, sharp conuli, about 1 millim. in height and 2 millims. apart; with a minute reticulation of fine ridges chiefly radiating from the apices of the conuli. Sometimes the surface reticulation is suppressed, and it may be present or absent in different parts of the same specimen. The surface is not sandy, except sometimes at the apices of the conuli. Vents inconspicuous, the sponge being, perhaps, sometimes lipostomous. Pores scattered abundantly in the meshes of the dermal reticulation. Colour (in spirit) varying from pale brown to black on the surface; pale brown internally. Consistence firm, but compressible and elastic. The largest specimen is about 75 millims. in length by 42 millims. in greatest breadth; another is about 140 millims. long, with a maximum diameter of 25 millims.

The skeleton (Plate XVI., fig. 1) is an extremely irregular network of highly arenaceous fibres. There is no distinct differentiation into main and secondary fibres, but the reticulation is much closer along tracts which run vertically to the surface and end in the surface conuli. These denser parts of the reticulation are evidently homologous with the trellis-like main fibres of other Hirciniæ. Between them large tracts may remain entirely devoid of skeleton. The fibres themselves vary a good deal in thickness and in the amount of foreign matter which they contain. Usually there is a very large proportion of sand or sponge spicules, and comparatively little spongin; occasionally, however, I have seen fibres without foreign inclusions. The spongin of the fibres is very distinctly lamellated.

The flagellate chambers are approximately spherical, up to about 0·04 millim. in diameter (but often smaller), and either eurypylous or with short exhalant canals. The ground-substance between them is finely granular, though perhaps somewhat less markedly so than in typical Spongiidæ. The larger canals are surrounded by a very large quantity of gelatinous, vesicular-looking collenchyma, and commonly more or less sub-divided by septa. Bands of fibrous tissue penetrate the soft tissues as in other Spongiidæ, but I have not found any of the "filaments" so common in the genus *Hircinia*. R.N. 13 contains an immense number of unicellular bodies of a pale yellow colour (staining brown with picro-carmine); these are oval or nearly spherical, and about 0·02 millim. in diameter; each with a small nucleus. Occasionally they appear to be broken up into fragments. Probably they are unicellular Algæ, comparable to those which I have described in *Hexadella*. R.N. 82 and 171 contain numerous groups of smaller cells which are, perhaps, the same Alga in process of division.

This species exhibits characters intermediate between those of the Spongeliidæ and those of the Spongiidæ. The skeleton, in its highly arenaceous character, agrees with that of *Spongelia*, but the small size of the flagellate chambers and the granular character of the ground-substance prevent us from including it in that genus. The absence of filaments, on the other hand, militates against our regarding the species as a typical *Hircinia*, but the nature of these filaments and their taxonomic value are still so obscure that I am not inclined to exclude the sponge from the genus solely on account of their absence.

In external appearance the species somewhat resembles *Cacospongia scalaris*.

R.N. 13 and 91 (Gulf of Manaar); 82 and 171 (deep water off Galle and onwards).

Aplysina, NARDO.

Spongiidæ with distinctly pithed horny fibres forming a coarse-meshed skeleton network. Of very compact texture, with narrow canals and very small flagellate chambers.

Aplysina purpurea, CARTER.

1880, **Aplysina purpurea,** CARTER (**4**); 1881, **Aplysina purpurea,** CARTER (**65**); 1889, **Aplysina purpurea,** DENDY (**3**); 1889, **Psammopemma fuliginosum,** LENDENFELD, *pars* (**66**).

There is only a single dry specimen of this sponge in the collection, so that I am not in a position to add anything to the descriptions of the species given by CARTER and myself, except by referring back to some preparations of spirit material collected by Mr. THURSTON, which show the sponge to be a true *Aplysina* and not, as LENDENFELD has supposed, a *Psammopemma*.

The skeleton is composed of dense local aggregations of very irregular, branching and anastomosing horny fibres, accumulated along certain tracts to form the so-called "compound fibres," while large intervening areas remain free from fibre altogether. The fibres themselves have a very curious structure, consisting of a very thin outer layer (if any) and a very thick "pith," the latter exhibiting a granular or often minutely reticulate appearance. They are free from foreign bodies. The inhalant pores are abundantly scattered over certain parts of the surface. The structure of the soft tissues is very compact and the flagellate chambers are small and probably aphodal or diplodal. In short, the canal-system probably agrees closely with that described and figured by SCHULZE in *Aplysina aërophoba*, although the condition of my material is not good enough to render a detailed comparison possible.

LENDENFELD has, as already indicated, made the curious mistake of confounding this species with "*Psammopemma fuliginosum*," a totally different sponge. CARTER's specimens of *Aplysina purpurea* were from the Gulf of Manaar and Trincomalee, but he subsequently (**65**) identified an Australian sponge with the same species. Still later, however, when describing his *Pseudoceratina durissima* (**18**), he showed that the *Australian* specimen previously identified by him as *Aplysina purpurea* should really be considered as a specimen of *Pseudoceratina durissima*. LENDENFELD, accordingly (**66**), in a manner very characteristic of that writer, observes that "CARTER himself has shown that his *Aplysina purpurea* and his *Pseudoceratina durissima* are identical," which, of course, is by no means the case. At the same time he omits the locality from which the types of *Aplysina purpurea* were obtained from the geographical distribution of *Psammopemma fuliginosum*, under which name (while admitting that it is not the oldest) he also includes (rightly or wrongly) CARTER'S *Pseudoceratina durissima*.

Mr. CARTER has given a characteristic sketch of the external form of the sponge, together with figures of the skeletal structure (**65**, Plate IX., fig. 1), which are sufficient for the identification of the species.

There can be no doubt that KELLER'S *Psammaplysilla arabica* from the Red Sea (**61**) is very closely related to, if not identical with, this species. The compound skeleton fibres, consisting entirely (according to KELLER) of reticulate "Marksubstanz," the cactiform surface, and black-violet colour in alcohol, all point to generic if not specific identity. In the Ceylon specimens, however, there appears to be (usually at any rate) no sand in the skeleton fibres. KELLER makes his species the type not only of a new genus, but even of a new family. He considers it to be closely related to *Aplysilla*, but, unfortunately, his material did not enable him to investigate the form and arrangement of the flagellate chambers, or he would probably have seen that the affinity was rather with *Aplysina*, as the firm, almost leathery texture of the living sponge and its stony hardness when dry might alone have indicated. I follow Mr. CARTER in retaining the Ceylon species, at any rate (with which KELLER does not appear to have been acquainted), in the latter genus, from which it differs in no important respect. In any case the name *Psammaplysilla* appears to have been very unfortunately chosen, as the sandy character of the fibre is hardly of generic value, and the relationship with *Aplysilla* is not nearly so close as that with *Aplysina*, a very distinct genus.

R.N. 95 (Stat. IV., off Karkopani, 6–9 fathoms, Gulf of Manaar).

Aplysina herdmani, n. sp.—Plate XVI., fig. 4.

The single specimen consists of a rather thin, irregular, flattened crust, from which short, slender, cylindrical, digitiform processes rise vertically upwards at wide and irregular intervals. The ends of these processes are truncated, and each has a single small vent in the middle.* The surface, both of the basal crust and of the digitiform processes, is glabrous, but beset with numerous minute conuli, from the apices of which the ends of the primary fibres sometimes project. The colour, in spirit, is dull purple throughout; the texture compact and rather fleshy, but compressible and resilient. The maximum diameter of the basal crust is about 55 millims. and its thickness about 4 millims. The digitiform processes are about 11 millims. high by only 2 millims. or 3 millims. in diameter.

The skeleton, in the basal crust, consists of a reticulation of thin-walled, pithed fibres of a rather dark brown colour, amongst which distinct primary fibres, running vertically into the surface conuli, are clearly differentiated (Plate XVI., fig. 4). These primary fibres are about 0·08 millim. in diameter, and the very thick, granular "pith" contains abundant broken sponge spicules as foreign inclusions. The primary fibres sometimes branch, and they are connected together by a network of secondaries which vary greatly in diameter, being sometimes as stout as the primaries and sometimes very slender, only about 0·016 millim. in diameter. The secondary fibres are free from foreign matter and the stouter ones commonly run across between the primaries and thus form rectangular meshes, but the meshes are usually irregularly polygonal and very variable in diameter.

In the digitiform processes the main fibres—containing broken spicules—run longi-

* One of the processes forks into two close to its extremity, and each of the very short branches thus produced bears a small vent on its truncated end.

tudinally and give off short branches—also containing broken spicules—into the surface conuli. The secondaries are arranged as in the basal crust.

The flagellate chambers are very small, only about 0·024 millim. in diameter, and approximately spherical, but the arrangement of the collared cells, on the inhalant side of the chamber only, gives them a curious crescentic appearance; moreover, they frequently appear in sections to be arranged in single curved rows; surrounding the narrow exhalant canals at about equal distances, and doubtless communicating with them by very long and narrow canaliculi, but the condition of the specimen is not good enough to enable me to make out minute histological details. The ectosome is chondrenchymatous rather than collenchymatous, but a large quantity of gelatinous tissue is developed around the larger canals in the choanosome. In the neighbourhood of the flagellate chambers the choanosome is abundantly granular, and both ectosome and choanosome contain numerous pigment cells.

It affords me much pleasure to name this well-characterised species after Professor W. A. HERDMAN.

R.N. 340 (Ceylon seas).

CLASS: CALCAREA.

Porifera with a skeleton composed of calcareous spicules.

The number of calcareous sponges in the collection is remarkably small, only four species being represented, two of which, however, are new. I have discussed the classification of the group in considerable detail in my earlier writings (**76, 78, 80**) and adhere to the opinions therein expressed.

ORDER 1: HOMOCŒLA.

Calcareous sponges in which the endoderm consists throughout of collared cells.

Leucosolenia, BOWERBANK.

With the characters of the order.

Leucosolenia (Clathrina) coriacea (MONTAGU), var. **ceylonensis**, nov.—Plate XIII., fig. 8.

[For literature and synonyms *vide* HAECKEL (**7**)].

This well-known European species is represented in the collection by a slight variety belonging to the reticulate section of the genus *Leucosolenia* as defined by the present writer (**76**). The sponge forms massive, closely reticulate colonies of slender ascon-tubes, each colony with a constricted base of attachment; with fairly numerous, small but prominent true oscula formed each by the coalescence of several tubes in a projection from the general surface. The ascon-tubes are only about 0·16 millim. in diameter and there is no pseudoderm. The entire colony attains a diameter of some 10 millims. or 20 millims. The colour in alcohol is pale grey.

The spicules are nearly all regular triradiates (Plate XIII., fig. 8, *a.*, *b.*, *c.*); with slender, not very sharply pointed rays of pretty uniform diameter and measuring about 0·088 millim. in length by 0·008 millim. in diameter at the base. The apex is rather abruptly and rather irregularly pointed. There are apparently no quadriradiates at all, but two (R.N. 377, 378) of the three specimens in the collection show a few very slender oxea (Plate XIII., fig. 8, *d*) projecting from the surface of some of the tubes. I have not been able to obtain these spicules in an unbroken condition, but they apparently closely resemble those found in the next species; whether or not they should be regarded as constant features of this variety, I am unable to say with certainty.

R.N. 377, 378, 379 (all from Cheval Paar).

Leucosolenia (Clathrina) tenuipilosa, n. sp.- -Plate XIII., fig. 9.

Sponge forming massive, reticulate colonies of ascon-tubes, closely resembling the preceding variety but somewhat coarser. Here and there on the surface of the colony the tubes converge to unite in small, prominent, true vents. The tubes themselves are about 0·5 millim. in diameter, and they form a close reticulation without any pseudoderm. The colour in alcohol is pale grey. The largest specimen (R.N. 158, which may be regarded as the type of the species) is cake-shaped and flattened, measuring about 47 millims. in length, 37 millims. in breadth, and 16 millims. in thickness.

The skeleton is arranged as usual in the genus, and the spicules are of three kinds :—

(1.) Regular triradiates (Plate XIII., fig. 9, *a*), with rather stout, slightly fusiform rays, bluntly and rather abruptly pointed at the apex, which is often somewhat irregular. Rays measuring about 0·1 millim. in length by 0·012 millim. in diameter at the thickest part.

(2.) Quadriradiates (Plate XIII., fig. 9, *b*, *c*) abundant; resembling the triradiates, but with an apical ray projecting at right angles into the gastral cavity. This ray is somewhat variable in form and size; typically it is long and slender, gradually and sharply pointed, and slightly undulated towards the extremity; in the type specimen it attains a length of about 0·14 millim.

(3.) Very slender, hair-like oxea (Plate XIII., fig. 9, *d*), sparsely hispidating the surface of the tubes. These may attain a length of more than 0·4 millim., with an average diameter of only about 0·002 millim. They taper very gradually from the proximal extremity, which is somewhat hastately sharp-pointed and may be as much as 0·004 millim. thick, to the distal, which is hair-like and apparently nearly always broken off.

This species is evidently closely related to *Leucosolenia coriacea*, var. *ceylonensis*, but differs in the presence of the quadriradiates, and also in the greater stoutness and the frequently fusiform shape of the rays of the triradiates.

R.N. 158 (Stat. LXIV., 5 fathoms, south-east of Modragam, March 17, 1902); 158A (south of Cheval); 380 and 381 (both from Cheval Paar, March 4, 1902).

ORDER 2: HETEROCŒLA.

Calcareous sponges in which the collared cells are confined to more or less well-defined flagellate chambers.

FAMILY: GRANTIIDÆ.

Heterocœla with a distinct and continuous dermal cortex, completely covering over the chamber-layer and pierced by inhalant pores. There are no sub-dermal sagittal triradiates, nor conspicuous sub-dermal quadriradiates. The flagellate chambers vary from elongated and radially arranged to spherical and irregularly scattered; while the skeleton of the chamber layer varies from regularly articulate to irregularly scattered

Leucandra (HAECKEL).

Grantiidæ in which the flagellate chambers are spherical or sac-shaped, never arranged radially around the central gastral cavity, with which (or with the main exhalant canals derived therefrom) they communicate by a more or less complicated exhalant canal-system. The skeleton of the chamber layer is composed of irregularly scattered radiate spicules, but it may still present traces of its derivation from a radially symmetrical type in the presence of a few sub-gastral sagittal triradiates.

Leucandra donnani, n. sp.—Plate XIII., fig. 10.

The only specimen in the collection consists of a single Leucon person of sac-like form; elongated, sub-cylindrical, but slightly compressed; rather strongly curved; tapering gradually from broadly rounded base to narrower apex, where the terminal osculum is situated. The outer surface is nearly smooth, but slightly granulated in appearance. The osculum has no spicular fringe, but a slightly developed membranous margin. The total length of the specimen is 23 millims.; the maximum diameter at the base is about 9·5 millims., and the diameter of the vent is 2 millims. The thickness of the sponge-wall in the middle is about 2 millims. The colour (in spirit) is light brown and the texture firm but brittle.

The dermal cortex, of sagittal triradiates, is only about 0·05 millim. thick; beneath it lie large, irregular sub-dermal cavities, without, however, any special supporting skeleton of their own. The gastral cortex, of sagittal quadriradiates, is about as thick as the dermal cortex and pierced by the numerous apertures of the exhalant canals. The skeleton of the chamber layer consists for the most part of very large sagittal triradiates, generally arranged with the basal ray pointing outwards.

The canal-system is typically leuconoid; the flagellate chambers, abundantly scattered in the ground-substance between the gastral and dermal cortex, being spherical or sac-shaped, and having a maximum diameter of about 0·08 millim. The epithelial cells lining the larger canals contain numerous brown pigment granules.

Spicules.—(1.) Dermal triradiates (Plate XIII., fig. 10, *c*, *d*); sagittal, with slender rays of not very unequal length, measuring, say, about 0·276 millim. in length by 0·016 millim. in thickness at the base, and tapering pretty gradually from base to apex, which is sharp-pointed. The rays are all straight, and the angle between the two paired rays is only slightly greater than the other two angles.

(2.) Triradiates of the chamber-layer (Plate XIII., fig. 10, *a*, *b*); stout, sagittal, with the basal ray somewhat shorter than the paired rays. Rays usually straight; somewhat fusiform and gradually and very sharply pointed. Angle between paired rays only slightly greater than the other two angles. The paired rays in a typical example measured about 0·7 millim. in length by 0·066 millim. in maximum diameter, with a basal ray about 0·57 millim. long and of about the same thickness as the others.

(3.) Gastral quadriradiates (Plate XIII., fig. 10, *e*, *f*); strongly sagittal, with the paired rays extended nearly, or quite, at right angles to the conspicuously shorter basal ray, and with the still shorter apical ray directed forwards almost in a line with the basal. The rays are all straight, or nearly so, and only moderately stout, and taper gradually from the base to the sharp-pointed apex. Length of paired rays about 0·188 millim., with a diameter at the base of 0·012 millim.; with basal ray about 0·072 millim. long and apical ray about 0·048 millim. long; the basal ray of about the same diameter as the paired rays; the apical ray rather more slender.

(4.) Fusiform oxea (Plate XIII., fig. 10, *g*); very slightly curved; gradually and finely pointed at the inner end, but with the outer end nearly always broken off; moderately stout, measuring, say, about 0·74 millim. in length by 0·02 millim. in maximum diameter. Arranged in sparse bundles at right angles to the surface, with the outer ends projecting but slightly.

This species is perhaps most nearly related to LENDENFELD's *Leucandra typica* (79) [= *Leuconia typica*, var. *tuba*, of POLÉJAEFF (77)], from the East Coast of Australia (and Bermudas ?), but differs considerably in details of spiculation. I have much pleasure in naming it after Captain DONNAN, the veteran Inspector and explorer of the Ceylon pearl banks.

R.N. 186 (DONNAN's Muttuvaratu Paar, Gulf of Manaar).

FAMILY: AMPHORISCIDÆ.

Heterocœla with a distinct and continuous dermal cortex. With conspicuous subdermal quadriradiate spicules with inwardly directed apical rays. Flagellate chambers varying from elongated and radially arranged to spherical and irregularly scattered.

Heteropegma, POLÉJAEFF.

Amphoriscidæ with elongated flagellate chambers arranged radially around the central gastral cavity. With a vestigial tubar skeleton of minute radiates. With a very thick dermal cortex, composed principally of triradiate spicules.

Heteropegma nodus-gordii, POLÉJAEFF (**77**).

This remarkable and well-characterised species is represented in the collection by a single good-sized specimen, which agrees very closely with the types described by POLÉJAEFF in 1883 from Australia (Cape York) and the Bermudas. The only other species known is the very closely related *H. latitubulata* from near Port Phillip Heads (**80**), so that the genus is apparently a characteristic Australian one, and the discovery of *H. nodus-gordii* (the Northern Australian form) at Ceylon affords another good example of the close relationship between the Ceylonese and Australian Sponge-Fauna. The anatomy of this species has been figured both by POLÉJAEFF (**77**) and by myself (**78**).

R.N. 155 (Ceylon seas).

LIST OF THE CEYLON SPONGE-FAUNA

so far as at present known; showing the classification adopted and the geographical distribution of those species which have been recorded from localities beyond the Ceylon area. The species marked H occur in Professor HERDMAN'S collection; those marked D are doubtful* :—

CLASS: NON-CALCAREA.

ORDER: MYXOSPONGIDA.

H 1. *Hexadella indica*, n. sp.
D 2. *Halisarca* (?) *rubitingens*, CARTER (**5**).

ORDER: TETRAXONIDA.

GRADE: TETRACTINELLIDA.

SUB-ORDER: HOMOSCLEROPHORA.

FAMILY: Plakinidæ.

H 3. *Dercitopsis ceylonica*, n. gen. et sp.

SUB-ORDER: ASTROPHORA.

FAMILY: Pachastrellidæ.

H 4. *Plakinastrella intermedia*, n. sp.
H 5. „ *schulzei*, n. sp.
6. *Stœba* (*Samus*) *simplex* (CARTER, **4**)†, Ternate (**87**).
H 7. *Stœba extensa*, n. sp.
8. *Triptolemus* (*Samus*) *parasiticus* (CARTER, **4**).†
9. *Nethea* (*Tisiphonia*) *nana* (CARTER, **4**).†
10. *Sphinctrella* ? (*Tisiphonia*) *annulata* (CARTER, **4**).†

FAMILY: Stellettidæ.

11. *Myriastra* (*Stelletta*) *crassicula* (CARTER, **5**).†
H 12. „ *clavosa* (RIDLEY). Off north coast of Australia; Philippine Islands; Amboyna (**83**); Ternate (**87**); Coast of Cochin China (**86**).
H 13. *Myriastra tethyopsis* (CARTER).
14. *Pilochrota ceylonica*, SOLLAS (**15**).
H 15. „ *haeckeli*, SOLLAS. Philippine Islands.

* In compiling this list no notice has been taken of varietal distinctions. It may be noted that the sponges described by me in my paper on "The Sponge-Fauna of Madras" (**2**) all came from the Gulf of Manaar (*vide* THURSTON, **99**).

† *Vide* SOLLAS (**15**).

H 16. *Pilochrota hornelli*, n. sp.
H 17. *Stelletta herdmani*, n. sp.
H 18. „ *vestigium*, n. sp.
19. *Aurora* (*Stelletta*) *globostellata* (CARTER, **21**).†
H 20. *Ecionema carteri*, n. sp.
H 21. „ *laviniensis*, n. sp.

FAMILY: Geodiidæ.

H 22. *Geodia perarmata*, BOWERBANK.
H 23. „ *peruncinata*, n. sp.
H 24. „ *areolata*, CARTER.
H 25. „ *ramodigitata*, CARTER.
26. „ *globostellifera*, CARTER. Port Darwin, Australia (RIDLEY, **16**).*
27. *Erylus carteri*, SOLLAS (**15**) = *Stelletta euastrum* CARTER (**4**).

SUB-ORDER: SIGMATOPHORA.

FAMILY: Tetillidæ.

H 28. *Tetilla hirsuta*, DENDY.
H 29. „ *poculifera*, n. sp.
H 30. „ *anomala*, n. sp.
H 31. „ *limicola*, n. sp.
H 32. *Craniella elegans*, n. sp.
H 33. *Paratetilla cineriformis*, n. gen. et sp.

FAMILY: Samidæ.

34. *Samus anonymus*, GRAY; *fide* CARTER (**4**). Bahia, West Indies, Australia, South Seas, Seychelles (**15**).

GRADE: LITHISTIDA.

35. *Discodermia papillata*, CARTER (**4**).
36. „ *aspera*, CARTER (**4**).
37. „ *lævidiscus*, CARTER (**4**).
38. „ *sinuosa*, CARTER (**5**).
H 39. „ *emarginata*, n. sp.
40. *Racodiscula* (*Discodermia*) *spinispirulifera* (CARTER, **4**).†
41. *Racodiscula* (*Discodermia*) *sceptrellifera* (CARTER, **5**).†
42. *Corallistes aculeata*, CARTER (**4**).
43. „ *verrucosa*, CARTER (**4**).
D 44. *Corallistes elegantissima*, CARTER (**4**).
H 45. *Aciculites orientalis*, n. sp.
H 46. *Taprobane herdmani*, n. gen. et sp.
H 47. *Petromica massalis*, n. sp.

GRADE: MONAXONELLIDA.

SUB-ORDER: ASTROMONAXONELLIDA.

FAMILY: Epipolasidæ.

48. *Coppatias* (*Tisiphonia*) *penetrans* (CARTER, **4**).
H 49. „ *reptans*, n. sp.
H 50. *Asteropus haeckeli*, n. sp.
H 51. *Cryptotethya agglutinans*, n. gen. et sp.

FAMILY: Tethyidæ.

H 52. *Tethya lyncurium*, LIN. Semi-cosmopolitan (especially in the North Atlantic).
H 53. *Xenospongia patelliformis*, GRAY. Torres Straits.

FAMILY: Spirastrellidæ.

H 54. *Hymedesmia stellivarians*, CARTER. Azores (**48**).
55. „ *moorei*, CARTER (**4**).
56. „ *spinatostellifera*, CARTER (**4**).
57. „ *capitatostellifera*, CARTER (**4**).
58. „ *trigonostellata*, CARTER (**4**).
H 59. „ *curvistellifera*, n. sp.
H 60. *Spirastrella vagabunda*, RIDLEY. Torres Straits; Ternate (**87**); Aden (**92**).
H 61. *Spirastrella tentorioides*, n. sp.
H 62. *Placospongia carinata* (BOWERBANK). Widely distributed in tropical seas (**35**).
63. *Placospongia melobesioides*, GRAY, *fide* CARTER (**4**). Widely distributed in tropical seas (**35**).
H 64. *Negombo tenuistellata*, n. gen. et sp.

FAMILY: Clionidæ.

65. *Cliona warreni*, CARTER (**5**).
66. „ *indica*, TOPSENT (**37**).
H 67. „ *margaritiferæ*, n. sp.
68. *Thoosa socialis*, CARTER (**4**).
69. *Dotona pulchella*, CARTER (**4**). Azores (**62**).
70. *Alectona higgini*, CARTER (**4**).

FAMILY: Suberitidæ.

71. *Suberites vestigium*, CARTER (**4**).
D 72. „ *inconstans*, DENDY (**2**).
H 73. „ *cruciatus*, n. sp.

* RIDLEY'S identification seems a little doubtful (*vide* SOLLAS, **15**).

† *Vide* SOLLAS (**15**).

FAMILY: Chondrosiidæ.

74. *Chondrilla nucula*, SCHMIDT; *fide* CARTER (**5**). Adriatic, Florida, Antilles, Azores (**48**); Red Sea (**61**).

H 75. *Chondrilla australiensis*, CARTER. Australia; Coast of Cochin China (**86**).

H 76. *Chondrosia reniformis*, NARDO. Adriatic; Aden (**92**); Amboyna (**83**).

SUB-ORDER: SIGMATOMONAXONELLIDA.

FAMILY: Haplosceridæ.

SUB-FAMILY: Gelliinæ.

H 77. *Gellius fibulatus* (SCHMIDT). Adriatic; European coast of North Atlantic; Azores (**62**); Australia (**16**); Ternate (**87**).

H 78. *Gellius angulatus* (BOWERBANK). British seas (**52**); Azores (**1, 48, 62**); Iceland (**88**).

H 79. *Gelliodes carnosa*, DENDY.

H 80. „ *incrustans*, n. sp.

H 81. „ *petrosioides*, n. sp.

H 82. *Toxochalina robusta*, RIDLEY. Port Jackson (Australia).

H 83. *Strongylophora durissima*, n. gen. et sp.

SUB-FAMILY: Renierinæ.

84. *Reniera madrepora*, DENDY (**2**). Java (**86**).

D 85. *Reniera albescens* (= *Halichondria albescens*, JOHNSTON), *fide* CARTER (**4**). British seas (**81**).

H 86. *Reniera implexa*, SCHMIDT. Adriatic (**50**); Azores (**1, 62**).

H 87. *Reniera pigmentifera*, n. sp.

H 88. „ *zoologica*, n. sp.

H 89. *Petrosia testudinaria* (LAMARCK). Queensland (**16**); Mergui Archipelago (**3**)

H 90. *Petrosia similis*, RIDLEY and DENDY. South of Cape of Good Hope and between Kerguelen and Heard Islands (**1**).

H 91. *Petrosia densissima*, n. sp.

H 92. *Halichondria panicea*, JOHNSTON. Cosmopolitan (**1**).

H 93. *Trachyopsis halichondrioides*, n. gen. et sp.

SUB-FAMILY: Chalininæ.

H 94. *Pachychalina subcylindrica*, n. sp.

H 95. „ *delicatula*, DENDY.

H 96. „ *brevispiculifera*, n. sp.

H 97. *Pachychalina spinilamella*, DENDY.

H 98. *Chalina subarmigera*, RIDLEY. Torres Straits (**16**); Port Jackson (**51**); Coast of Cochin China (**86**).

H 99. *Chalina obtusispiculifera*, n. sp.

H 100. „ *clathrata*, n. sp.

H 101. „ *cymæformis* (ESPER ?).

H 102. *Ceraochalina retiarmata*, n. sp.

H 103. „ *reticutis*, n. sp.

H 104. „ *multiformis*, LENDENFELD. Australia and New Zealand (**51**).

H 105. *Ceraochalina ceylonica*, n. sp.

H 106. *Siphonochalina communis* (CARTER). Port Jackson (**16**); Kurrachee (**16**).

SUB-FAMILY: Desmacellinæ.

H 107. *Desmacella tubulata*, n. sp.

SUB-FAMILY: Tedaniinæ.

108. *Tedania digitata*, SCHMIDT, *fide* DENDY (**2**). Cosmopolitan (**1**).

SUB-FAMILY: Heteroxyinæ.

H 109. *Acanthoxifer ceylonensis*, n. gen. et sp.

FAMILY: Desmacidonidæ.

SUB-FAMILY: Esperellinæ.

H 110. *Esperella parishii*, RIDLEY. Port Darwin, Australia (**16**).

H 111. *Esperella plumosa* (CARTER). Mauritius (**33**); Mergui Archipelago (**20**).

H 112. *Esperella crassissima*, n. sp.

H 113. „ *tenuispiculata*, n. sp.

D 114. *Esperella tunicata* (SCHMIDT), *fide* CARTER (**4**). Adriatic (**47**); Azores (**62**).

H 115. *Paresperella serratohamata* (CARTER). Vancouver, *fide* LAMBE (**85**).*

H 116. *Paresperella bidentata*, n. sp.

H 117. *Iotrochota purpurea* (BOWERBANK). Straits of Malacca (**49**); North Australia (**16**); Amboyna (**83**); Amirante group (**16**); ? South Coast of Australia (**10**); ? West Indies (**53**).

H 118. *Iotrochota baculifera*, RIDLEY. Western Indian Ocean (**16**); North Australia (**16**); Amboyna (**83**); Celebes (**39**); Ternate (**87**); Coast of Cochin China (**86**).

* LAMBE'S identification is probably erroneous.

119. *Yvesia* (?) (*Halichondria*) *aceratospiculum* (CARTER, **4**).

120. *Paramyxilla** (*Halichondria*) *infrequens* (CARTER, **5**).

SUB-FAMILY: Phlœodictyinæ.

H 121. *Phlœodictyon fistulosum* (BOWERBANK). Northern and Western Australia (**1**, &c.); Amboyna (**83**); Azores (**1**; **62**); ? off Bahia (**1**); Ternate (?) (**87**).

122. *Histoderma* (*Suberites*) *fistulatum* (CARTER, **4**). West Australia, *fide* CARTER (**4**).

H 123. *Histoderma vesiculatum*, n. sp.

SUB-FAMILY: Ectyoninæ.

H 124. *Myxilla arenaria*, n. sp.

H 125. „ *tenuissima*, n. sp.

H 126. *Clathria frondifera* (BOWERBANK). Straits of Malacca and Gaspar Strait (**49**); Queensland and Torres Strait (**16**); Western Indian Ocean (Providence, Amirante, Seychelles) (**16**); Red Sea (**91**); Java Sea (**86**).

H 127. *Clathria indica*, DENDY.

H 128. „ *spiculosa* (DENDY).

H 129. *Raspailia thurstoni*, DENDY.

H 130. „ *fruticosa*, DENDY.

H 131. „ *hornelli*, n. sp.

132. *Plumohalichondria* (*Halichondria*) *plumosa* (MONTAGU); *fide* CARTER (**5**). British seas (**52**, &c.); off Bahia (**1**); Kerguelen (**82**).

133. *Microciona armata*, BOWERBANK, *fide* CARTER (**4**). British seas (**52**).

134. *Microciona atrasanguinea*, BOWERBANK, *fide* CARTER (**4**). British seas (**52**).

135. *Microciona affinis*, CARTER (**4**).

136. *Hymeraphia clavata*, BOWERBANK, *fide* CARTER (**4**). British Isles (**52**); Azores (**62**); Amboyna (**83**); &c. (*vide* **62**).

137. *Hymeraphia* (*Microciona*) *bulboretorta* (CARTER, **4**).

138. *Hymeraphia* (?) (*Microciona*) *fascispiculifera* (CARTER, **4**).

139. *Hymeraphia* (?) *unispiculum* (CARTER, **4**).

H 140. *Agelas mauritiana* (CARTER). Mauritius (**54**); off Tristan da Cunha (?) (**1**); Ternate (**87**).

H 141. *Agelas ceylonica*, n. sp.

H 142. *Echinodictyum clathratum*, n. sp.

H 143. *Aulospongus tubulatus* (BOWERBANK).

144. „ (?) (*Dictyocylindrus*) *sessilis*, CARTER (**4**).

H 145. *Acarnus ternatus*, RIDLEY. Bombay (?) (**16**); Amirante (**16**); Torres Straits (**16**); Tahiti (**1**); Ternate (**87**).

H 146. *Cyamon quinqueradiatum* (CARTER).

147. „ (*Microciona*) *quadriradiatum* (CARTER) (**4**). West Indies (**4**).

H 148. *Plocamia manaarensis* (CARTER). California, *fide* LAMBE (**85**).†

H 149. *Bubaris eruca* (CARTER).

150. *Rhabdoploca* (*Microciona*) *curvispiculifera* (CARTER, **4**). Azores (**62**).

H 151. *Rhabderemia indica*, n. sp.

FAMILY: Axinellidæ.

H 152. *Spongosorites topsenti*, n. sp.

H 153. „ (?) *lamellata*, n. sp.

H 154. „ (?) *lapidiformis*, n. sp.

H 155. *Hymeniacidon petrosioides*, n. sp.

H 156. *Thrinacophora agariciformis*, n. sp.

H 157. „ *durissima*, n. sp.

H 158. *Axinella labyrinthica*, DENDY.

H 159. „ *manus*, n. sp.

H 160. „ *tenuidigitata*, n. sp.

H 161. „ *halichondrioides*, n. sp.

162. „ (?) (*Hymeraphia*) *erecta*, CARTER (**4**). North and South Atlantic and Southern Ocean (**1**); Azores (**62**).

H 163. *Phakellia donnani* (BOWERBANK).

164. „ *ridleyi*, DENDY (**2**).

H 165. „ *symmetrica*, n. sp.

H 166. „ *ceylonensis*, n. sp.

H 167. „ *crassistylifera*, n. sp.

H 168. *Acanthella carteri*, DENDY.

H 169. „ *flabelliformis*, KELLER. Red Sea (**61**).

H 170. *Auletta lyrata* (ESPER).

* This genus I now propose for the reception of CARTER'S *Halichondria infrequens*. It is evidently nearly related to *Myxilla*, and may be diagnosed as follows:—"Esperellinæ whose principal megascleres are spined oxea, with which are associated smooth tylota. Microscleres tridentate isochelæ and sigmata."

† LAMBE'S identification is doubtful.

H 171. *Auletta elongata*, n. sp.

H 172. *Leucophlœus fœtidus* (DENDY). Amboyna (**83**); Ternate (**87**); (?) China Sea (**86**).

H 173. *Ciocalypta tyleri*, BOWERBANK. Port Elizabeth (**22**); Southern and Eastern Coasts of Australia (**3**, **10**).

H 174. *Collocalypta digitata*, n. gen. et sp.

ORDER: EUCERATOSA.

FAMILY: Aplysillidæ.

H 175. *Darwinella simplex*, TOPSENT. Mediterranean, Azores.

H 176. *Megalopastas nigra* (DENDY).

H 177. „ *pulvillus*, n. sp.

FAMILY: Spongeliidæ.

H 178. *Spongelia fragilis*, MONTAGU. Cosmopolitan.

H 179. „ *elastica*, SCHULZE. Cosmopolitan.

H 180. „ *incrustata*, n. sp.

D 181. „ (?) *conica* (BOWERBANK, **8**). Western Indian Ocean (Glorioso Island) (**16**).

H 182. *Psammopemma crassum* (CARTER). Australia and New Zealand (**66**).

FAMILY: Spongiidæ.

183. *Cacospongia cavernosa*, SCHMIDT (*fide* LENDENFELD, **66**). Almost cosmopolitan (**66**).

H 184. *Cacospongia scalaris*, SCHMIDT. Mediterranean.

H 185. *Euspongia officinalis*, AUCTORUM. Almost cosmopolitan (**66**).

186. *Euspongia irregularis*, LENDENFELD (*fide* LENDENFELD, **66**). Madagascar; East Coast of Australia; Torres Straits; Oceania; Bahamas (**66**).

H 187. *Euspongia tenuiramosa*, n. sp.

188. „ *trincomalensis*, LENDENFELD (*fide* LENDENFELD, **66**). Nassau; Havannah; Pernambuco (**66**).

H 189. *Hippospongia intestinalis* (LAMARCK). Mediterranean; Zanzibar; Mascarene and Amirante Islands; Porto Rico.

H 190. *Hippospongia clathrata* (CARTER). Red Sea; Australia; American Coast of North Atlantic.

H 191. *Hippospongia anomala*, POLÉJAEFF. Torres Straits.

H 192. *Hippospongia dura*, LENDENFELD. American Coast of North Atlantic.

193. *Stelospongia onduatjeana*, LENDENFELD (**66**).

H 194. *Phyllospongia papyracea* (ESPER). Tranquebar; Cape of Good Hope; Mozambique; (?) West Coast of Australia; (?) New Zealand; (?) Chatham Islands (**66**).

H 195. *Phyllospongia holdsworthi* (BOWERBANK).

H 196. *Hircinia fusca*, CARTER.

197. „ *vallata*, DENDY (**2**). Port Phillip Heads, Australia (**66**).

H 198. *Hircinia tuberosa*, n. sp.

H 199. „ *schulzei*, n. sp.

H 200. „ *anomala*, n. sp.

D 201. „ *arundinacea*, CARTER (**4**).

H 202. *Aplysina purpurea*, CARTER.

203. „ *fusca*,* CARTER (**4**). Seychelles (**16**); South-west Coast of Australia (**65**).

204. *Aplysina spengelii*, LENDENFELD. Jamaica (**66**).

H 205. *Aplysina herdmani*, n. sp.

CLASS: CALCAREA.

ORDER: HOMOCŒLA.

H 206. *Leucosolenia coriacea* (MONTAGU). North-east Atlantic (**7**).

H 207. *Leucosolenia tenuipilosa*, n. sp.

208. *Leucosolenia* (*Ascaltis*) *darwinii* (HAECKEL, **7**). Red Sea, Java (**7**).

ORDER: HETEROCŒLA.

FAMILY: Sycettidæ.

209. *Sycetta sagittifera*, HAECKEL (**7**).

210. *Sycon raphanus*, SCHMIDT, *fide* HAECKEL (**7**). Mediterranean, Red Sea (**7**); South Coast of Australia (**7**, **80**).

FAMILY: Grantiidæ.

211. *Leucandra* (*Leucetta*) *primigenia* (HAECKEL, **7**). Cosmopolitan.

212. *Leucandra* (*Leucortis*) *pulvinar* (HAECKEL, **7**).† West Coast of Australia, Red Sea (**7**).

H 213. *Leucandra donnani*, n. sp.

FAMILY: Amphoriscidæ.

H 214. *Heteropegma nodus-gordii*, POLÉJAEFF. North Australia, Bermudas (**77**).

215. *Leucilla* (*Leucandra*) *cucumis* (HAECKEL, **7**). South Coast of Australia (**7**).

* According to LENDENFELD (**66**), this species is identical with HYATT'S *Dendrospongia crassa*. If so, the geographical range must be extended to Nassau.

† CARTER (**5**) adopts HAECKEL'S varietal name *indica* for the Ceylon form.

It appears from the above list that no less than 215 species of sponges (including about seven doubtful ones) have now been recorded from Ceylon waters, which evidently form an extremely rich centre of sponge distribution. Of these 215 species, 146 occur in Professor HERDMAN'S collection, of which 77 (or 52·7 *per cent.*) are here described as new. I consider it very satisfactory to have been able to identify as many as 69 previously known species in the collection, especially as I always prefer giving a new specific name to making a doubtful identification; mistakes of the latter kind being often far more difficult to correct than those of the former. Seventy-five out of the total number of species have been recorded from localities beyond the Ceylon area.

As regards the general character of the Ceylon Sponge-Fauna, the most striking feature, next to its richness, is its close relationship with the Sponge-Fauna of Australia and the adjacent islands. In the Report on the "Challenger" Monaxonida we defined an area of distribution (No. IV. on the chart) including Australia and the islands north of Australia as far as the Philippines (inclusive). This we called the Indo-Australian area. No less than 47 out of the 75 species whose range is known to extend beyond the Ceylon region are common to the latter and our Indo-Australian region—the majority of them occurring actually along the Australian Coast.

Of these 47 species, the following are not known to occur except in the Indo-Australian area (in the "Challenger" sense) and westwards as far as Southern India:—*Stœba simplex*, *Myriastra clavosa*, *Pilochrota haeckeli*, *Geodia globostellifera*, *Xenospongia patelliformis*, *Chondrilla australiensis*, *Toxochalina robusta*, *Reniera madrepora*, *Petrosia testudinaria*, *Chalina sub-armigera*, *Siphonochalina communis*, *Esperella parishii*, (?) *Iotrochota purpurea*, *Histoderma fistulatum*, *Leucophlœus fœtidus*, *Hippospongia anomala*, *Hircinia vallata*, *Leucilla cucumis*. The following extend (so far as known) westwards not further than the East Coast of Africa or eastwards not further than New Zealand:—*Spirastrella vagabunda* (Aden), *Ceraochalina multiformis* (New Zealand), *Iotrochota baculifera* (Western Indian Ocean), *Clathria frondifera* (Western Indian Ocean, Red Sea), *Acarnus ternatus* (Western Indian Ocean, Tahiti), *Ciocalypta tyleri* (Port Elizabeth), *Psammopemma crassum* (New Zealand), *Phyllospongia papyracea* (Mozambique, Australia ?, New Zealand ?), *Aplysina fusca* (Seychelles), *Leucosolenia darwini* (Red Sea), *Leucandra pulvinar* (Red Sea). Another characteristic Indo-Australian species is *Agelas mauritiana*, hitherto recorded only from Mauritius, Ceylon, Ternate (under the synonym *A. cavernosa*, THIELE), and doubtfully from Tristan da Cunha.

If, on the other hand, we compare the Ceylon Sponge-Fauna with that of the Red Sea, as elaborated chiefly by KELLER (**61**), we notice a considerable difference. KELLER records a total of 88 species from the Red Sea, to which TOPSENT (**91**, **92**) has added 13. Of these, only 14 are known to occur in Ceylon, viz.:—*Spongelia fragilis*, *Euspongia officinalis*, *Cacospongia cavernosa*, *Hippospongia clathrata*, *Clathria frondifera*, *Acanthella flabelliformis*, *Spirastrella vagabunda*, *Placospongia* *melobesioides*, *Chondrilla nucula*, *Chondrosia reniformis*, *Leucosolenia darwini*, *Sycon raphanus*, *Leucandra primigenia*, *Leucandra pulvinar*, of which all but five (*Clathria frondifera*, *Acanthella flabelliformis*, *Spirastrella vagabunda*, *Leucosolenia darwini*, and *Leucandra pulvinar*) are so widely distributed that their occurrence is of little significance. A few other Red Sea species, however, are very closely related to Ceylon forms, and it is not improbable that two or three which have been described by KELLER under new names may be identical with Ceylon species, as will appear from the descriptive part of this report. Amongst the Australian Sponge-Fauna also a number of species occur which are very nearly related to Ceylon species, and which have not been taken account of in the above comparison.

A considerable number of sponges have also been described from South and East African waters outside the Red Sea. The "Challenger" made collections in the neighbourhood of the Cape of Good Hope, and KIRKPATRICK (**17**) has lately described 45 species collected by Dr. GILCHRIST. KELLER (**61**) also gives a considerable list of species from the East African area, in which, however, while excluding South Africa, he includes the islands of the Western Indian Ocean visited by the "Alert." In spite of these researches only four Ceylon species appear to have been met with along the African Coast itself (outside of the Red Sea), viz. :—*Phyllospongia papyracea* (Mozambique), *Ciocalypta tyleri* (Port Elizabeth), *Tedania digitata* (Mozambique), and *Spongelia fragilis* (Zanzibar), the last two being cosmopolitan. On the other hand, a number of Ceylon species extend, as we have seen, to the islands of the Western Indian Ocean, viz. :—*Hippospongia intestinalis*, *Euspongia irregularis*, *Cacospongia cavernosa*, *Spongelia* (?) *conica*, *Aplysina fusca*, *Tedania digitata*, *Iotrochota baculifera*, *Iotrochota purpurea*, *Clathria frondifera*, *Acarnus ternatus*, *Agelas mauritiana*, *Chondrilla nucula*, *Samus anonymus*, *Leucandra primigenia*. These species have very possibly spread south-westwards from Ceylon along the chain of small islands formed by the Maldives, Seychelles, Chagos, Amirantes, &c.

Even if we make allowance for errors and omissions in identification and doubtful species, and also for the important fact that many more species are known from Australasian waters than from the Red Sea and East African Coast, it appears probable from the above data that the Sponge-Fauna of Ceylon is more closely related to that of the eastern side of the Indian Ocean than it is to that of the western side, and the Ceylon region may be safely included zoo-geographically in our Indo-Australian area. The similarity of the Sponge-Fauna of Ceylon to that of Australia is doubtless to be accounted for by the facilities of distribution and suitable habitats afforded by the broken coast line which extends between the two, for it is probable that, owing to the brief duration of their free-swimming larval condition, shallow-water sponges are rarely able to traverse wide areas of deep ocean.

A few other points concerning the geographical relationship of the Ceylon Sponge-Fauna are, perhaps, worth noticing in this place. The Sponge-Fauna of the Azores has lately been worked out in great detail by TOPSENT (48, 62), who records eight species from that area which are also met with in Ceylon, while two of these, *Dotona pulchella* and *Rhabdoploca unispiculifera*, have not yet been met with elsewhere. The genus *Petromica*, also, is only known as yet from the Azores and from Ceylon, the two species being almost identical. Hence, in spite of the great difference in point of distance, the Sponge-Fauna of the Azores appears to resemble that of Ceylon nearly as much as does that of the Red Sea!

There also appears to be a certain amount of affinity between the Sponge-Fauna of Ceylon and that of the American coast of the North Atlantic, especially amongst the horny sponges (*e.g.*, *Hippospongia dura*), though, perhaps, some of the identifications in this group are a little doubtful. The Lithistid genus *Aciculites*, however, has, so far as I am aware, only been recorded from Ceylon and Havannah, and the two species in these two remote localities are closely similar.

Very nearly two-thirds of the total number of species are, however, so far as is known at present, peculiar to the Ceylon area, and, although the number of such species (at present 140) will certainly be largely decreased by future identifications and discoveries in other localities, it will, on the other hand, also be augmented by fresh additions to the list of the Ceylon Sponge-Fauna. My investigations of the Sponge-Fauna of other parts of the world also lead me to believe that while a considerable number of species enjoy a very wide geographical range, the majority have comparatively small areas of distribution. I strongly suspect, however, that a large number of our so-called "species" will ultimately be found to be so closely connected by intermediate forms that it will no longer be possible to separate them sharply from one another. In the meantime they must be distinguished by separate names, and, if the different forms are fully and properly described, it should be easy for future workers to trace out their true relationships.

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DESCRIPTION OF PLATES.

PLATE I.

Fig. 1. *Hexadella indica*; vertical section of R.N. 46, combined drawing.
Ch., inhalant chones; *Ch.L.*, choanosomal lamella; *Cr.*, sub-cortical crypts; *Ect.*, ectosome; *F.C.*, flagellate chambers; *L.E.C.*, larger exhalant canal; *Mem.*, roofing membrane of inhalant chones; *P.E.C.*, primary exhalant canals; *P.I.C.*, primary inhalant canals; *Sy.A.*, symbiotic algæ.

„ 2. *Hexadella indica*; small portion of vertical section through choanosomal lamella, more highly magnified (ZEISS F., Oc. 2).
C.T.C., connective-tissue cells; *Ep.*, epithelium lining primary inhalant and exhalant canals; *I.Ca.*, inhalant canaliculi. (Other lettering as before.)

„ 3. *Hexadella indica*; tangential section of the ectosome, seen from below, showing the inhalant chones, &c. × 52. (Lettering as before.)

„ 4. *Plakinastrella intermedia*; R.N. 224. × 2.—*o.*, vent.

„ 5. *Ecionema carteri*; R.N. 175. × 2.—*o.*, vents; *p.s.*, pore-sieves.

„ 6. *Tetilla poculifera*; R.N. 230. × 3. Upper part in section.
Cl., cloaca; *L.E.C.*, larger exhalant canals.

„ 7. *Tetilla limicola*; R.N. 70. Nat. size.
o., vents; *r.t.*, root tuft of spicules matted together with mud.

„ 8. *Taprobane herdmani*; R N. 40. Slightly reduced; from a photograph.

PLATE II.

Fig. 1. *Dercitopsis ceylonica*; R.N. 139. Spicules. All × 230.
a.–h., calthrops and triods; *i.–o.*, oxea.

„ 2. *Plakinastrella intermedia*; R.N. 224. Spicules.
a.–d., dichotriænes, × 52; *e.–n.*, oxea, × 52; *o.–p.*, microxea, × 230; *q.–v.*, oxyasters, × 230.

„ 3. *Plakinastrella schulzei*; R.N. 149. Spicules.
a.–d., triænes, × 52; *e.–q.*, oxea, × 52; *r.–t.*, microxea, × 230; *u.–x.*, oxyasters, × 230.

„ 4. *Pilochrota haeckeli*; R.N. 127. Spicules. All × 52.
a., orthotriæne; *b.*, monstrous form of orthotriæne; *c.*, anatriæne; *d.*, *e.*, monstrous forms of anatriæne.

„ 5. *Pilochrota hornelli*; R.N. 176. Spicules.
a., *b.*, orthotriænes, × 52; *c.*, *d.*, cladomes of orthotriænes seen from above, × 52; *e.*, anatriæne, × 52; *f.*, oxeote, × 52; *g.–i.*, chiasters, × 230.

„ 6. *Stelletta herdmani*; R.N. 137. Spicules.
a.–c., triænes, × 52; *d.*, oxeote, × 52; *e.–h.*, chiasters, × 230; *i.–k.*, oxyasters, × 230.

„ 7. *Stelletta vestigium*; R.N. 200A. Spicules. All × 230.
a.–d., reduced triænes; *e.*, oxeote; *f.*, *g.*, spherasters; *h.*, *i.*, oxyasters.

PLATE III.

Fig. 1. *Ecionema carteri;* R.N. 175. Spicules.

a., *b.*, plagiotriænes, × 52; *c.*, plagiotriæne (protriæne ?), × 52; *c′.*, cladome of *c.*, × 230; *d.*, anatriæne, × 52; *d′.*, cladome of *d.*, × 230; *e.*, oxeote, × 52; *f.*, microstrongyla, × 230; *g.*, chiasters, × 230.

" 2. *Ecionema laviniensis;* R.N. 265. Spicules.

a., dichotriæne, × 52; *b.*, cladome of dichotriæne, seen from above., × 52; *c.*, anatriæne, × 52; *c′.*, cladome of *c.*, × 230; *d.*, oxeote, × 52; *e.*, chiasters, × 230; *f.*, oxyasters (?), × 230; *g.*, microstrongyla, × 230; *h.*, microxeote (?), × 230.

" 3. *Geodia peruncinata;* R.N. 223. Arrangement of the skeleton as seen in vertical section, × 52.

a., *a′.*, dichotriænes; *b.*, somal anatriæne; *c.*, reduced cortical anatriænes; *d.*, oxea; *e.*, sterrasters in cortical layer; *e′.*, young sterrasters in choanosome; *f.*, large spherasters.

" 3A. *Geodia peruncinata;* R.N. 223. Reduced anatriæne, × 230.

" 3B. *Geodia peruncinata;* R.N. 223. Microscleres. All × 230.

a., small spheraster (chiaster ?); *b.*, large spheraster; *c.*, outline of sterraster, to show relative size.

" 4. *Tetilla poculifera;* R.N. 230. Spicules.

a., *b.*, plagiotriænes, × 52; *c.*, anatriæne, × 52; *c′.*, cladome of *c.*, × 230; *d.*, protriæne, × 52; *d′.*, cladome of *d.*, × 230; *e.*, oxeote, × 52; *f.*, *g.*, microxea, × 230; *h.*, sigmata, × 230.

" 5. *Tetilla anomala;* R.N. 153. Spicules.

a., part of protriæne, × 230; *b.*, anatriæne, × 52; *b′.*, cladome of *b.*, × 230; *c.*, oxeote, × 52; *d.*, sigmata, × 230.

" 6. *Tetilla limicola;* R.N. 70. Spicules from body. All × 230.

a., anatriæne, cladome and part of shaft; *b.*, protriæne, cladome and part of shaft; *c.*, oxeote; *d.*, sigmata.

" 7. *Paratetilla cineriformis;* R.N. 214. Spicules.

a.–d., modified triænes, × 230. (The central canal of these spicules is indicated by the dark shading.) *e.*, protriæne, × 52; *e′.*, cladome of *e.*, × 230; *f.*, anatriæne, × 52; *f′.*, cladome of *f.*, × 230; *g.*, oxeote, × 52; *g′*, *g″*, ends of *g.*, × 230, showing their irregularity in shape and the central canal; *h.*, sigmata, × 230.

PLATE IV.

Fig. 1. *Craniella elegans;* R.N. 193. Vertical section, × 28.

a., anatriænes; *b.*, protriænes; *c.o.*, cortical oxea; *d.m.*, dermal membrane; *emb.*, embryo; *f.c.*, fibrous layer of cortex; *i.c.c.*, intracortical (sub-dermal) cavities; *r.b.*, radiating spicule-bundles of main skeleton.

" 2. *Taprobane herdmani;* R.N. 40. Desmas. All × 230.

a., *b.*, young monocrepid desmas; *c.*, adult desma.

" 3. *Aciculites orientalis;* R.N, 150. Spicules. All × 230.

a., *b.*, *c.*, young monocrepid desmas; *d.*, adult desma; *e.*, *f.*, strongyla.

" 4. *Discodermia emarginata;* R.N. 234. Spicules. All × 230.

a.–d., stages in the development of the tetracrepid desma; *e.*, end of branch of an adult desma; *f.*, very young discotriæne, side view, *s*, shaft; *g.*, adult discotriæne, surface view *s*, shaft; *h.*, microrhabds.

" 5. *Petromica massalis;* R.N. 257. Spicules. All × 52.

a., monocrepid desma; *b.–d.*, monaxonid megascleres, showing variation in form.

PLATE V.

Fig. 1. *Stæba extensa*; R.N. 167. Spicules.
a.–d., dichotriænes (*sh.* = shaft), × 230; *e.*, *e.*, microxea, × 530.

,, 2. *Coppatias reptans*; R.N. 242. Spicules.
a.–c., oxea, × 52; *d.*, chiasters, × 530.

,, 3. *Asteropus haeckeli*; R.N. 219. Spicules.
a., oxeote, × 52; *b.*, oxyaster, × 530; *c.*, *d.*, sanidasters, × 530.

,, 4. *Cryptotethya agglutinans*; R.N. 62. Half the specimen, after division in the median plane. Natural size.
ch., choanosome; *ect.*, ectosome; *f.b.*, foreign bodies adhering to the surface; *f.l.*, inner fibrous layer of ectosome; *f.p.*, finger-shaped process of ectosome; *x.*, process of ectosome flattened at the end and containing longitudinal canals.

,, 5. *Cryptotethya agglutinans*; R.N. 62. Spicules.
a., *b.*, oxea, × 52; *c.*, chiasters from ectosome, × 230.

,, 6. *Hymedesmia curvistellifera*; R.N. 320. Spicules.
a., tylostyle, × 230; *b.*, *c.*, *d.*, asters, × 530.

,, 7. *Spirastrella tentorioides*; R.N. 239. Spicules.
a., *b.*, tylostyli, × 230; *c.–g.*, spirasters, × 530.

,, 8. *Negombo tenuistellata*; R.N. 362. Spicules.
a.–c., styli, × 230; *d.*, sanidasters, × 530.

,, 9. *Cliona margaritiferæ*; R.N. 261. Spicules.
a., tylostyle, × 230; *b.–d.*, spirasters, × 530; *e.*, *g.*, intermediate microscleres, × 530; *h.*, *k.*, spined microxea, × 530.

,, 10. *Suberites cruciatus*; R.N. 315. Spicules.
a., *b.*, tylostyles, × 230; *c.–g.*, heads of tylostyles, showing variations, × 530.

PLATE VI.

Xenospongia patelliformis, R.N. 375.

Fig. 1. Entire specimen (young), upper surface, slightly diagrammatic, × 2.
a., projection caused by foreign body; *m.f.*, marginal fringe of spicules; *m.p.g.*, marginal pore-grooves; *o.*, vents; *r.p.g.*, radiating pore-grooves, feebly developed.

,, 2. Radial vertical section, showing the ectosome (cortex), the sand-free portion of the choanosome, and part only of the sandy layer of the choanosome; slightly diagrammatic.
cort., cortex; *d.b.*, dermal brushes of styli; *ex.c.*, exhalant canal; *f.b.*, bands of fibrous tissue running inwards from the cortex to the sandy layer; *m.f.*, marginal fringe of styli; *m.p.g.*, marginal pore-grooves, showing inhalant pores and canals; *o.*, vent.; *s.g.*, sand grains.

,, 3. Small portion of similar section, including the entire thickness of the cortex and a small portion of the choanosome, × 230.
cort., cortex; *f.b.*, band of fibrous tissue running inwards from the cortex; *fl.c.*, flagellate chambers; *scl.*, scleroblasts, containing small asters.

,, 4. Megascleres.
a., *b.*, styli, × 52; *b′.*, *b″.*, basal and apical portions of *b*, × 230.

,, 5. Larger microscleres, × 230.
a.–c., various forms of aster; *d.*, a much-branched aster from the interior of the sponge.

,, 6. Smaller microscleres, × 530.
a.–m., various forms of aster.

PLATE VII. (All the figures from photographs.)

Fig. 1. *Siphonochalina communis*, var. *tenuispiculata*; R.N. 117, reduced to nearly $\frac{1}{2}$.
,, 2. *Ceraochalina multiformis*, var. *manaarensis*; R.N. 98, × about $\frac{4}{7}$.
,, 3. ,, *ceylonica*; R.N. 5, × about $\frac{1}{2}$.
,, 4. *Pachychalina spinilamella*; R.N. 94, × about $\frac{4}{7}$.
,, 5. *Gelliodes carnosa*; R.N. 69, × about $\frac{1}{2}$.
,, 6. *Collocalypta digitata*; R.N. 74A, nearly natural size.

PLATE VIII. (All the figures from photographs.)

Fig. 1. *Plocamia manaarensis*; R.N. 107, × about $\frac{2}{3}$.
,, 2. *Clathria spiculosa*, var. *tessellata*; R.N. 92, × about $\frac{2}{3}$.
,, 3. *Phakellia ceylonensis*; R.N. 34, × $\frac{13}{18}$.
,, 4. *Acarnus ternatus*; R.N. 105, × about $\frac{1}{2}$.
,, 5. *Raspailia fruticosa*, var. *tenuiramosa*; R.N. 100, × about $\frac{5}{7}$.
,, 6. *Acanthella carteri*; R.N. 36, × about $\frac{2}{3}$.

PLATE IX.

Fig. 1. *Strongylophora durissima*; R.N. 244. Part of dermal skeleton, × 230.
m., microxea; *s.*, strongyla.
,, 2. *Toxochalina robusta*, var. *ridleyi*; R.N. 109. Part of main skeleton in vertical section, × 230.
o., oxea; *t.*, toxa.
,, 3. *Gelliodes petrosioides*; R.N. 146. Spicules, × 230.—*a.*, *b.*, *c.*, megascleres; *d.*, sigmata.
,, 4. *Desmacella tubulata*; R.N. 324. Spicules, × 230.
a., *b.*, styli; *c.*, sigmata; *d.*, trichodragmata; *e.*, isolated microxeote.
,, 5. *Acanthoxifer ceylonensis*; R.N. 247. Spicules, × 230.
a., smooth oxeote; *b.*, stylus; *c.*, spined oxeote; *d.*, trichodragmata.
,, 6. *Gelliodes incrustans*; R.N. 112. Part of dermal skeleton, × 230.—*o.*, oxea; *s.*, sigmata.
,, 7. *Gellius angulatus*, var. *canaliculata*; R.N. 140. Spicules, × 230.
a., oxeote; *b.*, sigmata; *c.*, toxiform.
,, 8. *Reniera zoologica*; R.N. 262. Oxea, × 360.
,, 9. *Petrosia densissima*; R.N. 138A. Oxea, × 360.
,, 10. *Reniera pigmentifera*; R.N. 290. Spicules, × 360.—*a.*, oxeote; *b.*, strongylote; *c.*, *d.*, stylote.

PLATE X.

Fig. 1. *Pachychalina subcylindrica*; R.N. 292. Part of dermal skeleton, × 52.
,, 2. ,, R.N. 292. Oxea, × 360.
,, 3. *Chalina clathrata*; R.N. 102. Part of skeleton in tangential section near the surface, × 360.
,, 4. *Ceraochalina retiarmata*; R.N. 342. Oxea, × 360.
,, 5. *Chalina subarmigera*; R.N. 116, about half natural size (dry specimen, from photograph).
,, 6. *Ceraochalina ceylonica*; R.N. 50. Oxea, × 360.
,, 7. *Pachychalina brevispiculifera*; R.N. 110. Oxea, × 360.
,, 8. *Ceraochalina reticutis*; R.N. 58. Part of dermal skeleton, × 360.
o., well developed oxea, lying for the most part outside the horny fibre; *v.s.*, vestigial oxea, lying in the horny fibre.
9. *Chalina obtusispiculifera*; R.N. 370. Part of surface skeleton, × 360.
10. *Trachyopsis halichondrioides*; R.N. 147. Oxea, × 230.

PLATE XI.

Fig. 1. *Paresperella bidentata*; R.N. 263A. Spicules, × 530.
a., tylostyle with bidentate apex; *b.*, *b.*, serrated sigmata; *c.*, anisochela, side view; *d.*, anisochela, front view.

" 2. *Paresperella serratohamata*; R.N. 220C. Spicules, × 530.
a., tylostyle with mucronate apex; *b.*, *b.*, serrated sigmata.

" 3. *Paresperella*, sp. Gigantic serrated sigma, × 230.

" 4. *Echinodictyum clathratum*; R.N. 325. Spicules, × 230.
a., large stylus; *b.*, slender stylus; *c.*, *d.*, oxea; *e.*, *f.*, spined tylostyli.

" 5. *Myxilla tenuissima*; R.N. 234A. Spicules, × 530.
a., polytylote; *b.*, spined tylostyle; *c.*, isochela, front view; *d.*, isochela, side view.

" 6. *Esperella crassissima*; R.N. 240. Spicules, × 230.
a., tylostyle; *b.*, anisochela, side view; *c.*, anisochela, front view; *d.*, sigmata; *e.*, trichodragmata.

" 7. *Raspailia hornelli*; R.N. 59. Spicules, × 230.—*a.*, large stylus; *b.*, *c.*, small surface styli; *d.*, *e.*, *f.*, *g.*, oxea; *h.*, *h.*, strongyla; *k.*, *l.*, *m.*, spined subtylostyli.

" 8. *Histoderma vesiculatum*; R.N. 212A. Part of dermal skeleton, × 230.
o., *o.*, *o.*, oxea; *s.*, *s.*, strongyla.

" 9. *Histoderma vesiculatum*; R.N., 212A. Isochelæ, × 460.—*a.*, side view; *b.*, front view.

PLATE XII.

Fig. 1. *Spongosorites topsenti*; R.N. 152. Spicules, × 52.
a.–*k.*, various forms of large megascleres; *l.*, two small oxea; *m.*, intermediate form.

" 2. *Spongosorites* (?) *lamellata*; R.N. 236.
a. b. c., styli, × 52; *d.*, two small oxea, × 52; *e.*, small oxeote, × 230.

" 3. *Spongosorites* (?) *lapidiformis*; R.N. 145. Spicules, × 79.

" 4. *Hymeniacidon petrosioides*; R.N. 151. Spicules, × 230.

" 5. *Thrinacophora durissima*; R.N. 355. Spicules, × 230.
a., stylote; *b.*, oxeote; *c.*, *d.*, trichodragmata.

" 6. *Thrinacophora agariciformis*; R.N. 160A. Spicules, × 230.
a., *b.*, *c.*, styli; *d.*, *e.*, oxea; *f.*, trichodragmata.

" 7. *Axinella halichondrioides*; R.N. 75. Spicules, × 230.—*a.*, oxeote; *b.*, *c.*, stylote.

" 8. *Axinella manus*; R.N. 53. Spicules, × 230.

" 9. *Agelas ceylonica*; R.N. 312. Spicules, × 230.

" 10. *Rhabderemia indica*; R.N. 341.
a., *b.*, *c.*, rhabdostyli, × 230; *d.*, minute spined styli, × 530; *e.*, contort sigmata, × 530.

PLATE XIII.

Fig. 1. *Collocalypta digitata*; R.N. 74. Oxeote spicule from body, × 230.

" 2. " R.N. 74. Part of transverse section of a digitiform process, × 52.
ax., axial skeleton of spicules and spongin; *d.p.*, position of dermal pores; *ect.*, collenchymatous ectosomal tissue; *l.c.*, longitudinal canals; *sept.*, septum between two longitudinal canals.

" 3. *Phakellia symmetrica*; R.N. 159. Spicules, × 230.—*a*, *b*, short styli; *c*, oxeote; *d*, long stylus.

" 4. *Axinella tenuidigitata*; R.N. 202A. Styli, × 79.

" 5. *Phakellia ceylonensis*; R.N. 34. Spicules, × 230.—*a*, *b*, styli; *c*, *d*, *e*, oxea.

" 6. *Phakellia crassistylifera*; R.N. 256. Three spicules, × 230.

Fig. 7. *Auletta elongata;* R.N. 73. Spicules, × 79.—*a*, *b*, styli; *c*, oxeote; *d*, *e*, *f*, strongyla.

„ 8. *Leucosolenia coriacea*, var. *ceylonensis;* R.N. 377. Spicules, × 360.
a, *b*, *c*, triradiates; *d*, portion of oxeote.

„ 9. *Leucosolenia tenuipilosa;* R.N. 158. Spicules, × 360.—*a*, triradiate; *b*, quadriradiate, facial view; *c*, quadriradiate, side view, showing apical ray; *d*, part of oxeote.

„ 10. *Leucandra donnani;* R.N. 186. Spicules, × 79.
a, *b*, parenchymal triradiates; *c*, *d*, dermal triradiates; *e*, *f*, gastral quadriradiates; *g*, oxeote.

PLATE XIV. (All the figures from photographs.)

Fig. 1. *Hircinia fusca;* part of R.N. 48, × $\frac{2}{3}$.

„ 2. *Hippospongia clathrata;* R.N. 24, × $\frac{11}{16}$.

„ 3. *Euspongia officinalis*, var. *ceylonensis;* R.N. 37A, × about $\frac{2}{3}$.

„ 4. *Spongelia elastica*, var. *crassa;* R.N. 35, × about $\frac{4}{5}$.

„ 5. *Hircinia anomala;* R.N. 13, × about $\frac{2}{3}$.

„ 6. *Phyllospongia papyracea*, var.; R.N. 104A, × $\frac{14}{25}$.

„ 7. *Megalopastas nigra;* R.N. 71, × $\frac{5}{8}$.

PLATE XV.

Fig. 1. *Darwinella simplex;* R.N. 302.—End of primary fibre, enclosed in conulus, × 230.

„ 2. *Darwinella simplex;* R.N. 302.—Portion of primary fibre, in which the pith (*p.*) is partially replaced by fungal (?) filaments (*f.*), × 230.

„ 3. *Megalopastas pulvillus;* R.N. 191.—Portion of skeleton as seen in vertical section, showing the old apices of primary fibres (*ap.*) enclosed in younger portions of the fibres, × 79.

„ 4. Diagrammatic sketch of the general anatomy of the genus *Megalopastas*, based upon vertical sections of a specimen of *M. elegans* (= *Dendrilla elegans*, LENDENFELD) from Port Phillip Heads, Australia, × 52.—*c.*, surface conuli; *e.c.*, embryo capsules; *em.*, embryo; *ex.c.*, exhalant canals; *f.c.*, flagellate chambers; *i.c.*, inhalant canal; *p.f.*, primary skeleton fibres; *p.s.*, pore-sieves; *s.c.*, subdermal cavities; *s.f.*, secondary skeleton fibres.

„ 5. *Megalopastas nigra;* R.N. 161A.—Part of skeleton, as seen in vertical section, including the dermal skeleton (*d.s.*) as well as the main skeleton, × 52.

„ 6. *Megalopastas nigra;* R.N. 161A.—Dermal skeleton, × 52.

„ 7. *Megalopastas nigra;* R.N. 161A.
End of primary fibre, showing mode of growth and origin of secondary fibres, × 230.

„ 8. *Megalopastas nigra;* R.N. 161A.
Origin of new primary fibre from a secondary fibre of the dermal skeleton, vertical section, × 230.—*c.*, surface conulus; *d.s.*, dermal skeleton; *p.f.*, new primary fibre.

PLATE XVI.

Fig. 1. *Hircinia anomala;* R.N. 82.—Part of skeleton, as seen in transverse section, × 52.

„ 2. *Hircinia tuberosa;* R.N. 88A.—Part of skeleton, as seen in vertical section through the surface, including the sand-cortex (*s.c.*), × 52.

„ 3. *Hircinia schulzei;* R.N. 277.—Part of skeleton, as seen in vertical longitudinal section, × 52.

„ 4. *Aplysina herdmani;* R.N. 340.—Part of skeleton, as seen in vertical section of body, × 79.

„ 5. *Euspongia officinalis*, var. *ceylonensis;* R.N. 101.—Part of skeleton, as seen in vertical section, × 79.

A. Dendy del. Figs 1-7

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FIGS. 1—3, HEXADELLA INDICA, n.sp.; FIG. 4, PLAKINASTRELLA INTERMEDIA, n.sp.; FIG. 5, ECIONEMA CARTERI, n.sp.; FIG. 6, TETILLA POCULIFERA, n.sp.; FIG. 7, TETILLA LIMICOLA, n.sp.; FIG. 8, TAPROBANE HERDMANI, n.sp.

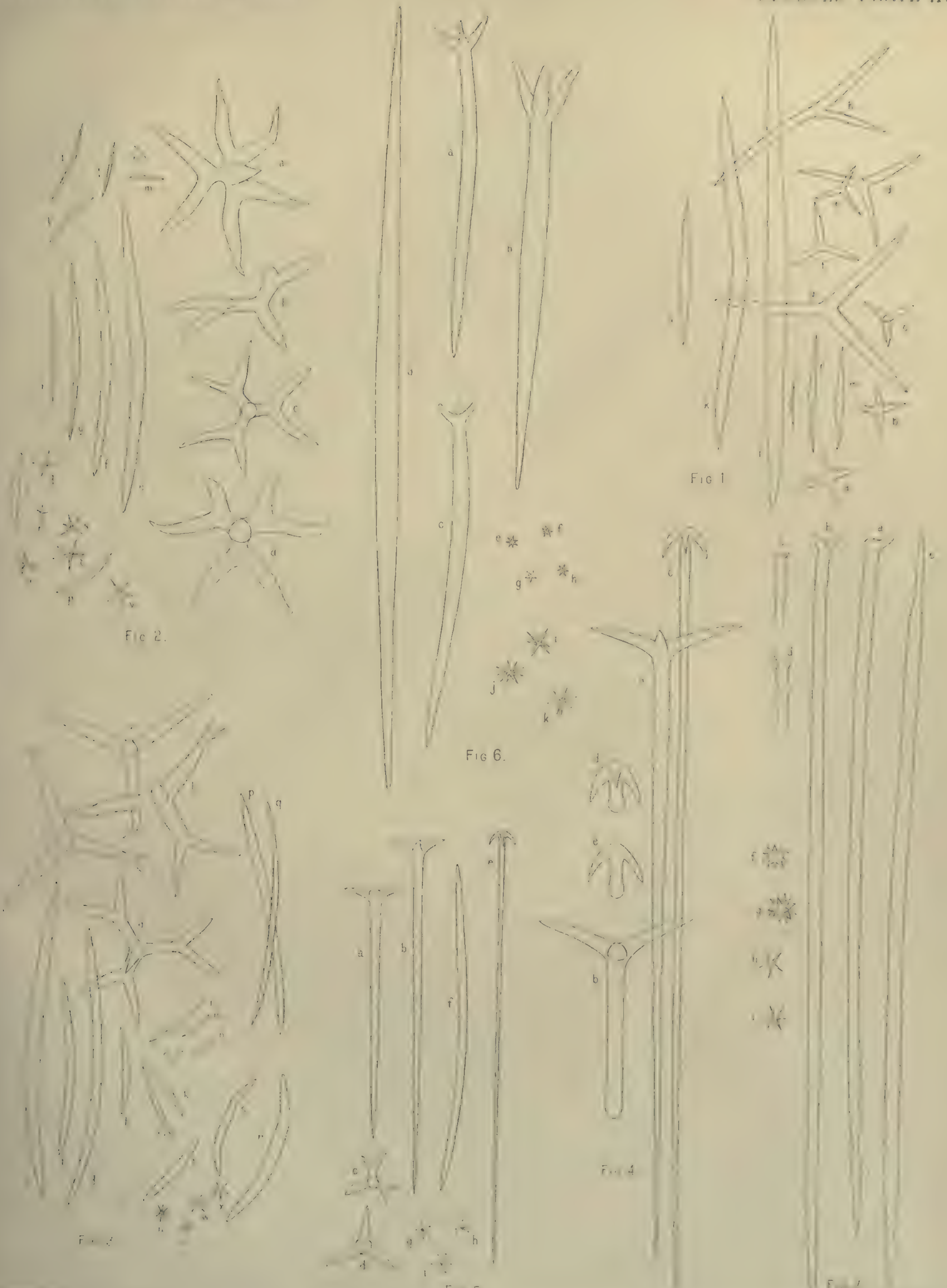

Fig. 1, Dercitopsis ceylonica, n.sp.; Fig. 2 Plakinastrella intermedia, n.sp.; Fig. 3, Plakinastrella schulzei, n.sp.; Fig. 4, Pilochrota haeckeli, Sollas; Fig. 5, Pilochrota hornelli, n.sp.;
Fig. 6, Stelletta herdmani, n.sp.; Fig. 7, Stelletta vestigium

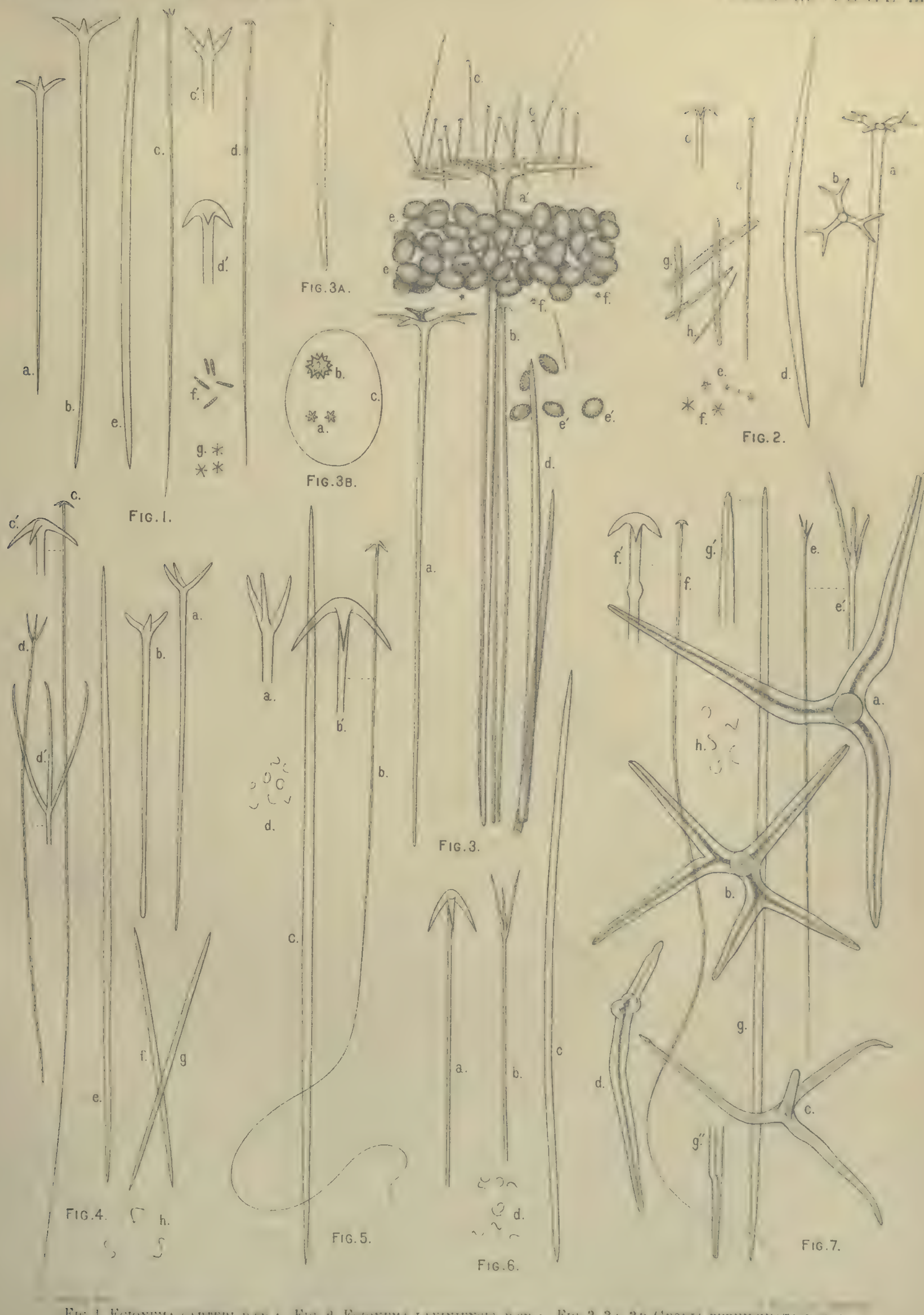

Fig. 1, Ecionema carteri, n.sp.; Fig. 2, Ecionema laviniensis, n.sp.; Fig. 3, 3a, 3b, Geodia peruncinata, n.sp.; Fig. 4, Tetilla poculifera, n.sp.; Fig. 5, Tetilla anomala, n.sp.; Fig. 6, Tetilla limicola, n.sp.; Fig. 7, Paratetilla cineriformis, n.sp

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FIG. 1, CRANIELLA ELEGANS, n.sp.; FIG. 2, TAPROBANE HERDMANI, n.sp.; FIG. 3, ACICULITES ORIENTALIS, n.sp.; FIG. 4, DISCODERMIA EMARGINATA, n.sp.; FIG. 5, PETROMICA MASSALIS, n.sp.

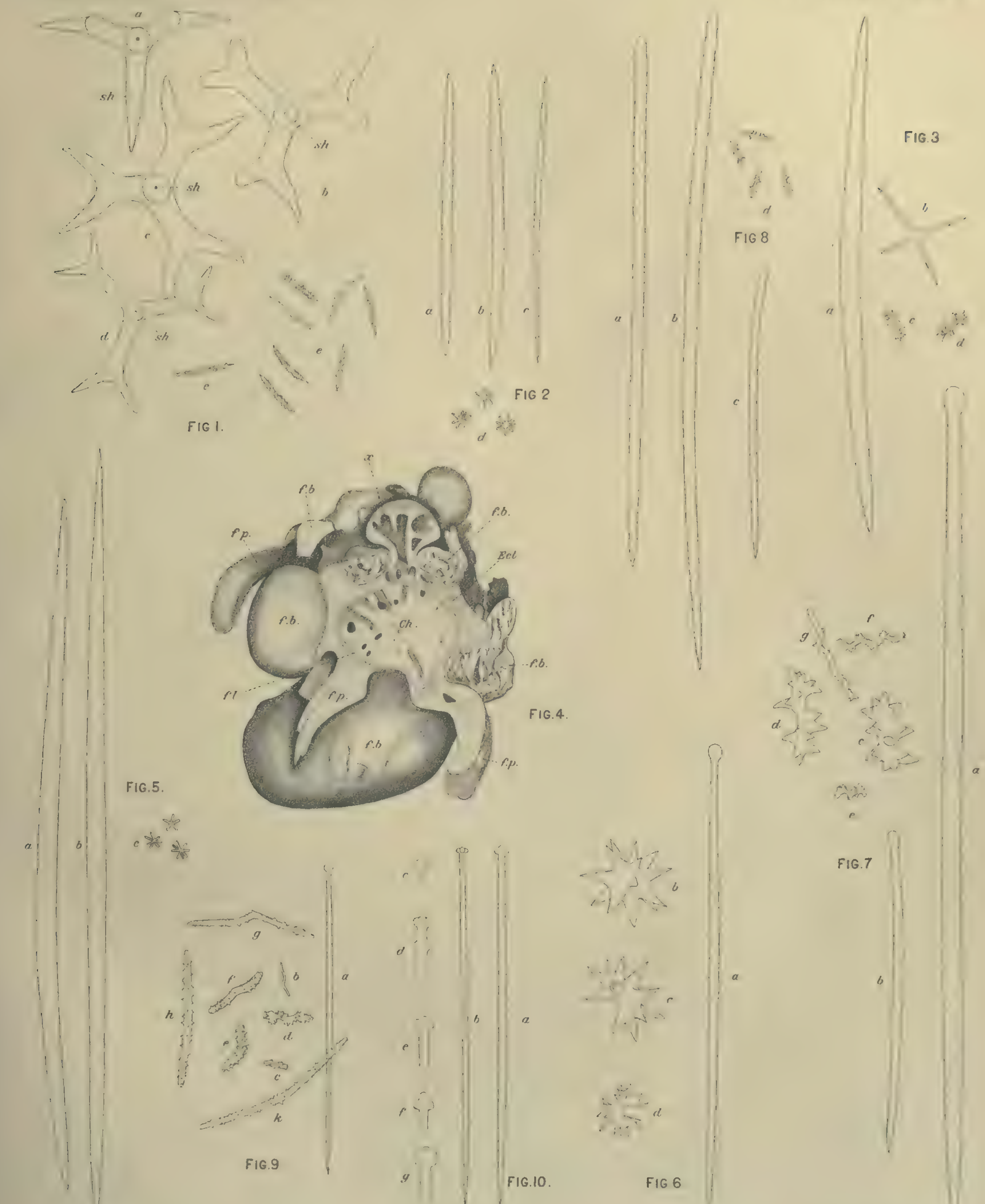
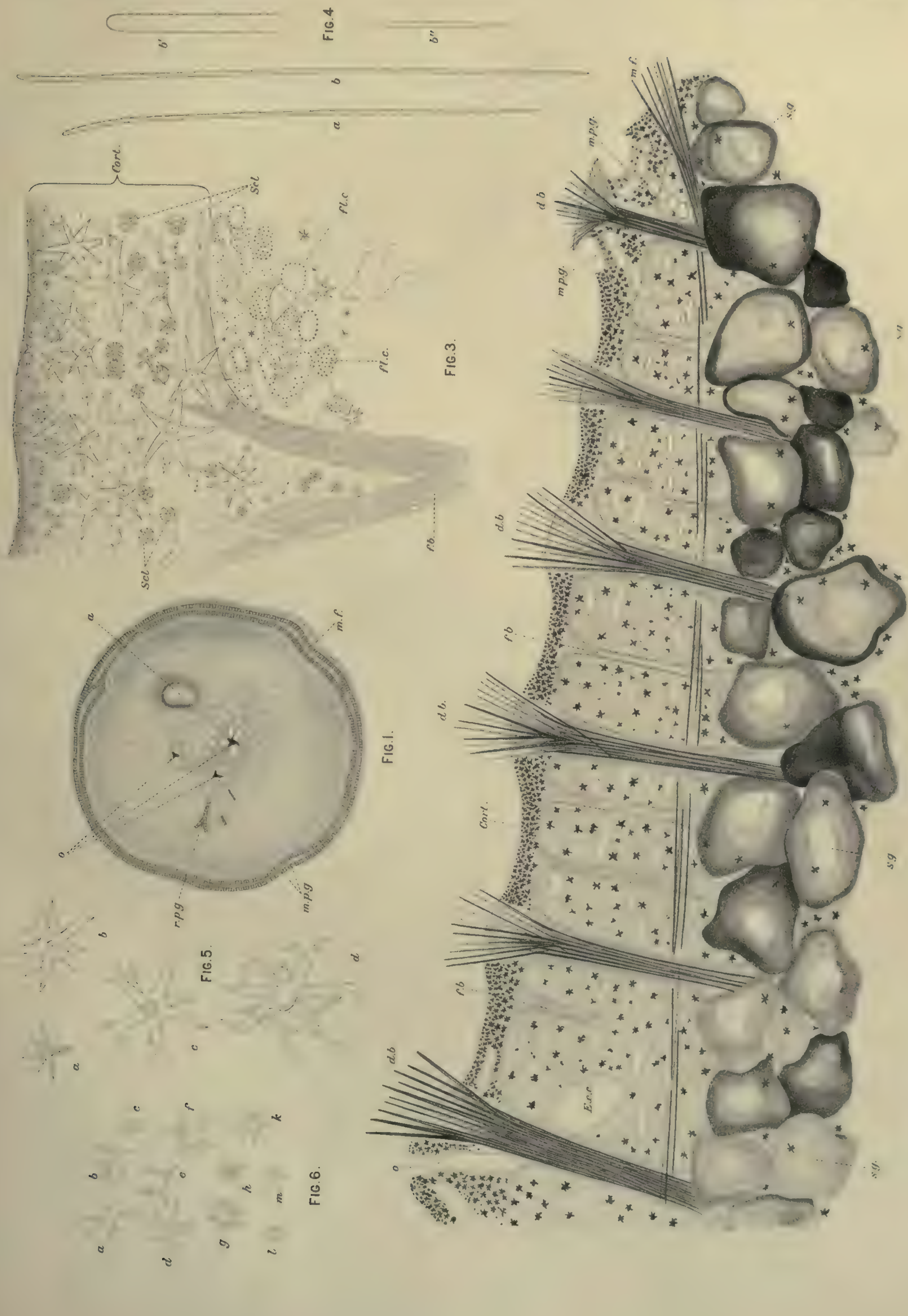


FIG. 1, STŒBA EXTENSA, n.sp.; FIG. 2, COPPATIAS REPTANS, n.sp.; FIG. 3, ASTEROPUS HAECKELI, n.sp.; FIGS. 4, 5, CRYPTOTETHYA AGGLUTINANS, n.sp.; FIG. 6, HYMEDESMIA CURVISTELLIFERA, n.sp.; FIG. 7, SPIRASTRELLA TENTORIOIDES, n.sp.; FIG. 8, NEGOMBO TENUISTELLATA, n.sp.; FIG. 9, CLIONA MARGARITIFERÆ, n.sp.; FIG. 10, SUBERITES CRUCIATUS, n.sp.



XENOSPONGIA PATELLIFORMIS, Gray.

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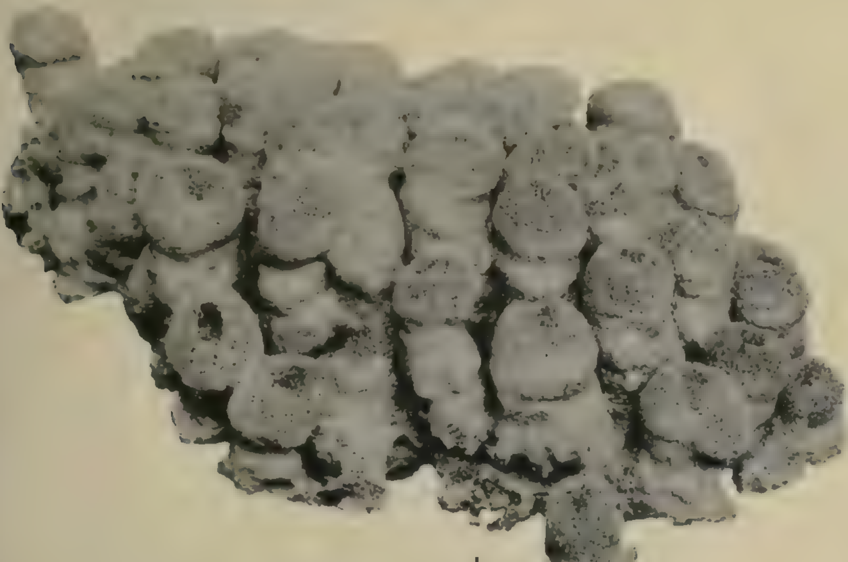

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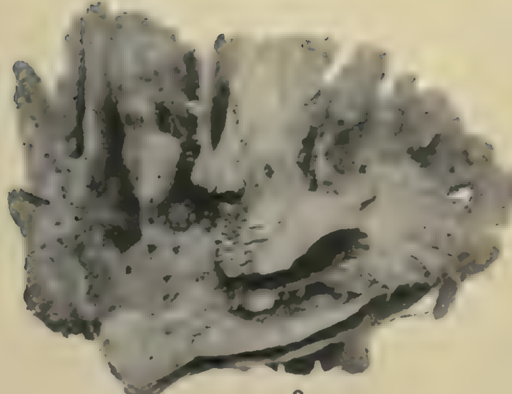

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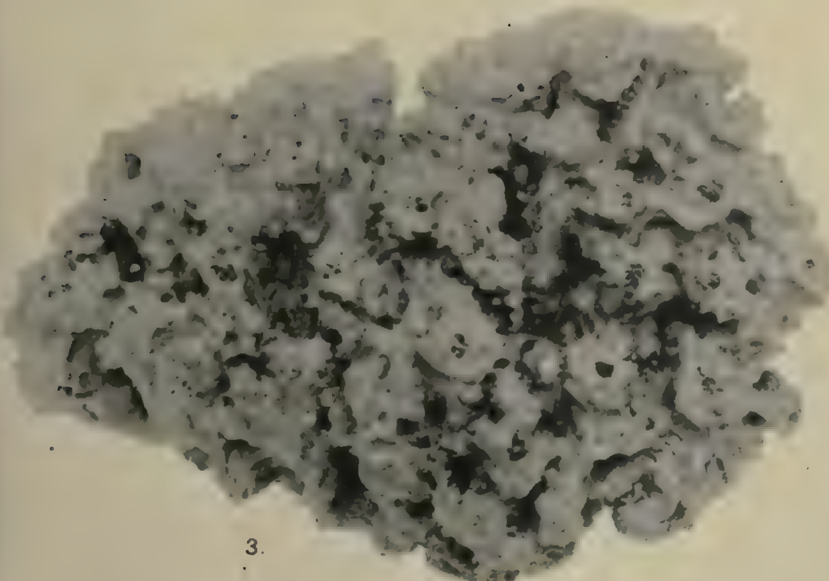

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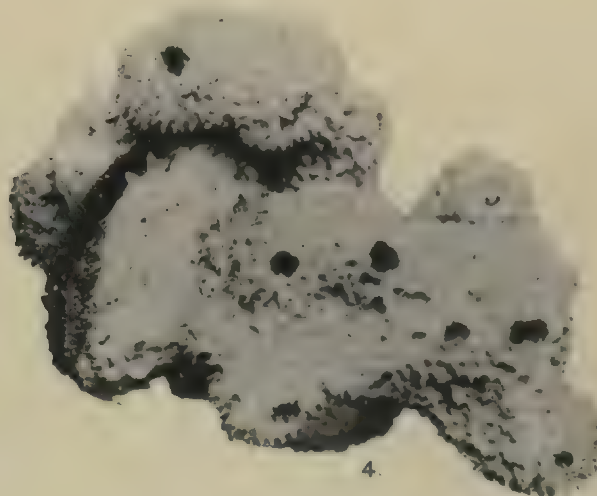

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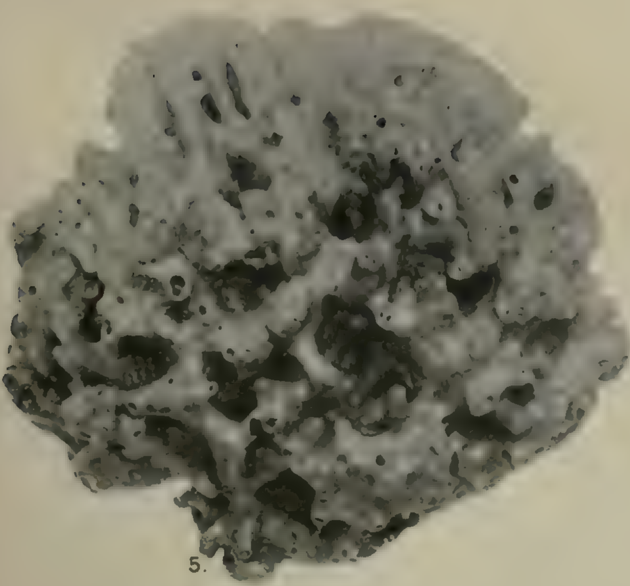

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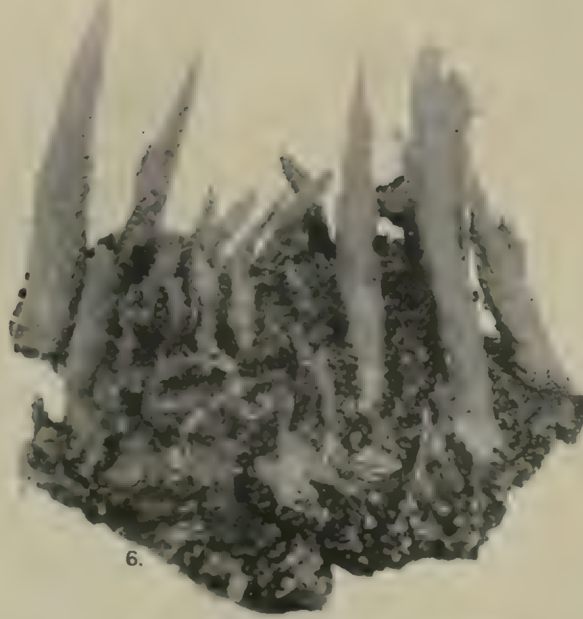

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FIG. 1, SIPHONOCHALINA COMMUNIS, var. tenuispiculata, n.; FIG. 2, CERAOCHALINA MULTIFORMIS, var. manaarensis, Dendy; FIG. 3, CERAOCHALINA CEYLONICA, n.sp.; FIG. 4, PACHYCHALINA SPINILAMELLA, Dendy; FIG. 5, GELLIODES CARNOSA, Dendy; FIG. 6, COLLOCALYPTA DIGITATA, n.sp.

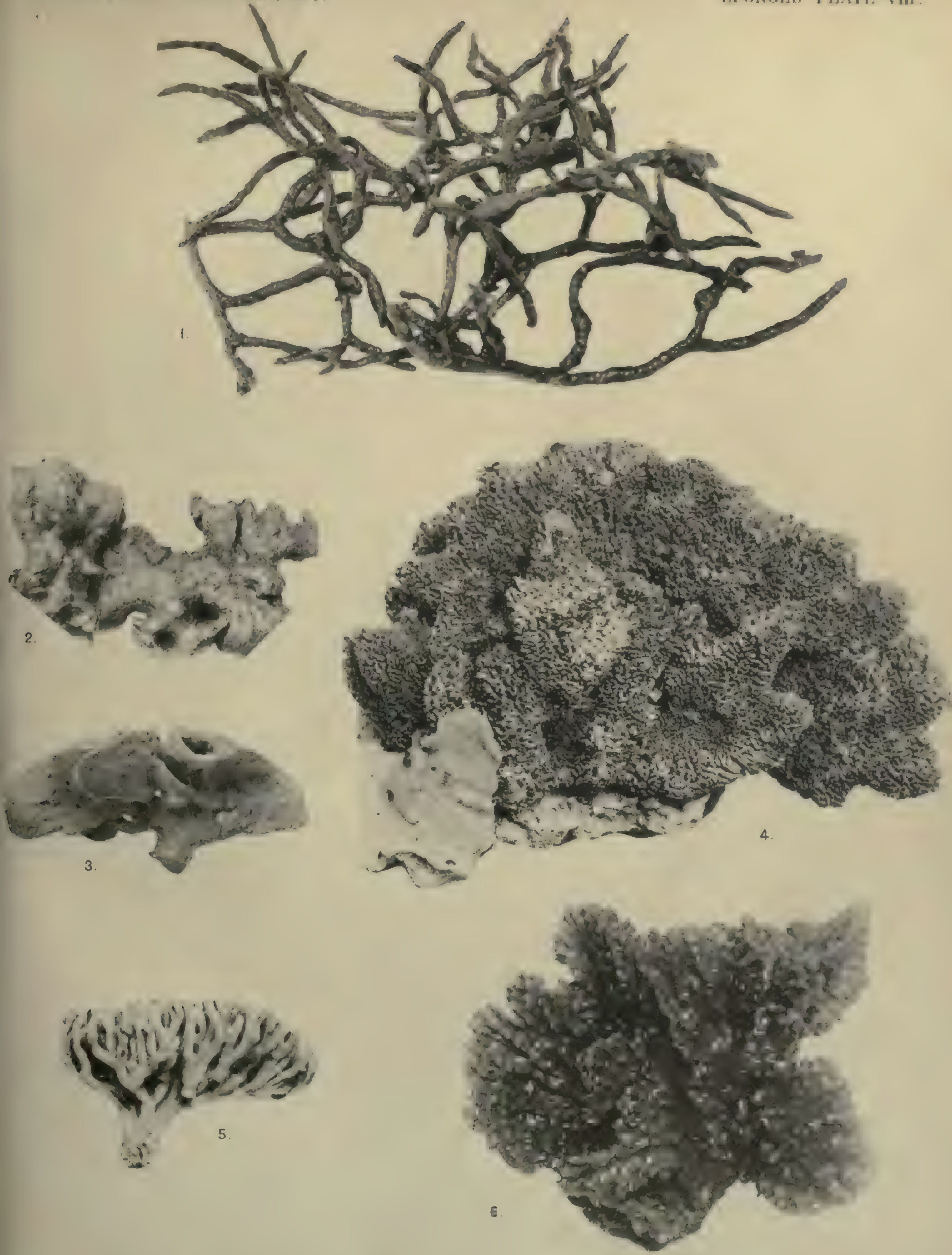


FIG. 1, PLOCAMIA MANAARENSIS (Carter); FIG. 2, CLATHRIA SPICULOSA, var. tessellata, n.; FIG. 3, PHAKELLIA CEYLONENSIS, n.sp.; FIG. 4, ACARNUS TERNATUS, Ridley; FIG. 5, RASPAILIA FRUTICOSA, var. tenuiramosa, n.: FIG. 6, ACANTHELLA CARTERI, Dendy.

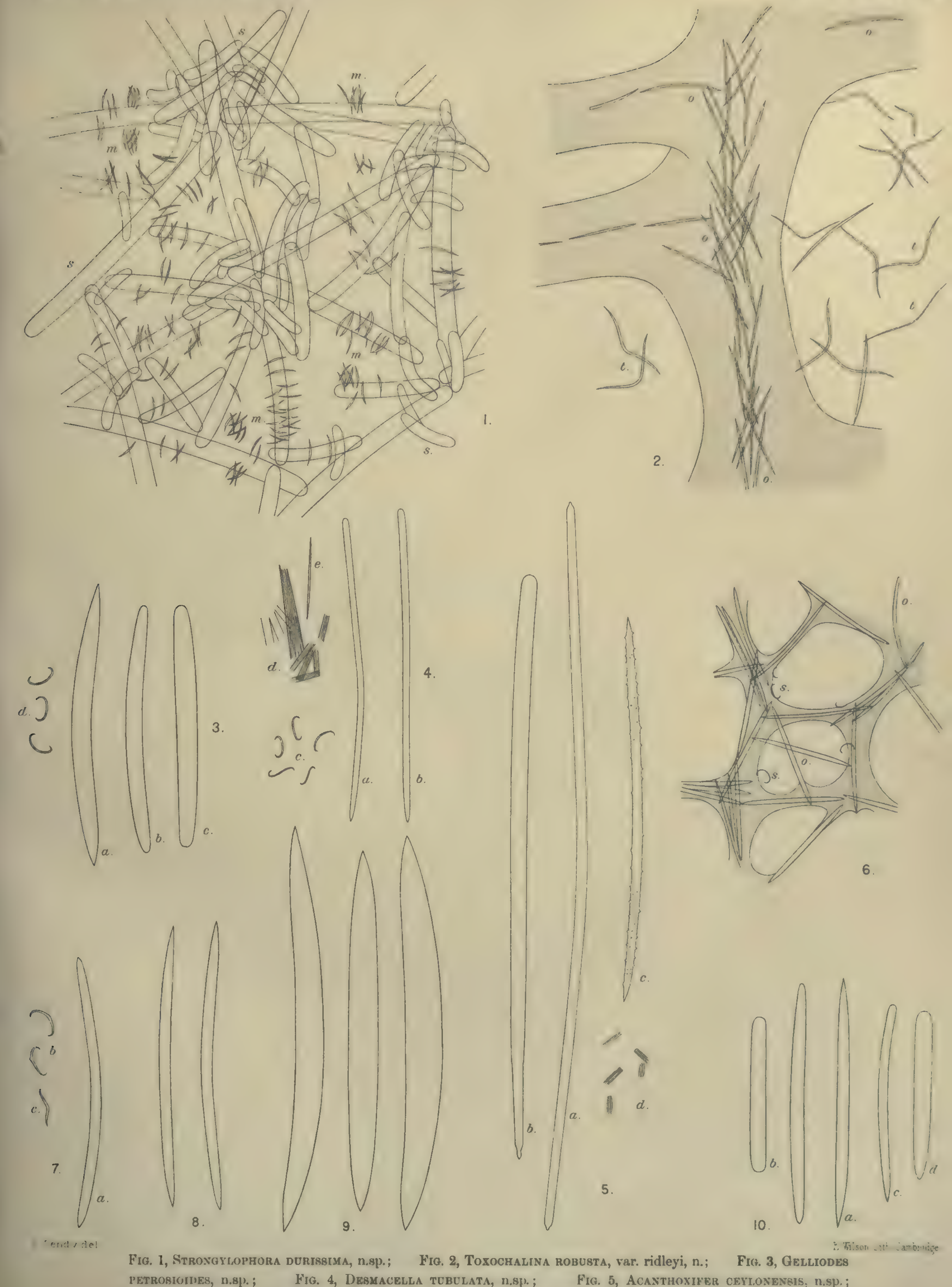
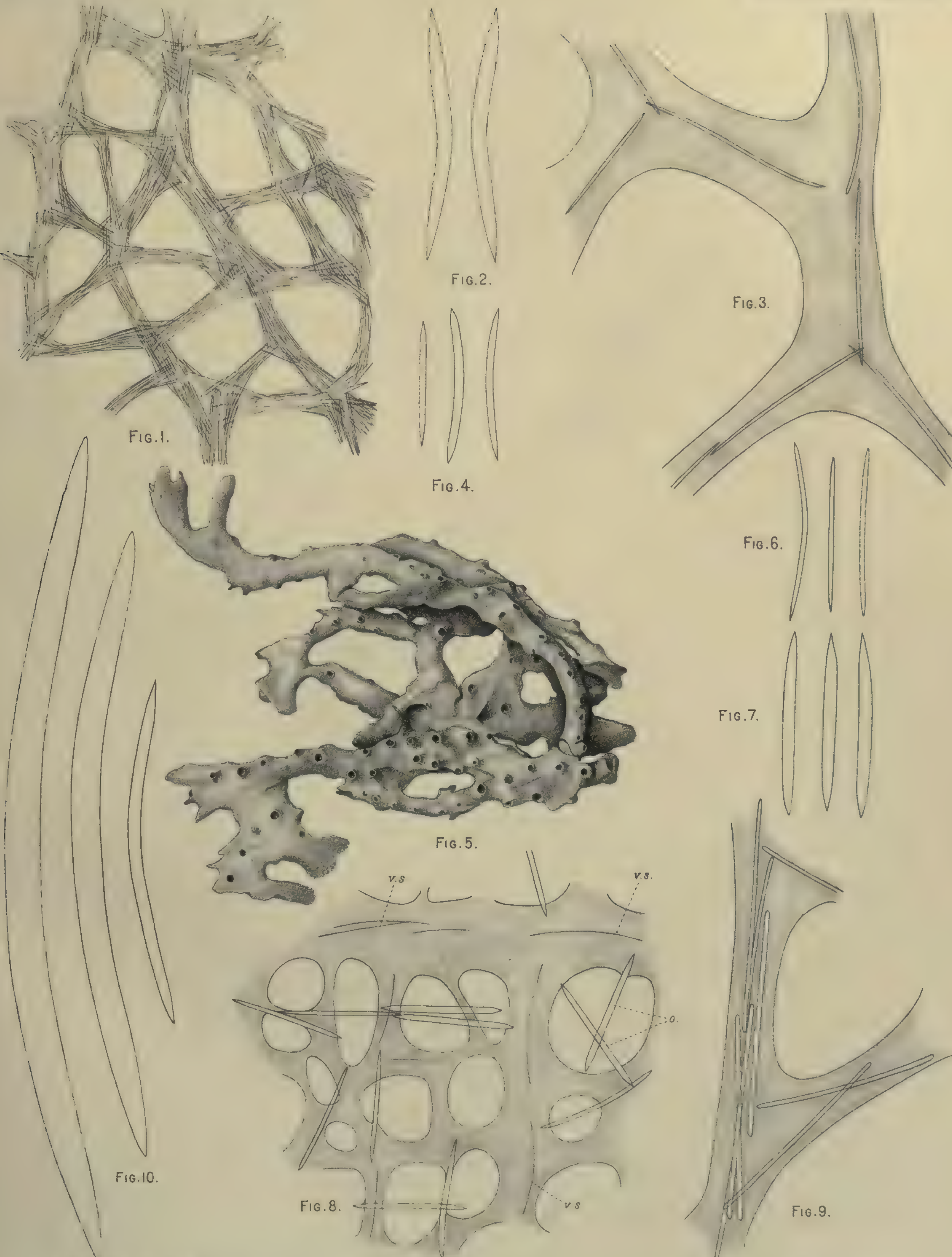


Fig. 1, Strongylophora durissima, n.sp.; Fig. 2, Toxochalina robusta, var. ridleyi, n.; Fig. 3, Gelliodes petrosioides, n.sp.; Fig. 4, Desmacella tubulata, n.sp.; Fig. 5, Acanthoxifer ceylonensis, n.sp.; Fig. 6, Gelliodes incrustans, n.sp.; Fig. 7, Gellius angulatus, var. canaliculata, n.; Fig. 8, Reniera zoologica, n.sp.; Fig. 9, Petrosia densissima, n.sp.; Fig. 10, Reniera pigmentifera, n.sp.



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FIGS. 1, 2, PACHYCHALINA SUBCYLINDRICA, n.sp.; FIG. 3, CHALINA CLATHRATA, n.sp.; FIG. 4, CERAOCHALINA RETIARMATA, n.sp.; FIG. 5, CHALINA SUBARMIGERA (Ridley); FIG. 6, CERAOCHALINA CEYLONICA, n.sp.; FIG. 7, PACHYCHALINA BREVISPICULIFERA, n.sp.; FIG. 8, CERAOCHALINA RETICUTIS, n.sp.; FIG. 9, CHALINA OBTUSISPICULIFERA, n.sp.; FIG. 10, TRACHYOPSIS HALICHONDRIOIDES, n.sp.

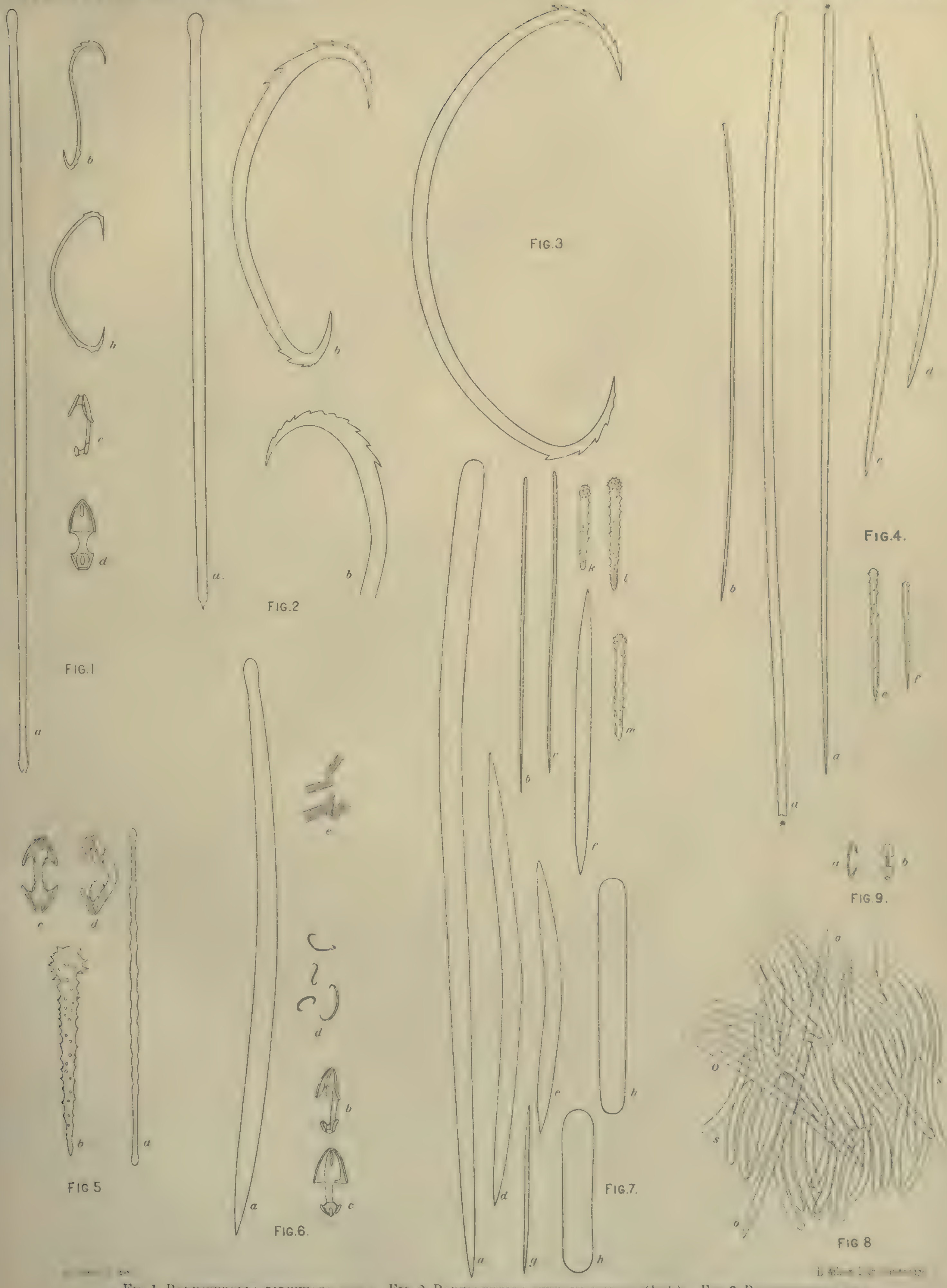


FIG. 1, PARESPERELLA BIDENTATA, n.sp.; FIG. 2, PARESPERELLA SERRATOHAMATA (Cart.); FIG. 3, PARESPERELLA, sp.; FIG. 4, ECHINODICTYUM CLATHRATUM, n.sp.; FIG. 5, MYXILLA TENUISSIMA, n.sp.; FIG. 6, ESPERELLA CRASSISSIMA, n.sp.; FIG. 7, RASPAILIA HORNELLI, n.sp.; FIGS. 8, 9, HISTODERMA VESICULATUM, n.sp.

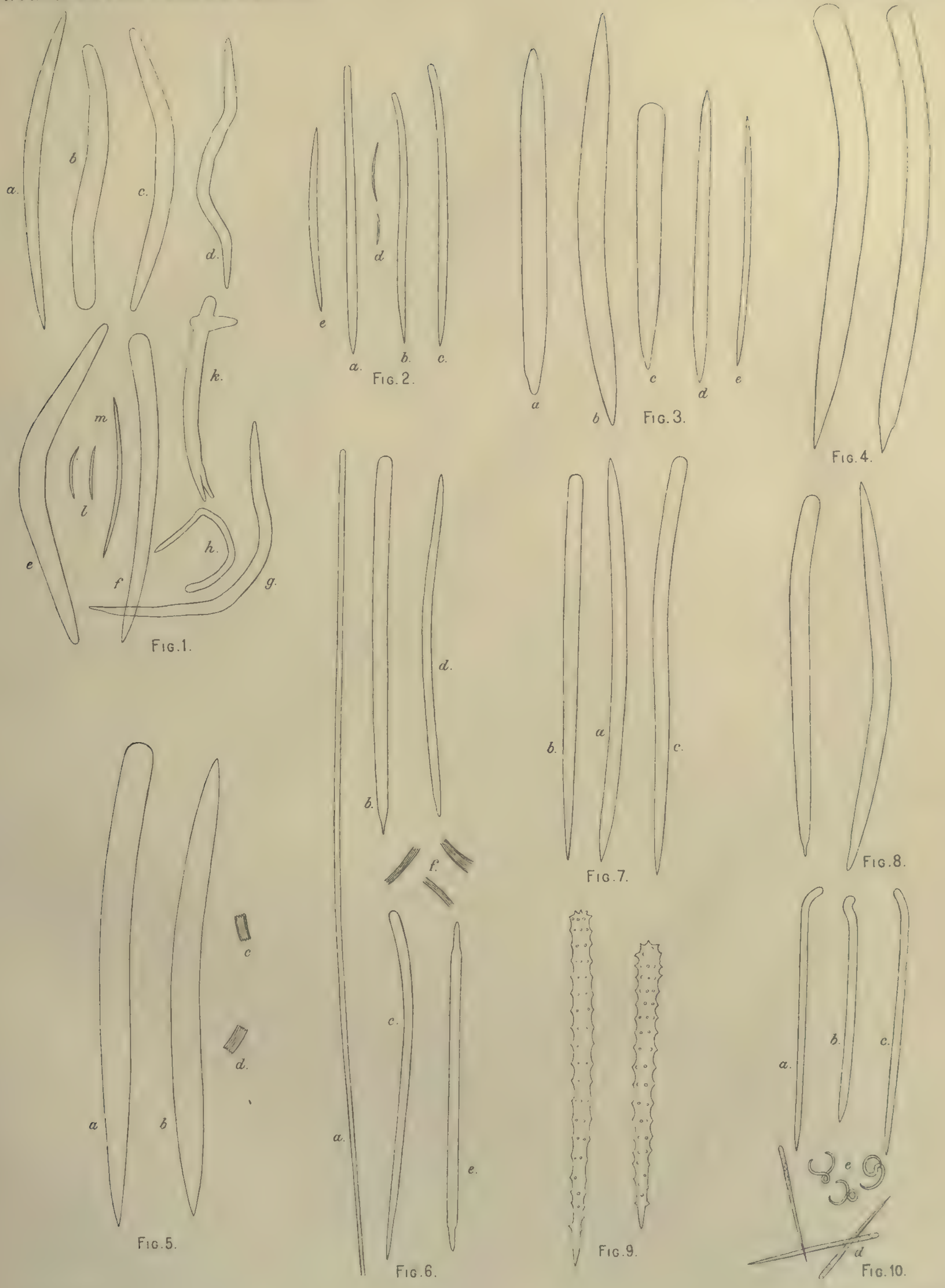
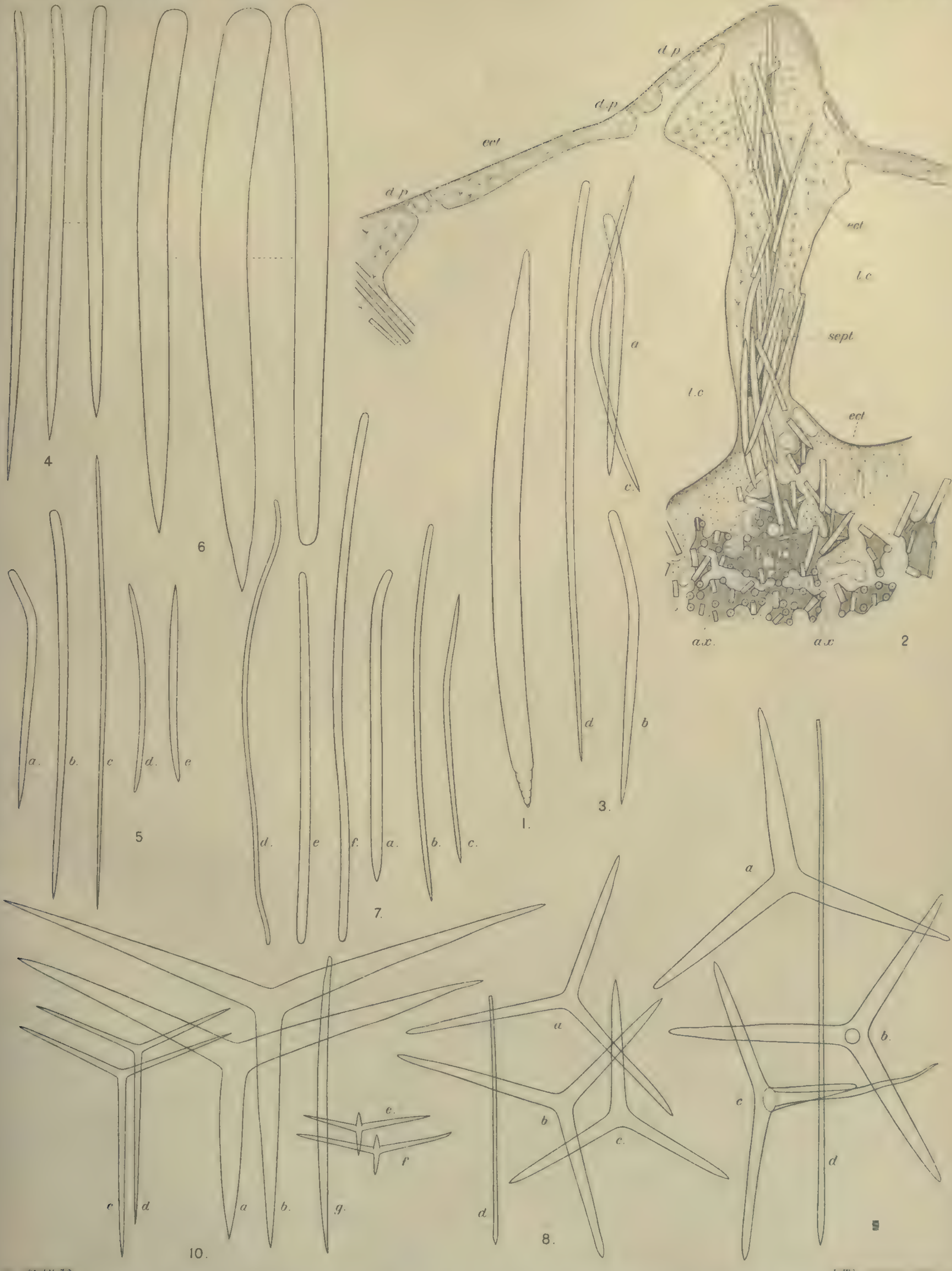


FIG. 1, SPONGOSORITES TOPSENTI, n.sp.; FIG. 2, SPONGOSORITES (?) LAMELLATA, n.sp.; FIG. 3, SPONGOSORITES (?) LAPIDIFORMIS, n.sp.; FIG. 4, HYMENIACIDON PETROSIOIDES, n.sp.; FIG. 5, THRINACOPHORA DURISSIMA, n.sp.; FIG. 6, THRINACOPHORA AGARICIFORMIS, n.sp.; FIG. 7, AXINELLA HALICHONDRIOIDES, n.sp.; FIG. 8, AXINELLA MANUS, n.sp.; FIG. 9, AGELAS CEYLONICA, n.sp.; FIG. 10, RHABDEREMIA INDICA, n.sp.



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FIGS. 1, 2, COLLOCALYPTA DIGITATA, n.sp.; FIG. 3, PHAKELLIA SYMMETRICA, n.sp.; FIG. 4, AXINELLA TENUIDIGITATA, n.sp.; FIG. 5, PHAKELLIA CEYLONENSIS, n.sp.; FIG. 6, PHAKELLIA CRASSISTYLIFERA, n.sp.; FIG. 7, AULETTA ELONGATA, n.sp.; FIG. 8, LEUCOSOLENIA CORIACEA, var. ceylonensis, n.; FIG. 9, LEUCOSOLENIA TENUIPILOSA, n.sp.; FIG. 10, LEUCANDRA DONNANI, n.sp.

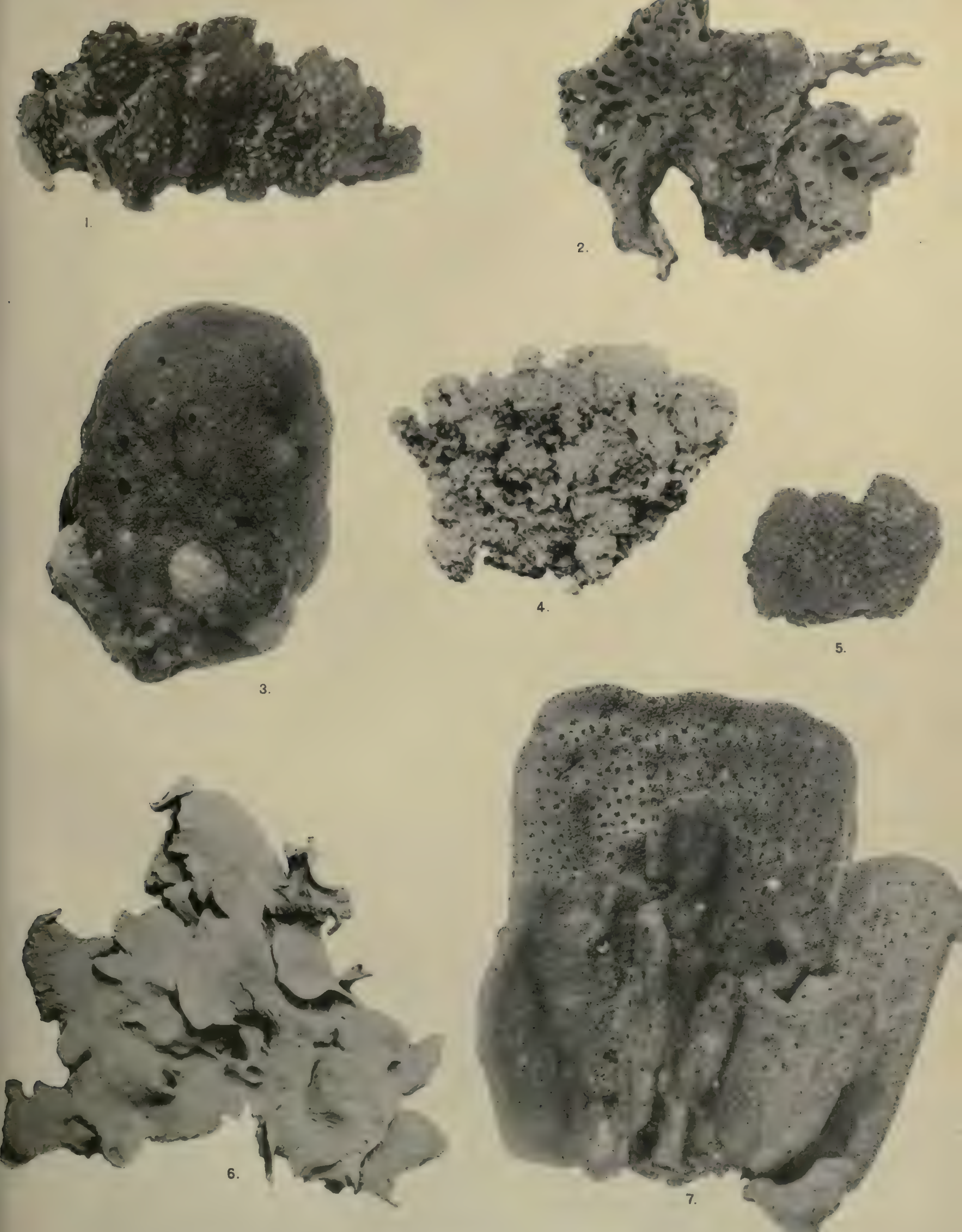
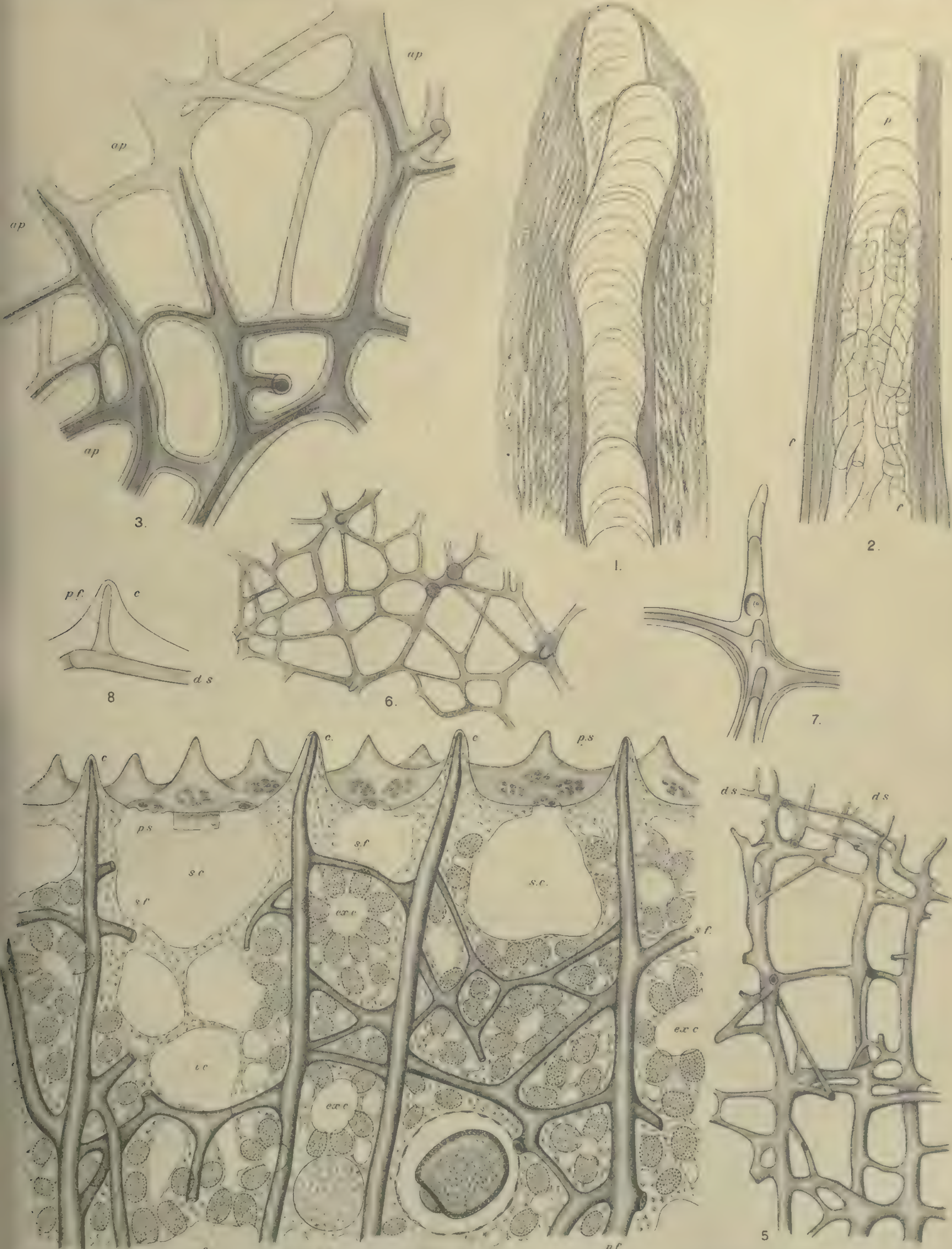


FIG. 1, HIRCINIA FUSCA, Carter; FIG. 2, HIPPOSPONGIA CLATHRATA (Carter); FIG. 3, EUSPONGIA OFFICINALIS, var. ceylonensis, n.; FIG. 4, SPONGELIA ELASTICA, var. crassa, n.; FIG. 5, HIRCINIA ANOMALA, n.sp.; FIG. 6, PHYLLOSPONGIA PAPYRACEA, var.; FIG. 7, MEGALOPASTAS NIGRA (Dendy).



FIGS. 1, 2, DARWINELLA SIMPLEX, Tops.; FIG. 3, MEGALOPASTAS PULVILLUS, n.sp.;
FIG. 4, MEGALOPASTAS ELEGANS (Lend.); FIGS. 5—8, MEGALOPASTAS NIGRA (Dendy).

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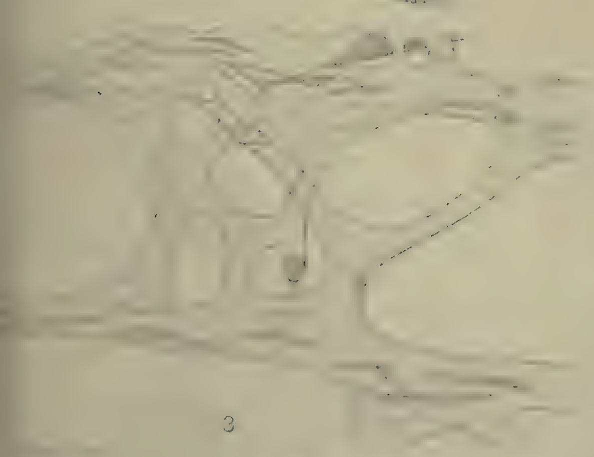

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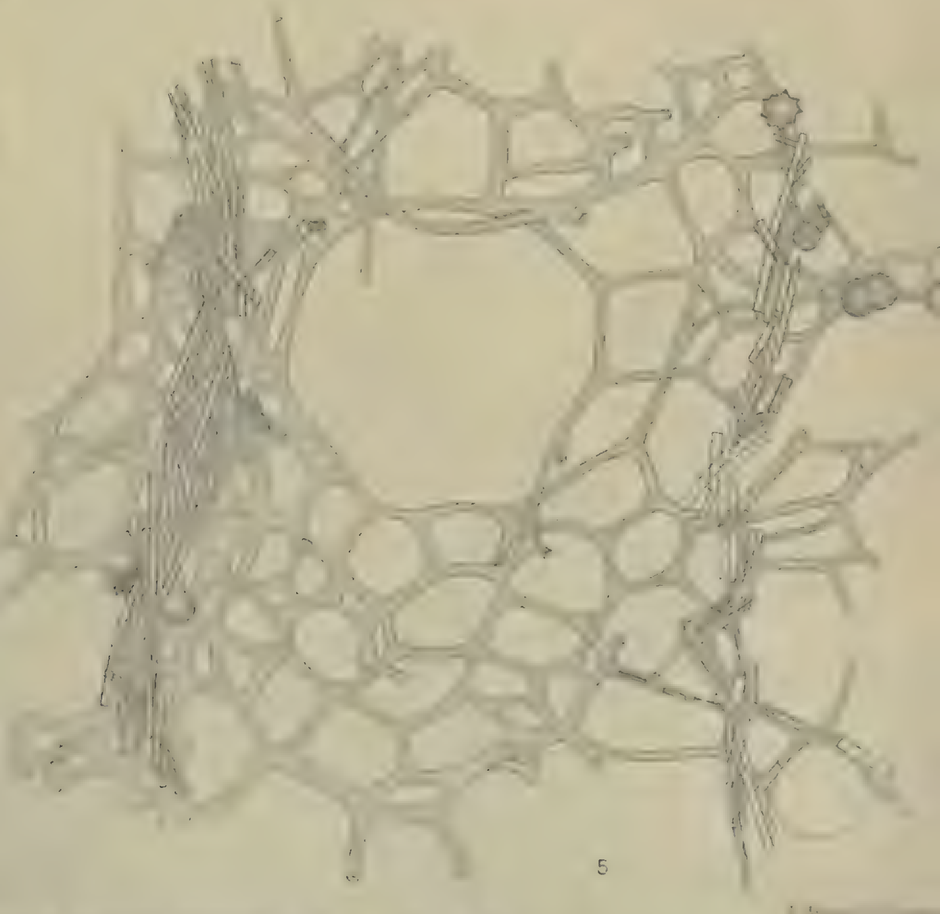

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Fig. 1, Hircinia anomala, n.sp.; Fig. 2, Hircinia tuberosa, n.sp.; Fig. 3, Hircinia schulzei, n.sp.;
Fig. 4, Aplysina herdmani, n.sp.; Fig. 5, Euspongia officinalis, var. ceylonensis, n.

REPORT

ON SOME

ALCYONIIDÆ

COLLECTED BY

PROFESSOR HERDMAN, AT CEYLON, IN 1902.

BY

EDITH M. PRATT, D.Sc.

[WITH THREE PLATES.]

THIS collection of Ceylon Alcyoniidæ* is remarkably similar to one made by Mr. STANLEY GARDINER some three or four years ago in the Maldive Islands (PRATT, 1903).† The resemblance in many cases is so pronounced as to indicate a very intimate relationship between the Alcyoniid fauna of these islands. The genera *Sarcophytum*, *Lobophytum*, *Sclerophytum*, and *Alcyonium* are common to both localities. These genera are represented in the present collection by 17 species, and of these 9 occur also in the Maldive collection, 5 are new, and 3 have only been recorded hitherto from the Pacific.

The Ceylon collection includes :—

I. Five species of *Sarcophytum:* of these, three are new ; one, *S. ehrenbergi*, has been recorded from the Maldives and Red Sea, and one, *S. plicatum*, has been recorded only from the Pacific (Ternate and North Celebes).

II. Two species of *Lobophytum:* one, *L. pauciflorum*, appears to be widely distributed in the tropical and southern sub-tropical waters of the Pacific and Indian Oceans, having been recorded from Tonga, Moluccas, Funafuti, New Britain

* See also the Report on the other Alcyonaria by Professor J. ARTHUR THOMSON, which follows in this volume.—W. A. H.

† See List of Literature on p. 265.

and New Zealand in the Pacific, from the Red Sea, and from the Maldive Islands and Gulf of Manaar in the Indian Ocean. The second species, *L. hedleyi*, has only been previously recorded from the Pacific (Funafuti). Its record from the Gulf of Manaar indicates a wide distribution of this hitherto little-known species.

III. Eight species of *Sclerophytum*: of these three, *S. marenzelleri*, *S. polydactylum*, and *S. densum*, are comparatively well-known species. *S. marenzelleri*, however, has only been before recorded from the Pacific (New Britain and New Hebrides); *S. polydactylum* from the Pacific (British New Guinea, China Seas), the Red Sea, Indian Ocean (Maldives), and now the Gulf of Manaar. *S. densum* is the most common species of the genus, and has a wide geographical range—it is now known from the Pacific (Funafuti, China Seas, British New Guinea), the Indian Ocean (Maldive Islands), and now the Gulf of Manaar.

Four species: *S. gardineri*, *S. palmatum*, *S. querciforme*, and *S. durum*, have been recorded only from the Maldives. One species is new.

IV. Two species of *Alcyonium*, one of which is new, and the other, *A. pachyclados*, is apparently generally distributed in the warm southern and tropical waters of the Pacific and Indian Oceans.

Several specimens of species common to Ceylon and the Maldive Islands vary considerably in size, external form, colour, consistency, size of spicules, &c., so that it was sometimes impossible to determine the identity of a species from a study of superficial characters. When examining a specimen of this family in the preserved condition, it is necessary to note that (1) the size of a specimen may vary according to age or environment; (2) external form is, to a certain extent, dependent on the state of expansion or otherwise of the colony at the time of fixing, and also upon the nature of the fixing re-agent; (3) the colouring matter in Alcyonaria, apart from that of the spicules, is usually acted upon, and in many cases dissolved, by alcohol; (4) the consistency of a colony, and to a certain extent the size of the spicules, may be affected by the use of an acid preservative. When these more or less artificial causes of difference are eliminated, the identification of most species, when based upon general anatomical principles, can usually be determined with considerable ease and accuracy.

List of Species occurring in Professor Herdman's Collection.

Sarcophytum bicolor, n. sp.
,, *oligotrema*, n. sp.
,, *contortum*, n. sp.
,, *plicatum*, Schenk.
,, *ehrenbergi*, Marenzeller.
Lobophytum hedleyi, Whitelegge.
, *pauciflorum*, Ehrenberg.
Sclerophytum herdmani, n. sp.
,, *marenzelleri*, Wright and St.
Sclerophytum polydactylum, Dana.
,, *gardineri*, Pratt.
,, *palmatum*, Pratt.
,, *densum*, Whitelegge.
,, *querciforme*, Pratt.
,, *durum*, Pratt.
Alcyonium ceylonicum, n. sp.
,, *pachyclados*, Klunzinger.

Sarcophytum bicolor, n. sp.—Plate I., figs. 1 and 2.

Four complete and several fragmentary specimens were taken from the Gulf of Manaar and from the coral-reef at Galle. The largest specimen is incomplete, but is 250 millims. high and 190 millims. broad, and is provided with huge marginal lobes.

One complete specimen is irregularly mushroom-shaped, with four lobes, and is attached basally to hard coral. It is 120 millims. high and the capitulum measures 150 millims. by 85 millims. across its surface. The stalk is 65 millims. high and has a transverse diameter of 96 millims. by 60 millims. The capitulum has a thick marginal seam.

The second complete specimen is very much smaller. It is only 50 millims. high, and the capitulum measures 47 millims. by 29 millims. across its surface (Plate I., fig. 1).

The stalk varies in length in individual specimens; its surface is usually smooth, but here and there are occasional longitudinal wrinkles. In many cases the autozooids may be seen through the transparent body-wall.

The colour (in spirit) varies from a dark slaty grey to a pale brownish-grey. In all specimens the autozooids and siphonozooids are of a beautiful creamy white colour.

Some of the specimens are moderately hard and tough, others are soft and fleshy, while a few are quite brittle. The texture of the species seems to vary with the age of the colony, locality, and state of preservation.

The small complete specimen differs from the larger specimen in the feeble development of the marginal seam, which is very thick in the older colony.

The *Autozooids* are extremely numerous and are usually uniformly distributed over the upper surface of the capitulum. In the largest colony they are most numerous on the upper surface of the marginal seam, where they average 12 to the centimetre, and are few in number or entirely absent on the extreme edge of the seam, where siphonozooids are very abundant. None of the specimens are completely expanded, but anthocodia of partially expanded zooids are fully 2 millims. in length and 0·5 millim. in diameter.

The tentacles are all contracted, and, although very small, are similar to those of other species. The stomodæum, mesenteries and mesenterial filaments do not apparently differ in any important respect from those of other species, but the specimens are not sufficiently well preserved to permit of histological examination.

The *Siphonozooids* (in spirit), of a beautiful cream colour, are outlined by a network of brown pigment, which also defines the outlines of the canals.

The average superficial diameter of a siphonozooid is 0·3 millim. The stomodæum is well marked and has an average length of 0·28 millim. The mesenteries are similar to those occurring in other species.

The *Canal System* is well marked, but exhibits no specially interesting features, with the exception of the presence in the canals of an orange-brown coloured pigment which may owe its existence to the disintegration of algæ cells, so abundant in many tropical corals (see below).

The *Spicules* are long and slender, and in form are characteristic of the genus (fig. 2). They are smaller in the actively growing superficial tissues than elsewhere. When an autozooid is in a state of contraction, the external aperture is effectually closed by a small conical cap of minute tentacular spicules.

This species exhibits considerable variation in form and consistency, but is characterised externally by the distinctive creamy white autozooids and siphonozooids and the greyness of the remaining portions of the colony.

Sarcophytum oligotrema, n. sp.—Plate I., figs. 3 to 5.

A complete cup-shaped colony attached basally to stony coral was taken in the Gulf of Manaar (fig. 3).

The specimen is almost stalkless and is 42 millims. high. The capitular cup, irregular in outline, is 32 millims. in depth and is 62 millims. by 50 millims. in breadth. The base of the cup is 10 millims. in thickness, the sides are about 5 millims. in diameter near the base, but thin out towards the edge, so that they are wedge-shaped in vertical section. Zooids are only present on the inner surface of the cup. The colour in spirit is of a dirty brownish-grey, with autozooids of a more pronounced brownish hue. The outer surface of the cup is moderately smooth, with few wrinkles. The specimen is moderately hard and tough.

Autozooids are very small, and are relatively very numerous on the sides and edges of the cup, but are somewhat scanty in the middle. As the colony is in a state of extreme contraction, it is impossible to determine the actual size of the autozooids; the young autozooids near the edge of the cup are smaller than elsewhere. The average diameter of a mature autozooid at the surface is about 0·3 millim.

The tentacles, stomodæum, mesenteries and mesenterial filaments do not differ in any essential respect from those of other species. Reproductive organs were not observed.

Siphonozooids are remarkably few in number (fig. 4). Usually only one or two of these zooids occur between two autozooids, but in the middle of the capitulum the number is slightly increased. The average superficial diameter of a siphonozooid is 0·35 millim., the mouth is sunk in a slight depression, and the stomodæum has an average length of 0·25 millim.

The canal system presents no specially interesting features. Transverse ciliated vessels connecting the cœlentera of neighbouring zooids (Pratt, 1903, p. 507, fig. 3) are very numerous.

The spicules, in the form of irregular warted spindles, are extremely small, but are characteristic of the genus. They are from 0·09 millim. to 0·3 millim. in length and from 0·09 millim. to 0·1 millim. in diameter (fig. 5).

This species has a superficial resemblance to *S. roseum*, from which however it differs chiefly in colour, form of spicules, in its abundance of autozooids and paucity of siphonozooids.

Sarcophytum contortum, n. sp.—Plate I., figs. 6 and 7.

Two complete specimens and one fragment were taken from the reef at Galle.

The largest specimen is 47 millims. high. The capitulum has a curiously lobed appearance, somewhat resembling a *Lobophytum*. This is due to the growth inwards of 8 more or less digitate marginal lobes (fig. 6, *c.m.l.*). All the lobes arise from the capitular margin and not from the upper surface of the capitulum as in *Lobophytum*. The convoluted character is not so strongly marked in the two other specimens of the species. The capitulum measures 47 millims. by 35 millims. across its surface. The lobes are somewhat flattened and rise slightly above the level of the true capitular margin. They are from 18 millims. to 30 millims. long and are from 9 millims. to 15 millims. broad at the base. The edges of the lobes curl upwards and slightly inwards (fig. 6, *c.m.l.*). The stalk is 40 millims. high, tapers towards the base and is drawn into furrows by the inward growth of the marginal lobes. Its surface is minutely granular and is marked by few longitudinal wrinkles.

The colony is in a state of extreme contraction, which may, to a certain extent, account for the complication of the marginal folds. All the specimens (in spirit) are of a pale fawn colour. They are hard to the touch, minutely granular, compact, and are readily cut with a knife.

The *Autozooids* are very small, and as they are withdrawn some distance below the surface, it is almost impossible to perceive their external apertures without the aid of a lens. The average surface diameter of an autozooid cavity is 0·25 millim. Autozooids are apparently more numerous in the margin of the capitulum and capitular lobes than elsewhere.

The tentacles, stomodæum and mesenteries with mesoglœal thickenings are similar to those of other species. Ova in several stages of development are present on many of the mesenteries, development proceeding from below upwards, as is usual in these forms. In one instance two series, one a little distance below the other, of developing ova were observed on one mesentary.

The *Siphonozooids* cannot be seen without the aid of a lens. They are fairly numerous, two or three may usually be counted between two autozooids. The average surface diameter of a siphonozooid is 0·3 millim. The stomodæum has an average length of 0·18 millim.

The canal system does not exhibit any specially noteworthy features.

The *Spicules* are of the usual *Sarcophytum* type, and are extremely numerous. They are from 0·3 millim. to 0·4 millim. in length, and from 0·1 millim. to 0·15 millim. in breadth. Occasionally a club with a pointed handle may be seen (fig. 7B).

This species is characterised by the curiously convoluted marginal lobes, the small size of the zooids, the hardness and compact character of the colony.

Sarcophytum plicatum, SCHENK (1896).

Two moderately large colonies of a pinkish-brown colour were taken from Station XXII., 13 fathoms, in Dutch Bay, near Trincomalee.

This species has previously only been recorded from Ternate, but in the zoological laboratories of the Victoria University are two specimens, one taken by Professor HICKSON in North Celebes and the other taken by Mr. J. STANLEY GARDINER at Funafuti (Ellice Islands). The latter has been identified by Miss HILES. This species therefore appears to have a very wide distribution within the tropical belt.

Sarcophytum ehrenbergi, MARENZELLER (1886).

One large and complete specimen was taken on the reef at Galle.

The colony is 50 millims. high, and the capitulum measures 245 millims. by 215 millims. across its surface. The capitular margin is thrown into deep folds.

The specimen is of a dark grey colour, but towards the middle of the capitulum it assumes a lighter shade.

The species has previously been recorded from the Red Sea and from the Maldive Islands (see PRATT, 1903).

Lobophytum hedleyi, WHITELEGGE (1897).

A single complete specimen and a fragment were taken from the reef at Galle; these agree with specimens from Funafuti in all essential respects, and only differ slightly in external form. The complete specimen is short and squat, and is 75 millims. high. The capitulum measures 136 millims. by 115 millims. across its surface. It has a fairly broad marginal seam, and is deeply concave in the middle; the lobes are arranged in fairly regular radiating lines from the middle of the capitulum, and vary in height from 36 millims. to 53 millims. The colony is hard and smooth, the stalk is here and there marked by wrinkles. The specimens in spirit are of a dirty greenish-grey colour with brownish patches. The autozooids are contracted, but in sections are seen to be of a paler shade of grey than the prevailing tint. They are relatively few in number, but are more abundant on the summits of the lobes, where they are from 1 millim. to 2 millims. apart, than in the furrows between the lobes, where they are separated from each other by wide intervals.

The average diameter of a contracted crown of tentacles is about 1 millim. Owing to their extreme contraction it is impossible to distinguish their pinnules. The stomodæum appears to be longer than in the species *L. pauciflorum* or *L. crassum*, but the walls are folded in such a manner that it is impossible to measure the actual length. The mesenteries and mesenterial filaments do not apparently differ from those of other species. Ova, exhibiting several stages of development, are present on the mesenteries of the autozooids. They are from 0·08 millim. to 0·2 millim. in diameter, and each is enveloped in a follicle which, in the largest ova, is 0·03 millim. in thickness.

The *Siphonozooids* are arranged with great regularity in the spaces between the autozooids, and are consequently most numerous where autozooids are fewest. WHITELEGGE describes the siphonozooids as being numerous and distinct, and states that there may be as many as 12 siphonozooids between two autozooids. On the side of one of the lobes 43 siphonozooids were counted in a straight line between two autozooids, but the distance between the autozooids is not so great on the summits of the lobes, where they are seldom more than 3 siphonozooids apart.

The siphonozooids are extremely well marked in this species, their average surface diameter of 0·27 millim. is slightly less than in the species *L. pauciflorum* and *L. crassum*, but their length is greater than in those species. The average length of the stomodæum is 0·23 millim.

The canal system does not differ in any essential respect from that of other species; transverse ciliated vessels are very numerous, especially near the surface.

Spicules.—The spicules of this species have been described and figured by WHITELEGGE (1897, p. 217). Those of the cortex are tiny spindles or clubs from 0·12 millim. to 0·15 millim. in length, and from 0·02 millim. to 0·05 millim. in breadth. The more deeply seated spicules are tuberculate spindles, and short, stout, sub-cylindrical spicules. These are from 0·15 millim. to 0·3 millim. in length, and from 0·03 millim. to 0·19 millim. in breadth.

Lobophytum pauciflorum, EHRENBERG (1834).

One fairly large fragment and two young mushroom-shaped colonies were taken from the Gulf of Manaar.

One of the latter was 10 millims. high, with a capitulum 12 millims. by 10 millims. in diameter, and the other was 12 millims. high, with a capitulum 12 millims. by 10·5 millims. in diameter.

This species (see MARENZELLER, 1886, and PRATT, 1903) appears to be very widely distributed and has been taken from the Red Sea, New Zealand, Andaman Islands, Tonga, Moluccas, Funafuti, New Britain and the Maldive Islands.

Sclerophytum herdmani, n. sp.—Plate II., figs. 8 and 9.

One complete and several fragmentary specimens were taken from the reef at Galle, and two specimens from the Pearl Banks off Aripu.

The complete specimen from Galle has a much lobed capitulum, the lobes are similar in size, and are regularly arranged on the capitular surface (fig. 8). The colony is 85 millims. high and the capitulum measures 135 millims. by 140 millims. across its surface. The stalk is 70 millims. high and 120 millims. broad. The capitulum has no marginal seam, but passes almost imperceptibly into the stalk. On the wrinkled stalk, some little distance below the capitulum, are three small tubercles which bear zooids on their upper surface (fig. 8, *tu*). This appears to be the only recorded instance of the occurrence of zooid apertures on the stalk. The colour in spirit is pale drab, the summits of the branches have a yellowish tinge. When living, the zooids were of a pale brown colour, which, however, has been dissolved by the spirit preservative.

A specimen from Aripu is smaller. It is 50 millims. high and measures 45 millims. by 35 millims. across the surface of the capitulum, which is seamed at the margin. In spirit the stalk is light brown and the capitulum yellowish-drab. When living, the capitulum was a pale yellowish-green colour.

The fragmentary specimens are of a uniform drab colour. All the specimens are moderately hard, yield slightly to the touch, and are somewhat brittle.

The species is monomorphic. The autozooids appear to be rudimentary. They are extremely small, numerous, and are arranged with great regularity on the capitular surface. The average surface diameter of a contracted autozooid is 0·04 millim. Frequently as many as 20 zooids may be counted in a linear centimetre. It is unfortunate that the preservation of the specimens will not permit of a more complete investigation of the anatomy of this interesting species.

The ventral mesenterial filaments are extremely small, but the dorsal filaments are as well developed as in other species. The superficial and internal canal systems do not differ in any essential respect from those of other species. The endodermal tissues and canals are crowded with zoochlorellæ. The minuteness of the ventral mesenterial filaments and the smallness of the autozooids is doubtless correlated with the extreme abundance of zoochlorellæ, and is discussed in a paper now in the press (PRATT, 1905).

The *Spicules* (fig. 9) are similar in character to those of other species. Tuberculate spicules usually in the form of spindles, but sometimes forked, are comparatively numerous, and average 3 millims. in length and 0·5 millim. in breadth. Clubs sometimes with spiny handles, and spindles set with minute spines, are closely packed near the surface, so as to form an outer crust. The average size of the clubs is 0·09 millim. by 0·04 millim., of the spindles 0·25 millim. by 0·03 millim. A few spiny crosses also occur.

Sclerophytum marenzelleri, WRIGHT and STUDER (1889).

A single specimen of this species was taken in the Gulf of Manaar.

The colony forms an extremely hard cake-like mass, with lobes of varying size arising vertically from the upper surface of the capitulum. The basal attachment consists of hard coral encrusted with Polyzoa and shells. The colony is 93 millims. high; the capitulum has a transverse diameter of 337 millims. by 257 millims; the stalk is 55 millims. in height and is irregular in outline. The capitulum has a well-marked marginal seam and bears numerous conical lobes—many being fully 20 millims. high. A few of the lobes are branched.

The specimen in spirit is of a pale pinkish-brown colour, which originally was doubtless of a more intense hue, as the spirit is of a golden-brown colour. The capitulum is tough in consistency and slightly yielding to pressure; that of the stalk hard, granular and more brittle. Towards the base the stalk is extremely hard owing to the great abundance of spicules in this region.

The spicules are relatively small compared with other species. They are adequately described by WRIGHT and STUDER (1889, p. 251).

The species is monomorphic. The autozooids are all contracted, but appear to be extremely small. They are much more numerous in the lobes than in the furrows between, where they are often from 2 millims. to 4 millims. apart. They are also very scantily distributed on the capitular margin. Owing to the extreme contraction of the autozooids, the pinnate character of the tentacles cannot be distinguished. The stomodæum is comparatively long and has a well-marked siphonoglyph. As in other species, the dorsal mesenteries are of considerable size. There are of course no siphonozooids.

This species has been previously recorded from Api Island, New Hebrides (60 fathoms to 70 fathoms) and Cape Gazelle, New Britain.

Sclerophytum polydactylum (DANA).

One complete specimen and several fragments were obtained from the Gulf of Manaar.

The complete colony is 35 millims. high, the capitulum measures 37 millims. by 22 millims. across its surface. It is smaller, slightly harder and more brittle than the Maldive specimen, but does not appear to differ from it in any essential respect. This species (see PRATT, 1903) has been recorded from the Red Sea, China Strait, British New Guinea, the Maldive Islands and now the Gulf of Manaar.

Sclerophytum gardineri, PRATT (1903).

Three complete specimens were obtained from the Gulf of Manaar.

Two of the specimens (in spirit) are of a beautiful cream colour, while the third is of a pale drab colour. These specimens agree with the type specimen from the Maldive Islands in all essential respects. Two are slightly larger, while the third is of similar size.

This species has been hitherto recorded only from the Maldive Islands.

Sclerophytum palmatum, PRATT (1903).

Two complete and several fragmentary specimens were taken from the reef at Galle and from the Gulf of Manaar.

The complete specimens are small, and from their manner of growth do not appear to be so robust as the type specimen from the Maldive Islands. The fragmentary specimens are from shorter and stouter colonies, and have broader and larger lobes. The zooids are very similar in all the specimens, the tentacles having the double row of pinnules characteristic of the species (PRATT, 1903, p. 526). None of the Ceylon specimens in spirit show the vivid green colour of the type specimen when living, but several of the specimens have a greenish tinge.*

This species has hitherto only been recorded from the Maldive Islands.

Sclerophytum densum, WHITELEGGE (1897).

One very young mushroom-shaped colony (PRATT, 1903, fig. 18) was taken from Gulf of Manaar; two specimens, brown in colour, were taken from the reef at Galle; one reddish-brown specimen from a coral bank in the Gulf of Manaar, and a light brown and a fawn specimen were taken from the reef at Galle.

The light brown specimen is complete, and is comparatively young, having not yet outgrown its early mushroom shape. It is 22 millims. high, and the capitulum measures 46 millims. by 27 millims. across its surface.

The capitulum is concave, with a central depression of 12 millims. Small lobes from 2 to 4 millims. high arise from the middle of the cup, while larger ones from 5 to 6 millims. high occur near the edge.

The fawn-coloured specimen was taken on the reef at Galle. It is 70 millims. high, and the capitulum measures 240 millims. by 200 millims. across its surface. The colony forms a large, hard, cake-like mass, with a more or less vertical short and thick stalk, having almost the same breadth as the capitulum, which has no marginal seam. Lobes are very numerous near the edge of the capitulum, but are few and small in the middle. Zooids are numerous on the lobes, but are scantily distributed over the centre of the capitulum.

This species appears to be the most common as well as the most widely distributed species of the genus. It is known from Funafuti, China Seas, British New Guinea, Maldive Islands, and now from the Gulf of Manaar and Galle.

Sclerophytum querciforme, PRATT (1903).

Two specimens similar in form, size, texture, and apparently in all essential respects, to the specimens from the Maldive Islands, were taken from the Gulf of Manaar.

This species has hitherto only been recorded from the Maldive Islands.

Sclerophytum durum, PRATT (1903).

Four specimens were taken. Three from the Reef at Galle and one from the pearl banks in the Gulf of Manaar.

Three specimens, one complete and two fragmentary, are of a beautiful orange colour (in spirit)—of a deeper shade towards the middle and paling towards the margin. The fourth, a cup-shaped colony, is of a deep cream colour.

As already pointed out (PRATT, 1903, p. 528), specimens of this species from the limited area of the Maldive Islands exhibit great diversity in form and colour. Further modifications in these respects occur in the Ceylon specimens. The cup-shaped colony is similar in form, size, and texture to the cup-shaped Maldive

* Some of these colonies from Ceylon were certainly green when alive.—W. A. H.

specimens. The remaining three specimens, which appear to be very much older, are extremely hard, irregular, mushroom-shaped masses, with convex capitula thinning out towards the edges, set with short frequently laterally compressed lobes, usually arranged in radiating ridges.

The lobed specimen from the Maldive Islands appears to be intermediate in form and age between the cup-shaped specimens and the hard, irregular, mushroom-shaped specimens from Ceylon.

The complete specimen is 47 millims. high and the capitulum measures 92 millims. by 80 millims. across its surface. The stalk is short, broad, laterally compressed and constricted in the middle. It is 25 millims. high and has a diameter at the base of 80 millims by 40 millims. A few of the lobes are branched. Their average height near the middle is 10 millims. All the specimens give off a peculiar pungent odour even in spirit.

Only autozooids are present in this species. They are fairly numerous on the margin of the colony and on the lobes, but are few in number in the furrows between the lobes. All the specimens are hard and granular, owing to the enormous spicules which are very thickly set and extremely abundant.

This species has hitherto only been recorded from the Maldive Islands.

Alcyonium ceylonicum, n. sp.—Plate II., figs. 10 to 12.

A single complete colony was taken from the reef at Galle.

The specimen has an irregularly ridged capitulum and is creamy white in colour. The colony is 60 millims. high and the capitulum measures 75 millims. by 55 millims. across its surface.

It is tough and fleshy in consistency, slightly softer and more fleshy in the middle than near the surface, where the spicules are much more abundant.

The *Zooids* are extremely small and are very numerous (13 or 14 to the centimetre), they are uniformly distributed over the entire upper surface of the capitulum. Measurements across the partially expanded crown of tentacles average 0·6 millim. None of the zooids are completely expanded. The apertures of contracted zooids are so minute as to be almost imperceptible without the aid of a lens. As the tentacles are only partially expanded, it is difficult to distinguish their pinnate character. They are extremely short, the longest measuring only 0·16 millim. in length. The stomodæum averages 0·5 millim. in length and has a moderately large siphonoglyph.

The mesenteries are small, and the musculature only feebly developed. As in many other tropical forms, the dorsal mesenteries have extremely long and well developed filaments, but the ventral mesenteries have no filaments (Plate II., fig. 11, *v.m.*). As in several other instances (PRATT, 1904, in the press), this reduction of the digestive surface is accompanied by an abundance of zoochlorellæ in the superficial endodermal tissues.

The *Spicules* are similar in form (fig. 12) to those of *A. pachyclados*, but are slightly larger than in that species and are much less numerous. They have the form of tuberculate dumb-bells. They are fairly abundant in the superficial tissues, but are scantily distributed in the more deeply seated portions of the colony.

The average size of the spicules is 0·14 millim. by 0·1 millim.

As in other species of *Alcyonium*, there is only one system of canals. This, the internal system, is extremely well developed in the interior of the colony, but becomes less well marked towards the surface of the capitulum. This system consists chiefly of short transverse vessels which connect the cœlentera of the zooids (PRATT, 1903). Owing to the great number of zooids, which in this species penetrate deeply into the interior, the longitudinal canals are comparatively few in number.

This species is characterised by its soft fleshy consistency, its numerous but very minute zooids, the entire absence of ventral mesenterial filaments, accompanied by an abundance of zoochlorellæ in superficial tissues, and the small spicules.

It approaches *A. pachyclados* in the absence of ventral mesenterial filaments and in the form of the spicules. It differs however from that species in the texture of the colony, the minuteness of the zooids and in its less numerous but larger spicules.

Alcyonium pachyclados, KLUNZINGER (1877).

Three complete specimens of this widely distributed species were taken from the Gulf of Manaar.

They are all similar in external form, consistency and colour, but specimens in the Victoria University of Manchester from different localities exhibit considerable variation in these respects. The Ceylon colonies form low, more or less lobate, sessile, encrusting masses, from 10 millims. to 20 millims. high and from 28 millims by 18 millims. and 42 millims. by 23 millims. broad. The capitulum has a more or less convex surface, on which are studded, with varying frequency, the short and broad, rounded or conical lobes; the largest lobe is 7 millims. high and has a basal diameter of 8 millims. by 7 millims. These colonies are very similar in external form and character to specimens from the Maldive Islands (PRATT, 1903), China Strait and New Britain, but differ considerably in colour and manner of growth from the arborescent specimens which have been attributed to this species from the Cape of Good Hope (HICKSON, 1900). The Ceylon specimens are harder and more brittle than the forms I have examined from other localities, this being no doubt attributable to the great abundance of spicules.

The Ceylon specimens (in spirit) are of a creamy-white colour with autozooids of a darker shade, and are similar in this respect to the specimens from China Strait. The Maldive specimen (in spirit) is a pale brownish-grey colour, of a darker shade between the lobes. The specimen from New Britain is a uniform grey colour, while some of the Cape specimens are white, some yellow and others red in colour.

In distribution this species is known from the Red Sea, Maldive Islands, China Strait, New Britain, Cape of Good Hope and now the Gulf of Manaar.

ANATOMICAL NOTES.*

NEMATOCYSTS (figs. 13 and 14).

MOSELEY was unable to find nematocysts in specimens of *Sarcophytum*, and therefore states (1881, p. 119) that they do not occur in this genus. In his description of the occurrence of nematocysts in several members of the Alcyonaria, ASHWORTH (1899, p. 193) records them for *Sarcophytum pauciflorum*. This species, however, is now placed in the genus *Lobophytum*, for which the record of the presence of nematocysts is new. Hitherto they have not been observed in any species of *Sarcophytum*.

On examining several preparations of a single species stained with iron brazilin, some specimens seemed to contain no nematocysts, many contained few nematocysts, and in only a very few instances were they at all numerous. The apparent absence or scarcity of nematocysts in individual members of a species may be attributed to the use of a fixing preservative which permeates the tissues so slowly that the stinging cells are discharged before the colony is fixed. If a rapidly fixing preservative such as an 8 per cent. aqueous solution of hot formalin be employed, the tissues apparently suffer no contraction and the tentacles are found to contain innumerable batteries of nematocysts.

Nematocysts in *Alcyonium digitatum* were first described by HICKSON (1895).

I have been successful in observing nematocysts in all the species of *Alcyonium*, *Sarcophytum*, *Lobophytum*, and *Sclerophytum* which I have examined. They are, however, apparently more numerous in the British species than in the tropical representatives of the family. They always occur in batteries, and are never uniformly distributed in the ectoderm. The most common type is the well-known form occurring in *Alcyonium*. Modifications of this with regard to size, and length and thickness of thread are not infrequent, and may be found in *Sarcophytum roseum* (fig. 13*a*) and *S. glaucum* (fig. 13*c*), and in *Sclerophytum gardineri*. The accompanying table shows that they vary considerably in size in specific members of the family, and are apparently more uniform in this respect in *Alcyonium* and *Lobophytum* than in *Sarcophytum*, where they are from 6μ to 22μ long, and from 2μ to 14μ broad, and in *Sclerophytum*, in which they are from 5μ to 12μ long, and from 2μ to 4μ broad.

Nematocysts attain their greatest size in *Sarcophytum glaucum* (fig. 13*c*), in which species they are comparatively few in number. The thread is extremely short and broad, being usually fully 2μ in breadth. In sections, the internal portion exposed at the cut surface stains more deeply than the external portion of the thread. Within the cell the thread lies loosely and irregularly coiled, there being usually only from 3 to 4 turns of the spiral. The smallest nematocysts occur in *Sclerophytum*

* I have given an account of the physiology and comparative anatomy of the digestive organs of the Alcyonaria in a paper which is in the Press at the time of writing (PRATT, 1905).

durum. In this species they are extremely difficult to see, and are only about 5μ long and 2μ broad.

Throughout the family the thread is apparently unbarbed; nematocysts of *Alcyonium* with discharged threads are figured by HICKSON (1895). The nucleus of the cnidoblast is usually long and curved (fig. 13), and stains very readily. Nematocysts, similar to those occurring in batteries in the tentacles, are frequently to be found in the ectoderm of the mouth disc, in the stomodæum, imbedded in the peripheral portions of the mesenterial filaments, in the endoderm of the canals, and in some cases in the mesoglœa some little distance below the surface. They are extremely rare in the ectoderm covering the general surface of the colony between the zooids.

Genus. Species.	Size of nematocysts.	Author.
Alcyonium digitatum	$7\frac{1}{2}\mu$ by 2μ to 3μ	HICKSON
,, *pachyclados* . . .	8μ to 9μ by 2μ to 3μ	PRATT
Lobophytum pauciflorum . . .	6μ by 2μ	ASHWORTH
,, *validum*	6μ to 7μ by 2μ to $2{\cdot}5\mu$	PRATT
,, *crassum*	$5{\cdot}9\mu$ to $6{\cdot}9\mu$ by 2μ	,,
Sarcophytum roseum	$8{\cdot}9\mu$ to 9μ by 4μ	,,
,, *latum*	6μ by 2μ to 3μ	,,
,, *glaucum*	16μ to 22μ by 10μ to 14μ Thread 2μ broad.	,,
,, *ehrenbergi* . . .	6μ by 2μ	,,
Sclerophytum tuberculosum . .	7μ to 8μ by 2μ	,,
,, *densum*	7μ by 3μ	,,
,, *capitale*	8μ to 9μ by 3μ to $3{\cdot}5\mu$	,,
,, *hirtum*	8μ to 9μ by 3μ to 4μ	,,
,, *gardineri* . . .	12μ by $4{\cdot}5\mu$	,,
,, *durum*	5μ by 2μ	,,
,, *palmatum* . . .	6μ by 2μ	,,
Heteroxenia elizabethæ. . . .	9μ by $2{\cdot}5\mu$	ASHWORTH
Heliopora cærulea	9μ by 2μ to 3μ	MOSELEY
Xenia hicksoni	8μ by 2μ to 3μ	ASHWORTH
Clavularia prolifera	10μ to 15μ by 2μ to 3μ	V. KOCH

TENTACLES.

When the tentacles of *Alcyonium* are expanded, their ectoderm is extremely thin, and is composed almost entirely of batteries of cnidoblasts, columnar interstitial cells, scleroblasts, and a few mucous cells. I have observed no granular gland cells such as occur on the mouth disc. In the ectoderm of the body wall, nematocysts are comparatively few in number, and are rarely seen in the ectoderm covering the colony.

ZOOCHLORELLÆ.

Zoochlorellæ are more or less fully described in a publication now in the Press (PRATT, 1905). In a specimen of *Sclerophytum densum* some of the zoochlorellæ are seen to have lost their cellulose cell walls (fig. 16). In such a case the nucleus, chromatophore, and protoplasm of a cell exhibit unmistakable signs of division. This probably represents an early stage of sporogenesis. Very minute zoochlorellæ (fig. 16, *c.*) are also seen in the canals, but I have been unable to determine the intermediate stages of spore formation.

Yellow Cells.

The more or less rounded cells of a yellow colour which occur in the ectodermal as well as endodermal tissues are to be found in many tropical forms, but are more numerous in the specimens of *Sarcophytum* (Pratt, 1903, fig. 4) than in those of *Lobophytum* and *Sclerophytum.* They appear to be very abundant in certain Madreporaria, and have been described and figured by Duerden (1903, p. 439).

As small portions of yellow granular matter, similar in all respects to the contents of the yellow cells, may be frequently observed in the zoochlorellæ, it is suggested that the yellow cells represent an early stage of sporogenesis. The presence of yellow granular matter may be due to the breaking up of the chromatophores, but this point can only be satisfactorily settled by a systematic study of the life-history of the zoochlorellæ in living corals.

Generative Organs.

Comparatively few specimens in the collection contain generative organs, and in such instances they are entirely of a female character. Hickson (1895, pp. 376–380) has already described the oogenesis, and to a certain extent the spermatogenesis, of *Alcyonium*, and Ashworth (1898, pp. 207–209) has described the spermatogenesis of *Xenia.* In the British *Alcyonium digitatum* the development of the sexual cells occupies a very considerable period, as the ova begin to appear about April or May, and are usually not sexually ripe until December or even later. I have observed the discharge of ripe ova at Port Erin during the early part of April. In the British species the period of the sexually mature condition is extremely short. Apparently the colonies inhabiting a particular district discharge all their ripe ova and spermatozoa almost simultaneously. In tropical members of the family, however, such is not the case.

In his description of the spermatogenesis of *Xenia*, Ashworth (1898, p. 207) states that the spermatozoa closely resemble those of *Alcyonium* in development and structure, but spermatozoa occur in a single specimen in all stages of development, so that the discharge of ripe spermatozoa extends over a considerable period; this he attributes to the fact that as the coral lives on reefs in the shallow waters of tropical seas, it is not subjected to any great variation in temperature and food supply.

The development of the ovum in *Sarcophytum*, *Lobophytum*, and *Sclerophytum* closely resembles that of *Alcyonium*, and is typically Alcyonarian in character (figs. 17 and 18). Frequently (in specimens of *Sarcophytum latum*, *Sclerophytum durum*, and *Sclerophytum gardineri*), however, ova in several stages of development may be observed on a single mesentery, the development proceeding from above downwards, so that the youngest ova usually occur nearest the lower end of the stomodæum. In a specimen of *Sarcophytum latum*, ova on a single mesentery vary in size from 0·03 millim. to 0·5 millim. in diameter. Two series of developing ova, one a little distance below the other, were observed on a single mesentery in *Sarcophytum contortum*.

On comparing the oogenesis of *Sarcophytum*, *Lobophytum*, and *Sclerophytum* with ASHWORTH's description of the spermatogenesis of *Xenia*, it would appear that the sexually mature condition, in these tropical genera, extends over a considerably longer period than in the case of corals inhabiting temperate waters. The complete absence of male colonies, and of generative organs in many specimens, in the collection, is very noteworthy. I can offer no explanation, for many of the colonies are of considerable size, and the zooids appear to be mature in every other respect.

In the Alcyonaria generative organs usually occur on the ventral and lateral mesenteries only (fig. 17). In a specimen of *Sclerophytum gardineri*, however, ova occur also on the dorsal mesenteries (fig. 18). They are not connected with the ectoderm of the mesentery, but are borne and supported by lateral outgrowths of the mesenterial endoderm. ASHWORTH (1898, p. 207) records the presence of spermaria on the dorsal mesenteries of *Xenia*, but these are apparently the only records of their occurrence on these mesenteries in the Alcyonaria. As both forms in which they occur present modifications in other respects, this must be regarded also as a secondary feature, and of no special morphological interest.

SIPHONOZOOIDS.

I have slight additions to make to the description of the siphonozooids of *Sarcophytum*, *Lobophytum* and *Sclerophytum* already given in a previous publication (PRATT, 1903).

In *Sarcophytum* and *Lobophytum* the siphonozooids are small in comparison with the size of the autozooids, but in *Sclerophytum* they are either very minute (fig. 20) or absent. In all well marked cases of dimorphism the stomodæum is large, usually ciliated throughout, and has a well marked siphonoglyph furnished with long flagella (fig. 19). The dorsal mesenteries are long and have large, grooved and ciliated filaments. Even when of considerable size siphonozooids are usually only slightly contractile, and have only small ventral mesenteries. The specialisation of these zooids to fulfil a circulatory function has been accompanied by a reduction and atrophy of those organs which are concerned in the capture and digestion of food. Throughout the Alcyonaria siphonozooids apparently have no tentacles and their ventral mesenteries no filaments. The increase of the flagellate surface of the stomodæum has been at the expense of the digestive surface. The increased current of sea water within the zooids would carry away the food particles so rapidly, that they would be unable to receive the secretion of the gland cells, which, however, would be rendered so dilute as to be quite useless for digestive purposes. These zooids therefore have become incapable of capturing and digesting food. The increased circulation brought about by their specialisation would relieve the autozooids to a certain extent of that function, hence the feebly marked siphonoglyph in the autozooids of *Sarcophytum* and *Lobophytum*.

The stomodæal ectoderm of the siphonozooids in *Sarcophytum* and *Lobophytum* is composed of the same elements as in the autozooids, but owing to the physiological division of labour they occur in very different proportions.

In the stomodæum of the siphonozooid there is a pronounced increase in the number of flagellate cells, so that the siphonoglyph is proportionately larger than in the autozooid—this is accompanied by a very pronounced reduction in the number of granular gland cells, which are extremely rare in these two genera, but are entirely absent in *Sclerophytum*. The stomodæum of the siphonozooid in *Sarcophytum* and *Lobophytum* consists chiefly of flagellate cells, which constitute the well marked siphonoglyph and the ciliated columnar epithelial cells which line the remaining portion of the stomodæum. Among the latter are interspersed a few interstitial cells, nematocysts, scleroblasts, and a very few gland cells.

Siphonozooids and autozooids frequently communicate with each other by means of short ciliated canals, which differ from the vessels of the canal system in the presence of long columnar endoderm cells provided with fairly long cilia (fig. 22).

In *Sclerophytum* modification of the stomodæal ectoderm has proceeded still further. In this genus the siphonozooids are very much reduced. The stomodæum has neither flagellate cells nor gland cells, but consists in the species *S. densum* and *S. hirtum* (fig. 20) of a short simple tube opening to the exterior and lined apparently by undifferentiated ectoderm cells. In the species *S. palmatum* and *S. capitale* there is no aperture to the exterior ; in *S. durum* and *S. polydactylum*, an aggregation of a very few ectoderm cells is the degenerate representative of the stomodæum in other forms. The stomodæum is entirely unrepresented in *S. gardineri* and *S. querciforme*. Mesenteries are only present in very few cases and are extremely small and very feebly developed (fig. 20 *m*).

Development by Budding.

The siphonozooid buds differ from those which are destined to become autozooids in that their development is arrested at a very early stage, which appears to be constant for the species, and also to a certain extent in development, although the very early stages of both forms of zooids are identical.

In *Sclerophytum* the siphonozooids are extremely small and retain throughout life their intimate connection with the transverse vessels of the canal system from which they originated. In the development of the siphonozooids of *S. densum* a cæcum is formed by an outgrowth from an endodermal canal near the surface of the colony. This is accompanied by a multiplication and aggregation of the ectoderm cells at the surface, immediately opposite the cæcum (fig. 20). These cells arrange themselves so as to form a tube, usually one cell in thickness, which is at first blocked by a plug of mesoglœal-like substance (*pl.*). Rudiments of mesenteries frequently appear (*m.*), and by the removal of the plug an aperture is formed to the exterior. If a bud is destined to become an autozooid, mesenteries appear at a very early stage and usually attain a considerable size before the completion of the stomodæum or formation of the tentacles. My study of the development of the buds is yet incomplete, but there can be no doubt of the ectodermal origin of the stomodæum and the endodermal origin of the mesenteries. I have not yet worked out the origin of the ventral mesenterial filaments.

Canal Systems.

The canal systems of the Alcyonaria have been described by Hickson (1895) for *Alcyonium*, Moseley (1881) for *Sarcophytum*, Ashworth (1898) for *Xenia*, and Pratt (1903) for *Lobophytum* and *Sclerophytum*.

The canals in *Alcyonium* are very similar to each other in form and structure, but very irregular in their course; there appear to be no large vessels which maintain a course parallel to the periphery or to the longitudinal direction of the zooids, so that it is impossible to divide the canals into superficial and internal systems as in *Sclerophytum*. The vessels of the canal system are most numerous near the surface—in the deeper portions of the colony they are very sparingly distributed and are confined to the basal portions of the secondary polyps and the adjacent portions of their neighbours (Hickson, 1895, p. 362, Plate 37, fig. 8).

In *Sclerophytum* the superficial and internal canal systems are extremely well marked throughout the colony; near the base the internal system is very complex, owing to the branching and anastomosing of numerous vessels. In the presence of two systems of canals, and in their manner of distribution, *Sclerophytum* resembles *Xenia*.

The canal system of *Sarcophytum* is very similar to that of *Lobophytum*, and differs from *Sclerophytum* and *Xenia* in the absence of a superficial system, and in the fact that the principal longitudinal vessels are direct prolongations of the cœlentera of the siphonozooids.

New canals frequently arise as outgrowths from pre-existing vessels in the following manner:—One or more endoderm cells wander from a canal into the mesoglœa and divide and multiply to form a strand of cells; the individual cells of the strand multiply and form a fairly solid cord of endoderm, which usually remains attached to the canal from which it grew. Eventually a longitudinal splitting occurs and the lumen of the canal is formed (fig. 23).

This investigation of the Ceylon Alcyoniidæ has been carried out in the Zoological Laboratories of the Victoria University of Manchester. I am greatly indebted to Professor Hickson for much valuable advice and kind assistance in my work.

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EXPLANATION OF PLATES.

List of Reference Letters.

amb.c., amœboid cell in mesoglœa.
ap.c., aperture of canal.
au., contracted autozooid.
b.cn., battery of nematocysts.
c.m.l., capitular marginal lobe.
e.au., expanded autozooid.
c.c., cœlenteric cavity.
cap., capitulum.
cap.mar., capitular margin.
cl., clubs.
col.end., columnar endoderm.
c.v., ciliated vessel.
d.m.f., dorsal mesenterial filament.
ect., ectoderm.
end., endoderm.
end.b.w., endoderm body-wall.
end.can., endodermal canals.
g.v., germinal vesicle.
in.m.sp., inter-mesenterial space.
l.m.f., lateral mesenterial filament.
l. lobe.
m., mesentery.
m.ap., mouth aperture.
mar.lob., marginal lobe of capitulum.
mg., mesoglœa.
mg.b.w., mesoglœa body-wall.
mg.c., mesoglœal cells.
mg.d., dense layer of mesoglœa surrounding siphonozooids.
nuc., nucleus.
ov., ovum.
s., stomodæum.
si., siphonozooid.
sp., spicule.
sp.h., hole left by spicule after decalcification.
st., stalk.
tent., tentacle.
tr.s.c., transverse superficial canal.
tu., tubercle-like zooid on the stalk.
v.m., ventral mesentery.
v.m.f., ventral mesenterial filament.
y.au., young autozooid.
yk., yolk of ovum.
zo., *zx.*, zoochlorellæ.

PLATE I.

Fig. 1. *Sarcophytum bicolor*, n. sp.—Drawing of the smaller specimen, which has no capitular marginal seam. Autozooids and siphonozooids are of a beautiful creamy white colour, the remaining portion of the colony being dark grey. × 2.

Fig. 2. *Sarcophytum bicolor*, n. sp.—Different forms of spicules. × 60.

Fig. 3. *Sarcophytum oligotrema*, n. sp.—Drawing to show cup-like form of colony. × $1\frac{1}{3}$. The autozooids on the margin are smaller and relatively more numerous than in the middle of the capitulum. Siphonozooids are very few in number in this species.

Fig. 4. *Sarcophytum oligotrema*, n. sp.—Surface view of a decalcified fragment of the capitulum, about an inch from the margin, to show the relative abundance of autozooids and of siphonozooids. × 27.

Fig. 5. *Sarcophytum oligotrema*, n. sp.—Three warted spicules. × 60.

Fig. 6. *Sarcophytum contortum*, n. sp.—Drawing to show the complicated folding inwards of the capitular marginal lobes (*c.m.l.*). All these lobes arise as marginal ingrowths and not, as in *Lobophytum* and *Sclerophytum*, from the general surface of the capitulum. Autozooids and siphonozooids in this specimen can only be seen with the aid of a lens and are, therefore, not indicated in the drawing. × $1\frac{1}{3}$.

Fig. 7. *Sarcophytum contortum*, n. sp.—Three warted spicules. × 60.

PLATE II.

Fig. 8. *Sclerophytum herdmani*, n. sp.—From a photograph, showing the zooids on the stalk. About $\frac{1}{2}$ nat. size.

Fig. 9. *Sclerophytum herdmani*, n. sp.—Drawings of the different forms of spicules found in this species. *a.b.c.* × 7. *d.e.f.* × 60.

Fig. 10. *Alcyonium ceylonicum*, n. sp.—From a photograph. About $\frac{1}{2}$ nat. size.

Fig. 11. *Alcyonium ceylonicum*.—A contracted autozooid showing 2 large dorsal mesenterial filaments and a ventral mesentery which has no filament. × 60.

Fig. 12. *Alcyonium ceylonicum*.—Three spicules characteristic of the species. × 140.

Fig. 13. Nematocysts of *a*. *Sarcophytum roseum*.—Actual size $8 \cdot 5\mu$ by $4 \cdot 5\mu$.
b. *Sclerophytum densum*.—Actual size 6μ by $4 \cdot 5\mu$.
c. *Sarcophytum glaucum*.—Actual size 20μ by 12μ.
d. *Lobophytum pauciflorum*.—Actual size 7μ by $2 \cdot 5\mu$.

The nematocysts of *Sarcophytum glaucum* are enormous. The thread is loosely coiled within the cell. The internal portion of the thread stains more deeply than the external.

Fig. 14. *Alcyonium digitatum* (British).—Drawing of an extended living tentacle, showing the batteries of nematocysts and the single bi-lateral row of pinnules (*b.cn.*). Cam. luc. × 26.

Fig. 15. *Lobophytum pauciflorum*.—An autozooid tentacle, showing the asymmetrical arrangement of pinnules. × 60. Cam. luc. The tentacles of the tropical species are usually much smaller than those of the British species (fig. 14).

Fig. 16. *Sclerophytum densum*.—Zoochlorellæ: *a* and *b* show early stages of sporogenesis. The cellulose cell walls have disappeared, and the protoplasm and nuclei of the cells show unmistakable signs of division. In *b* the division is more complete than in *a*. *c* represents two very young zoochlorellæ I have been unable to observe the intermediate stages between *b* and *c*. *a* × 1300, *b* × 1600, *c* × 1200. Cam. luc.

PLATE III.

Fig. 17. *Sclerophytum gardineri.*—Transverse section through a ventral mesentery bearing a typical Alcyonarian ovum. × 930. Cam. luc.

Fig. 18. *Sclerophytum gardineri.*—Transverse section showing the unusual occurrence of two young ova on a dorsal mesentery. × 930. Cam. luc.

Fig. 19. *Lobophytum pauciflorum.*—Transverse section through a siphonozooid just below the surface. All the columnar cells lining the stomodæum are ciliated, but those of the siphonoglyph are more closely packed and have very long flagella. The endoderm is greatly distorted owing to the presence of zoochlorellæ. × 80.

Fig. 20. *Sclerophytum densum.*—Longitudinal section showing stages in development of siphonozooids, Si_1, Si_2, Si_3, by budding. Si_1 is the youngest and is formed as a bud from the endodermal canal leading from Si_3, and by an aggregation of ectodermal cells to form the stomodæum, which in the section consists at this stage of only two cells. A plug of mesoglœa at this stage closes the mouth aperture. Si_2 is an older bud. The development of the stomodæum has advanced, but the mouth aperture is still closed. Si_3 is a siphonozooid which has attained its normal development in this species. The mouth aperture is present and a very rudimentary mesentery (*m.*) is seen on the right. × 600.

Fig. 21. *Sclerophytum densum.*—Longitudinal section through a developing autozooid. The mesenteries are fairly well developed before the mouth aperture and tentacles are formed. Only one mesentery is indicated in the drawing. × 360.

Fig. 22. *Lobophytum pauciflorum.*—Transverse section showing the ciliated communication between two siphonozooids. The endoderm cells differ from those lining the cœlenteron in that they are long, columnar, and are provided with fairly long cilia. × 600.

Fig. 23. *Sclerophytum densum.*—Drawing showing the formation of an endodermal canal by the splitting of a solid cord of cells. × 700.

FIG. 1.

FIG. 4.

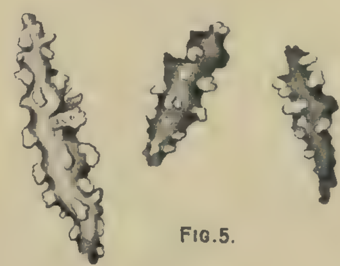

FIG. 5.

FIG. 2.

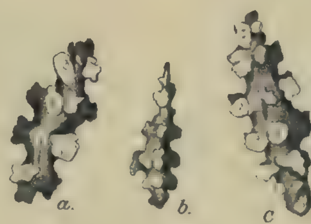

FIG. 7.

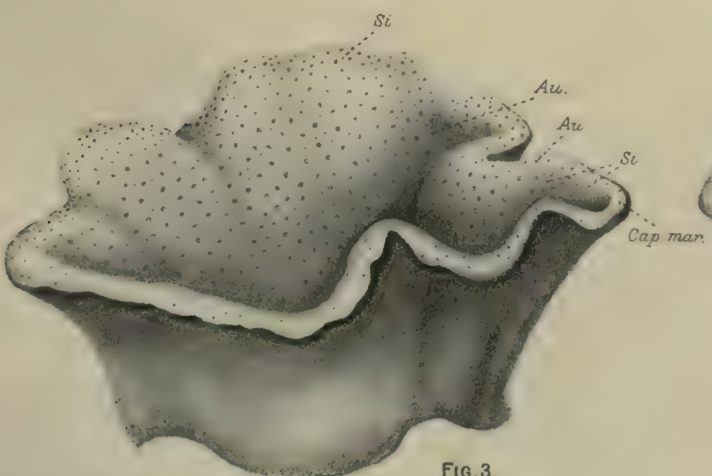

FIG. 3.

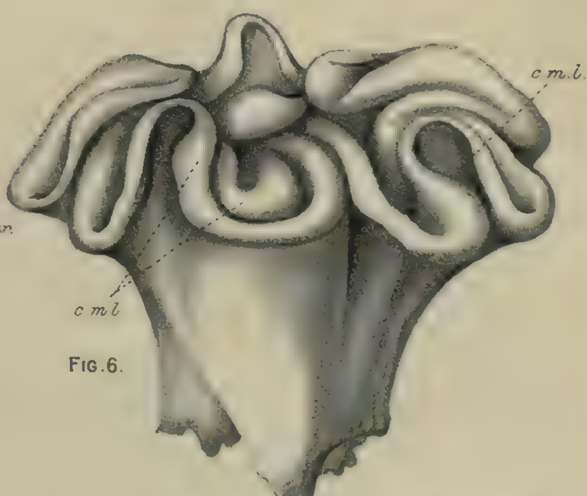

FIG. 6.

Figs. 1, 3 & 5. E. R. Dust.
E. M. Pratt. del.

E. Wilson. Cambridge.

FIGS. 1, 2, SARCOPHYTUM BICOLOR, n.sp.; FIGS. 3—5, SARCOPHYTUM OLIGOTREMA, n.sp.;

FIGS. 6, 7, SARCOPHYTUM CONTORTUM, n.sp.

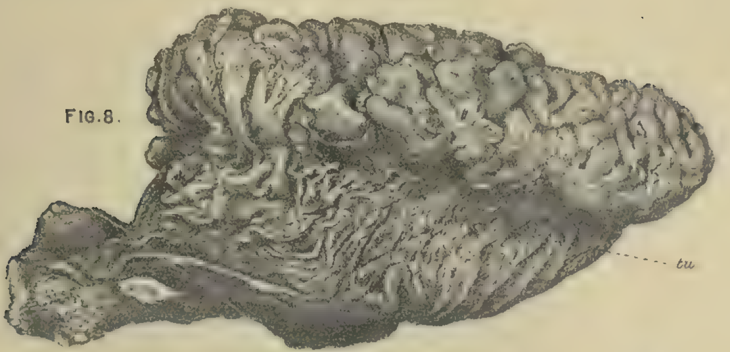

Fig. 8.

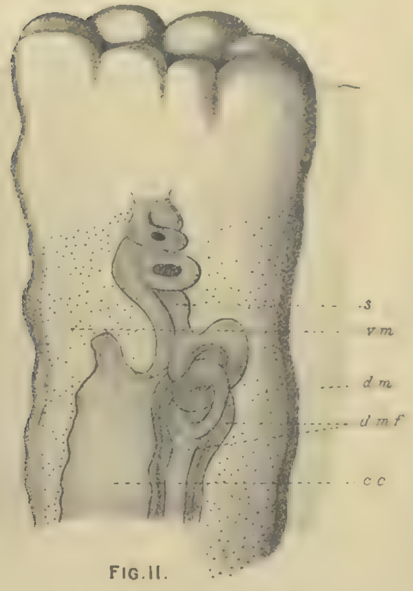

Fig. 11.

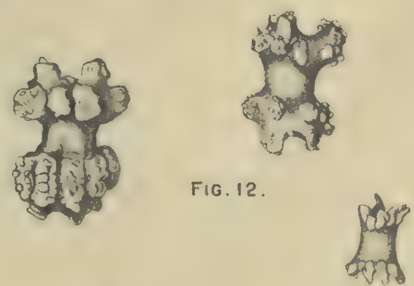

Fig. 12.

Fig. 9.

Fig. 13.

Fig. 15.

Fig. 14.

Fig. 10.

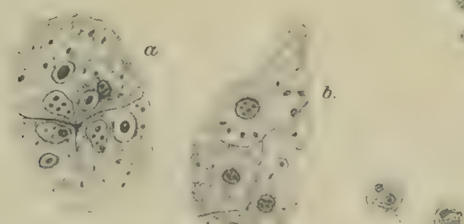

Fig. 16.

E. M. Pratt del.

Figs. 8, 9, Sclerophytum herdmani, n.sp.; Figs. 10–12, Alcyonium ceylonicum n.sp.;
Fig. 13, Nematocysts; Figs. 14, 15, Tentacles; Fig. 16, Zoochlorellæ.

FIG. 17.

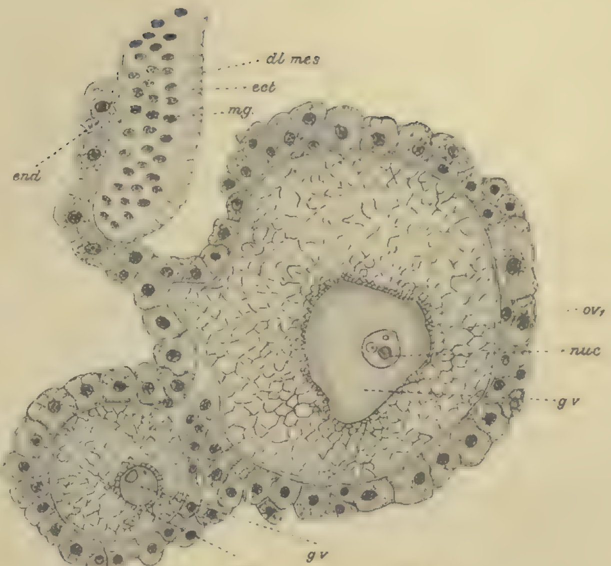

FIG. 18.

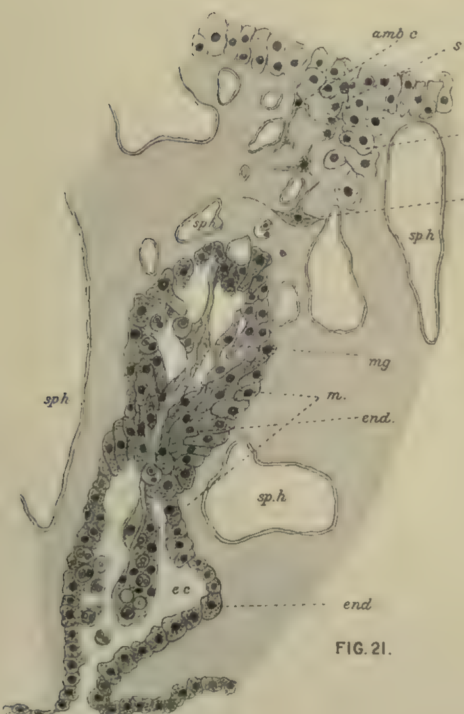

FIG. 21.

FIG. 20

FIG. 22.

FIG. 19.

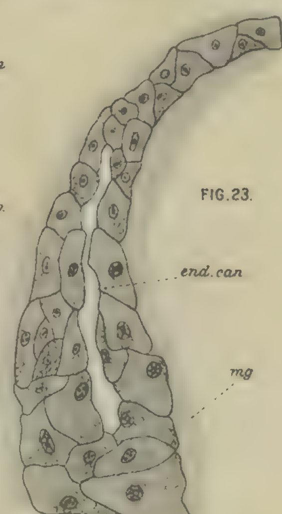

FIG. 23.

E M Pratt, del

E Wilson, Cambridge

MINUTE ANATOMY.

REPORT

ON THE

ALCYONARIA

COLLECTED BY

PROFESSOR HERDMAN, AT CEYLON, IN 1902.

BY

PROFESSOR J. ARTHUR THOMSON, M.A., UNIVERSITY OF ABERDEEN,

AND

W. D. HENDERSON, M.A., B.Sc., CARNEGIE SCHOLAR,* UNIVERSITY OF ABERDEEN.

[WITH SIX PLATES.]

THE rich collection of Ceylonese Alcyonarians† here reported on was made in 1902 from the Pearl Oyster Banks in the Gulf of Manaar, by dredging within the 100-fathom line off Trincomalee and off Galle, and in adjacent littoral areas. The localities are more precisely referred to in Professor HERDMAN's "Narrative" in Part I. of the general Report (1903).

As only a few Alcyonarians from Ceylon have been previously recorded, *e.g.*, by THURSTON‡ (1890) and RIDLEY§ (1883), Professor HERDMAN found an almost fresh field, which his faunistic genius recognised as extraordinarily rich. We have not been able to exhaust the material which his skilful collecting has garnered. His collection

* It is more than a formal duty to make grateful acknowledgment of the assistance of the Carnegie Trust: Mr. HENDERSON did part of his share in this Report as a Carnegie Scholar, and I received from the Trust £30 towards the expenses of preparations and drawings.—J. A. T.

† The "fleshy" Alcyoniidæ, *e.g.*, *Alcyonium*, *Lobophytum*, *Sarcophytum*, *Sclerophytum*, are reported on separately by Miss EDITH M. PRATT, D.Sc. (see this volume, p. 247).

‡ THURSTON'S list is as follows:—*Echinogorgia pseudosasappo*, *E. sasappo*, *E. cerea*, *E. furfuracea*, *Plexaura flabellum*, *Juncella juncea*, *Gorgonia (Leptogorgia) miniacea*, *Gorgonella umbella*, *Suberogorgia suberosa*, *Pteroeides javanicum*, *Pt. esperi*, *Virgularia juncea* and *Lituaria* sp.

§ RIDLEY'S list is as follows:—*Alcyonium polydactylum*, *A. submurale*, *Sarcophytum pauciflorum* *Spongodes* sp., *Rhizoxenia* sp., *Menacella reticularis*, *Echinogorgia pseudosasappo*, *Plexaura flabellum*, *Juncell juncea*, *Suberogorgia verriculata*, *S. suberosa*, and (?) *Corallium nobile*.

is "*littoral*" in the wide sense, but it may be noted that the explorations of the "Investigator" show that the *deep water* off Ceylon is also very rich in Alcyonarians. In reporting on Professor HERDMAN'S collection, we have had to deal with at least 75 species, representing at least 40 genera. About 32 of the species seem to us to be new, and the number might have been considerably increased if we had exercised less restraint. Our restraint in multiplying species has been mainly due to the ignorance that obtains in regard to the internal structure of many Alcyonarian types—an ignorance that cannot be removed without specimens specially preserved for histological purposes. Wonderfully diagnostic as spicules often are, they have been used too confidently and liberally in the establishment not only of species, but of genera, and a secure natural classification of Alcyonarians is still far to seek. Moreover, in some of the forms which we have studied, *e.g.*, *Spongodes*, there is great specific variability both as regards spiculation and branching. As an astounding illustration of diversity of spiculation in a single species, we may refer to our description of the form which we have called *Echinogorgia multispinosa*, n. sp.

Before proceeding to the systematic report, we may call attention to a few facts of general interest:—

(*a*) Very striking is the frequent illustration of "convergence," *i.e.*, the occurrence of superficially similar forms which are not in reality nearly related. Thus, on one occasion, three similar bright red forms were collected in one haul and loosely bound together with thread. An examination of this small parcel disclosed three species belonging to separate genera—*Keroeides gracilis*, *Verrucella rubra*, n. sp., and *Telesto rubra*. Equally marked is the resemblance between *Echinomuricea indo-malaccensis*, RIDLEY, and *Echinogorgia pseudosasappo*, KÖLLIKER, to which RIDLEY calls attention (1883, p. 235), and many other examples might be given.

(*b*) We have compared the Ceylon collection with two others entrusted to us, one made in the Indian Ocean by Major A. ALCOCK, F.R.S., the other made at Zanzibar by Mr. CYRIL CROSSLAND, M.A., and we find that the three collections have extremely little in common. This is mainly because ALCOCK'S collection was from deep water, and CROSSLAND'S chiefly from close in-shore, but it may also indicate that many Alcyonarians have a restricted local distribution. There is also a great difference between the collection here discussed and those made off the Maldives by Mr. GARDINER, and off New Britain, New Guinea, &c., by Dr. WILLEY. It may be of interest to note that three Alcyonarians brought from Patani (Siam) by Mr. NELSON ANNANDALE and Mr. H. C. ROBINSON are unrepresented in HERDMAN'S collection (though included in this report), viz., *Telesto trichostemma*, *Astromuricea ramosa*, n. sp., and *Juncella trilineata*, n. sp.

(*c*) Some of the distributional facts, on the other hand, point in a different direction, showing that species occur in Ceylonese waters which enjoy a wide range elsewhere. Thus the exceedingly beautiful *Primnoa ellisii* is known from the

Mediterranean and from off the Andaman Islands, and *Gorgonia capensis* is known from the Cape and further south. In many respects the Ceylonese Alcyonarian fauna is, *as regards genera*, remarkably cosmopolitan. Few naturalists, however, have contrived to collect so exhaustively as Professor HERDMAN did in his Ceylon expedition.

(*d*) There is in some species great variability in colour, in mode of branching, in dimensions of spicules, and in the proportionate numbers of different forms of spicules. In illustration we may refer to *Spongodes pulchra*, n. sp., *Spongodes bicolor*, WRIGHT and STUDER, *Chironephthya variabilis*, HICKSON, *Bebryce hicksoni*, n. sp., *Verrucella flexuosa*, RIDLEY. In many cases we have given details in regard to these variations, partly as a contribution to the data of variability in general, and partly to facilitate a future revision of species. It can hardly be doubted that many of the Alcyonarian species, *e.g.*, of *Xenia*, *Spongodes*, *Scirpearella*, *Juncella*, and *Verrucella*, are in a state of evolutionary flux, and yet it is at present difficult to reduce the number of species. As we have had numerous specimens of many of the apparently most variable forms, we have not felt justified in regarding these as instances of merely individual variation.

(*e*) As a simple illustration of the way in which even these Alcyonarians may interact with the life of such animals as pearl oysters, we may refer to *Clavularia margaritiferæ*, n. sp., which spreads on the pearl oyster shell, and to the occurrence of young pearl oysters attached to Alcyonarians, *e.g.*, to the branches of *Heterogorgia* sp. Not a few specimens, *e.g.*, *Nephthya lobulifera*, were found attached to dead pearl oyster shells.

(*f*) We have had the pleasure of confirming in *Gorgonia capensis* Professor S. J. HICKSON'S interesting discovery of viviparity.

It may be convenient to place here a classified list of the species reported on :—

ALCYONARIA (EXCLUDING MOST OF THE ALCYONIIDÆ).

ORDER I.: STOLONIFERA.

FAMILY: Clavulariidæ.

**Clavularia margaritiferæ*, n. sp.

FAMILY: Xeniidæ.

Xenia ternatana, SCHENCK.
„ *umbellata*, SAV.

ORDER II.: ALCYONACEA.

FAMILY: Alcyoniidæ.

**Bellonella indica*, n. sp.

FAMILY: Nephthyidæ.

Nephthya chabrolii, AUD., var. *ceylonensis*, n.
„ *lobulifera*, HOLM.
**Nephthya ceylonensis*, n. sp.
**Eunephthya purpurea*, n. sp.
**Paraspongodes striata*, n. sp.
**Capnella manaarensis*, n. sp.
**Spongodes pulchra*, n. sp.
„ *bicolor*, WRIGHT and STUDER.
„ „ „ „ var. *ceylonensis*, n.
„ „ „ „ var. *dubia*, n.
* „ *aurantiaca*, n. sp.
„ *rosea*, KÜKENTHAL.
„ *armata*, HOLM., var. *ceylonensis*, n.
„ *dendrophyta*, WRIGHT and STUDER.
„ *splendens*, KÜKENTHAL.

* The forms with an asterisk are reported as new.

FAMILY: Siphonogorgiidæ.

**Paranephthya pratti*, n. sp.
Chironephthya variabilis, HICKSON.
Siphonogorgia pustulosa, WRIGHT and STUDER.
„ *miniacea*, KÜKENTHAL.
„ *köllikeri*, WRIGHT and STUDER.

ORDER III.: PSEUDAXONIA.

FAMILY: Briareidæ.

Solenocaulon tortuosum, GRAY.

FAMILY: Sclerogorgidæ.

Keroeides gracilis, WHITELEGGE.
Suberogorgia verriculata, ESPER.

ORDER IV.: AXIFERA.

FAMILY: Primnoidæ.

Primnoa ellisii, v. KOCH.

FAMILY: Muriceidæ.

**Acanthogorgia media*, n. sp.
„ *muricata*, VERRILL, var. *ceylonensis*, n.
* „ *ceylonensis*, n. sp.
**Astromuricea ramosa*, n. sp.
Echinomuricea indo-malaccensis, RIDLEY.
* „ *ceylonensis*, n. sp.
Echinogorgia pseudosasappo, KÖLLIKER.
* „ *multispinosa*, n. sp.
**Heterogorgia verrilli*, n. sp.
**Bebryce hicksoni*, n. sp.
**Acamptogorgia atra*, n. sp.
„ *spinosa*, HILES.
„ „ var. *ceylonensis*.
**Acis indica*, n. sp.
* „ *alba*, n. sp.
„ *orientalis*, RIDLEY.
* „ *ceylonensis*, n. sp.
**Muricella ramosa*, n. sp.
* „ *ceylonensis*, n. sp.
„ *nitida*, VERRILL.
„ *complanata*, WRIGHT and STUDER.

FAMILY: Plexauridæ.

Plexaura prælonga, var. *typica* (RIDLEY).
„ „ „ *elongata*, n.
„ *antipathes*, var. *flexuosa*.

FAMILY: Gorgonidæ.

Lophogorgia lutkeni, WRIGHT and STUDER.
* „ *rubrotincta*, n. sp.
**Lophogorgia irregularis*, n. sp.
Leptogorgia australiensis, RIDLEY, var. *flavotincta*.
„ „ „ „ *perflava*.
„ (?) sp.
**Stenogorgia ceylonensis*, n. sp.
Gorgonia capensis, HICKSON.
Rhipidogorgia sp.

FAMILY: Gorgonellidæ.

**Scirpearella aurantiaca*, n. sp.
* „ *divisa*, n. sp.
„ sp. α.
„ sp. β.
„ sp. γ.
Scirpearia sp.
Juncella gemmacea, VALENCIENNES.
„ *juncea*, PALLAS.
„ *fragilis*, RIDLEY.
„ „ „ var. *rubra*, n.
* „ *trilineata*, n. sp.
**Verrucella rubra*, n. sp.
„ *flexuosa*, KLUNZ., var. *aurantiaca*, n.
„ „ var. *gallensis*, n.

ORDER V.: STELECHOTOKEA.

SECTION I.: ASIPHONACEA.

FAMILY: Telestidæ.

Telesto rubra, HICKSON.
„ (*Carijoa*) *trichostemma*, WRIGHT and STUDER.

SECTION II.: PENNATULACEA.

FAMILY: Umbellulidæ.

Umbellula sp.

FAMILY: Virgularidæ.

Virgularia multiflora, KNER.
„ *loveni*, KÖLLIKER.
* „ *tuberculata*, n. sp.
„ sp.

FAMILY: Pennatulidæ.

**Halisceptrum periyense*, n. sp.
„ *gustavianum*, HERKLOTS.
Pteroeides lacazei, var. *spinosum*, KÖLLIKER.

FAMILY: Veretillidæ.

Cavernularia obesa, VALENCIENNES.
**Stylobelemnoides herdmani*, n. gen. et sp.

* The forms with an asterisk are reported as new.

DESCRIPTION OF THE SPECIES.

ORDER I. : STOLONIFERA.

FAMILY : CORNULARIIDÆ.

Clavularia margaritiferæ, n. sp.—Plate III., fig. 8.

The stolon consists of a number of thin and narrow branching threads, forming a network on the surface of a pearl-oyster shell. The strands of the stolon vary in breadth from 0·4 millim. to 0·6 millim. They do not form any membranous expansion. The polyps arise vertically from the branches of the stolon at intervals of 2 millims. to 2·5 millims.; there does not seem to be any interpolation of new polyps among the older.

The polyps measure 3 millims. in height, with a distal diameter of 0·9 millim., and a proximal of 0·5 millim. to 0·65 millim. They are thus broader than the stolon branches, *cf. Clavularia reptans*, HICKSON (1895). They have, in all cases, their crowns retracted; there is no indication of longitudinal grooves or lines.

The walls of the polyps and of the stolons show thickly crowded spicules of minute size (0·06 millim. to 0·07 millim. × 0·03 millim. to 0·04 millim.) interlocked by their wart-like projections, *cf. Clavularia flava*, HICKSON (1895). Most of the spicules are substantial rods bearing blunt wart-like projections often in a whorl of four towards each end. The short and simple tentacles, bearing a few blunt pinnules (not sufficiently fixed to allow of precise examination) are supported by numerous longitudinally disposed elongated and curved rods, which may measure 0·1 millim. in length. They are smooth and only occasionally bear projections. All the spicules are colourless, and the whole colony is white in its preserved condition.

Locality :—Pearl banks, Gulf of Manaar.

FAMILY : XENIIDÆ.

Xenia ternatana, SCHENCK.

A single specimen attached to a sandy worm-tube, with polyps in three groups, agrees on the whole with *Xenia ternatana*, SCHENCK, notably in having only two rows of pinnules on each side of the tentacles, and about 18 slender pinnules in each row, as also in the measurements of the polyp-body and of the tentacles.

Xenia umbellata, SAV.

Attached to the substratum of another specimen, which we unfortunately omitted to note in the business of assortment, there was a species of *Xenia* which appears to be referable to *X. umbellata*. The locality was low water at Pamban. We assume that the presence of only two species of *Xenia* in the collection simply means that Professor HERDMAN'S work was outside the *Xenia*-zone. There must be many species of *Xenia* in Ceylon.

ORDER II.: ALCYONACEA.*

FAMILY: ALCYONIIDÆ.

The genera *Sarcophytum*, *Sclerophytum*, *Lobophytum*, and *Alcyonium* are discussed in Miss PRATT's Report, this volume, p. 247. There has been left to us to describe what seems to be a new species of the little-known genus *Bellonella*.

Bellonella indica, n. sp.—Plate VI., fig. 5.

A small cylindrical specimen of a crimson-vermilion colour with yellow calyces and white polyps. It is attached to a fragment of rock and stands 24 millims. in height, with a basal diameter of 10 millims. and an apical diameter of 6 millims. The lower half is a sterile trunk, the upper half bears crowded polyps, whose white colour contrasts well with the red of the general cœnenchyma and the rich yellow of the calyces. Many of the calyces measure 1 millim. in diameter, and the interval between them is often the same. Smaller forms occur among the larger, but there is no evidence of dimorphism of zooids. The margin of the calyx is neatly 8-lobed, and here and there the white polyps are expanded. The tentacles, which seem to run somewhat markedly to a triangular point, bear on each side about 18 finger-like pinnules. A longitudinal cut shows the large longitudinal canals traversing the bright red cœnenchyma, and the eight longitudinal strands in each canal stand out sharply as bright white lines.

The spicules of the cœnenchyma are of an orange-red to yellowish colour, mostly like knobbed capstans, or double clubs with large warty heads, or double wheels with a very slight constriction between them. They form a granular pavement over the surface and densely fill the cœnenchyma. In the sterile trunk there seem to be no double clubs in the strict sense; the form is more like a knobbed dumb-bell with an exceedingly slight and short constriction in the middle. In all cases the warts are few, large, and blunt. The spicules are thus unlike the fusiform echinate forms reported as characteristic of *Bellonella*, but the genus has not been well defined, and it may be noted that two isolated polyps showed a few colourless or faintly yellowish fusiform spicules with a few thorns. It is not certain, however, that these belonged to the polyp; they may have been artificial inclusions.

The following measurements of the typical spicules were taken, length and breadth, in millimetres:—

0·08 × 0·06 (0·04 at middle); 0·06 × 0·06 (0·04 at middle); 0·06 × 0·045; 0·06 × 0·04; 0·05 × 0·04 (0·03 at the middle); 0·045 × 0·0375 (0·025 at the middle).

The specimen is very different from *Bellonella* (*Cereopsis*) *bocagei*, SAV. KENT, and *B. variabilis*, STUDER, but neither of these agrees conspicuously well with GRAY's

* Exclusive of the Alcyoniidæ described by Miss PRATT (this vol., p. 247).

original definition. GRAY'S description of *Bellonella granulatum* ('Proc. Zool. Soc.,' 1862, p. 35) is unfortunately short and vague. He speaks of the "angular tips" of the calyces; he figures longitudinal furrows on the stem, and these features are here absent. It seems better, therefore, to start afresh with a new species.

Locality :—Deep water south of Galle.

FAMILY: NEPHTHYIDÆ.

SUB-FAMILY: SPONGODINÆ.

Nephthya chabrolii, AUD., var. **ceylonensis,** n.

To this species, known to include several varieties (KÜKENTHAL, 1903, p. 157), we refer a specimen which differs from ordinary forms of *N. chabrolii* in being dull greyish-white, and in having a "Stützbündel" spicule projecting beyond the polyp for 0·5 millim. The following comparison with KÜKENTHAL'S description of *N. chabrolii* may serve to illustrate dimensional variability.

	Polyp.		Polyp spicules.		Stem spicules.	
	Length.	Breadth.	Length.	Breadth.	Length.	Breadth.
	millims.	millims.	millims.	millims.	millims.	millims.
KÜKENTHAL'S measurements.	0·5 to 0·7	0·5 to 0·7	0·08 to 0·45	0·015 to 0·06	1·1 to 1·9	0·12 to 0·26
HERDMAN'S specimen . . .	0·6 „ 0·7	0·6 „ 0·65	0·15 „ 0·35	0·02 „ 0·06	0·65„ 2	0·16 „ 0·26

For description, see HOLM (1895).

Locality :—Pearl banks, Gulf of Manaar, March, 1902, and DONNAN'S Paar.

Nephthya lobulifera, HOLM.

From an elongated base attached to an oyster shell there rise 7 main branches apparently flaccid in character, bearing numerous lobes of unequal size and variable arrangement. On these the polyps occur in groups often united by a few individuals scattered in the intervening spaces. The polyps are light yellow and stand out prominently against the general white colour of the colony. They measure 0·7 millim. to 1·3 millims. in length. The "Stützbündel" spicules are strong, slightly curved, warty spindles up to 1·9 millims. in length; the three longest project beyond the polyp. The polyp spicules measure 0·06 millim. to 0·25 millim., and the stem spicules 1·1 millims. to 1·95 millims. in length. For description, see HOLM (1895).

Locality :—1½ miles off Old Dutch Modragam Paar, Gulf of Manaar.

Nephthya ceylonensis, n. sp.—Plate I., fig. 4.

A small rigid colony fixed to a stone rises to a height of 38 millims., giving off three lobes crowded with polyps. The general colour of the lower part of the stem is greyish-white, but in the region of the polyps the colour is light violet, and the polyps themselves are canary-yellow. The lower part of the stem has a stiff leathery character and a granular appearance; the upper part is entirely covered with large spicules which are for the most part disposed longitudinally.

The polyps occur in small almost contiguous groups or singly. Each is an elongated cylinder, standing at right angles to the "Stützbündel," measuring 1·2 millims. in length by 0·8 millim. in breadth.

The spicules of the lower part of the stem consist of short thick spindles (1·1 millims. to 1·4 millims. in length by 0·1 millim. to 0·2 millim. in breadth), sometimes bifurcate or trifurcate at one end, and also of triradiate and quadriradiate forms. All exhibit numerous blunt warts.

In the upper part the spicules are spindle-shaped, covered with numerous spines, and tinged with violet. Some of them are forked at one end, and a few give off a short branch about the middle of their length. They vary in length from 1·1 millims. to 2·4 millims., and in breadth from 0·1 millim. to 0·18 millim. Those of the "Stützbündel" measure 1·55 millims. to 1·8 millims. There is only a slight projection beyond the polyp.

The polyp spicules are very small, deeply tinged with yellow, measuring 0·4 millim. by 0·08 millim.

Eunephthya purpurea, n. sp.—Plate I., fig. 3; Plate V., fig. 5.

This species is represented by several specimens which present a striking appearance owing to the contrast between the yellow polyps and the purple-red of the stem and branches. The stem is large and flaccid, and gives off numerous small branches and twigs. The superficial cœnenchyma is rough, and has a granular appearance due to the arrangement of the numerous small spicules. The twigs, however, have a different appearance, for there the spicules are longer and are mainly disposed transversely. Two good specimens measured in centimetres,—11 × 7 and 12 × 3.

The spicules of the lower part of the stem are very short, irregularly branched rods with prominent spines. They measure 0·1 millim. in length by 0·08 millim. in width. The spicules of the twigs and the tip of the stem are slender spindles, varying in length from 0·23 millim. to 0·25 millim. and in breadth from 0·02 millim. to 0·023 millim.

The polyps are scattered over the stem and branches, occurring either singly or in small groups. They are yellow in colour, and they contrast well with the red colour of the twigs and branches. The length of the polyps is 0·9 millim. to 1 millim. and the width varies from 0·5 millim. to 0·6 millim. The polyp spicules are very small yellow spindles with prominent warts and spines. Their measurements are 0·14 millim. to 0·3 millim. in length and 0·015 millim. to 0·03 millim. in breadth. Below the anthocodial part of the polyp there is a collar formed of several rings of spicules, red in colour, which measure from 0·5 millim. to 0·7 millim. in length by 0·04 millim. to 0·06 millim. in breadth.

Localities :—Pearl banks off Aripu, Gulf of Manaar; and deep water off Galle.

Paraspongodes striata, n. sp.—Plate II., figs. 2 and 7.

A specimen without "Stützbündel," with no spicules in the canal walls, and polyps disposed in well-defined bundles must be referred to the genus *Paraspongodes* (see KÜKENTHAL, 1896).

The colony studied stands 67 millims. high by 49 millims. in maximum breadth; the general colour is whitish. A short substantial stem gives off three main branches which divide and re-divide, so that the appearance of an irregular corymb of umbels results. The average length of a terminal branch is 4 millims. The polyps occur in bundles of 6 to 7, and these bundles are grouped to form an umbel. A much finer specimen, which was left at Liverpool, measured 22 centims. in height, 11 centims. before the first branching, and 4 centims. across at the base.

The superficial cœnenchyma of the branches is deeply striated transversely, we may almost say ringed, and is tough in character; on the main stem the surface is irregularly wrinkled and rough in texture.

The polyps vary in length from 1·1 millims. to 2·3 millims., and in breadth from 0·65 millim. to 0·9 millim. They are supported by spindle-shaped spicules uniformly disposed in contiguous longitudinal rows, and measuring 0·18 millim. to 0·6 millim. in length by 0·04 millim. to 0·06 millim. in breadth. The tentacles measure 0·6 millim. in length, and two or three pairs of plump pinnules are visible.

In the cœnenchyma the spicules are minute but very numerous. They occur as rough spindles or rods irregularly branched, and also as what may be called irregular stars. They vary in length from 0·09 millim. to 0·16 millim., and in breadth from 0·03 millim. to 0·06 millim.

Locality :—Deep water outside pearl banks, Gulf of Manaar.

Another larger specimen, 169 millims. in length by 69 millims. in maximum breadth, from the same locality seemed at first different.

It had a relatively much longer stalk with basal rhizoid branches; it showed greater transparency of texture, less abundant superficial spicules, less marked transverse wrinkling, and a larger number (7 to 11) of polyps in each bundle. Closer examination showed essential agreement as to spicules, polyps, tentacles, &c. The measurements for this specimen show considerable variation, as the following table indicates :—

Polyps.		Polyp spicules.	
Length.	Breadth.	Length.	Breadth.
millims.	millims.	millims.	millims.
1·2	0·8	0·6	0·05
		0·63	0·05
1·3	0·85	0·7	0·05
0·9	0·7	1·0	0·10
		0·9	0·08
1·0	0·8	0·25	0·016
		0·18	0·03

Capnella manaarensis, n. sp.—Plate II., fig. 4; Plate V., fig. 14.

A specimen without "Stützbündel," with numerous spicules in the canal walls, and with the polyps arranged not in bundles but in conical lobes or catkins, we refer to the genus *Capnella*, as reconstructed by KÜKENTHAL (1902).

The colony is fairly rigid and stands 79 millims. high by 75 millims. in maximum breadth. The general colour is a greyish-white or a dirty white. A short stem gives off several main branches, which in their ultimate divisions give rise to polyp-bearing lobes or catkins.

The superficial cœnenchyma of the branches and the main stem is rough in texture and has a stringy appearance owing to the arrangement of the spicules.

The polyps have an average length of 0·95 millim. by an average breadth ot 0·65 millim. They are supported by spindle-shaped spicules which are arranged longitudinally, and vary in length from 0·29 millim. to 0·55 millim. and in breadth from 0·04 millim. to 0·08 millim.

In the cœnenchyma the spicules are spiny spindles. They are usually straight or curved, but several show a bifurcation at one end, or give off a short branch near their middle point. They show considerable variation in size, measuring from 0·5 millim. to 1·35 millims. in length and 0·10 millim. to 0·16 millim. in breadth.

Locality:—Pearl banks off Aripu, Gulf of Manaar.

Spongodes pulchra, n. sp.*—Plate I., fig. 5; Plate V., fig. 10.

This species is represented by many specimens, 3 of which give the following measurements:—

* The third instalment of Professor W. KÜKENTHAL'S "Versuch einer Revision der Alcyonarien" ('Zool. Jahrb.,' xxxi., 1905, pp. 503–726, 7 pls., and 61 figs.) appeared while this report was being passed for press, and it could not be utilised. He splits the old genus *Spongodes*, with which one is loth to part, into the two new genera *Dendronephthya* and *Stereonephthya*, with 90 species to the former and 8 species to the latter. Everyone will welcome KÜKENTHAL'S important contribution to the study of a difficult and polymorphic genus, but what is gained by trying to do away with the old title *Spongodes*, which is practically equivalent to *Dendronephthya*, just as *Spongodia* is to *Stereonephthya*? KÜKENTHAL has studied

	(A.)	(B.)	(C).
Total height	66 millims.	66 millims.	36 millims.
Length of trunk	14 ,,	13 ,,	9 ,,
,, ,, head	52 ,,	53 ,,	27 ,,
Maximum width of same .	39 ,,	43 ,,	21 ,,

The trunk or bare part of the stem is granular in appearance and leathery in texture. In (B.) and (C.) it is greatly wrinkled, owing to the large canals and the weak partition walls between.

The branching is very profuse, the stem giving off a large number of primary branches which break up into secondaries, and these in their turn into the twigs bearing the polyps. The twigs or tertiary branches bear the polyps in corymb-fashion, so that they all reach the same level, and owing to the large number of the polyps the stem and branches are completely hidden.

The polyps are arranged in groups of 4 to 6, and they in their turn are aggregated into larger bundles. They are red, with markedly white tentacles. Although some of the spicules close to the polyps become a little stronger, none of them project, so that the colony has not the slightest appearance of being spiny.

The surface of the stem is rough to the touch and has a granular appearance. In the primary and secondary branches, however, the spicules appear more prominently and give the surface an irregular stringy appearance, and finally they take an almost longitudinal arrangement in the twigs.

In (A.) the stem, primary and secondary branches are almost white, while in (B.) and (C.) they are yellow. In (A.) the twigs are white, but become pinkish below the polyps, while in (B.) and (C.) they are yellowish, but also become pink below the polyps. Thus there is considerable colour-variation.

The spicules of the trunk are very short and furnished with long spines. They are very varied in shape—short rod-like bodies, 3-rayed stars, and irregular crosses. In all, however, the spines are well developed. They measure, length by breadth, in millimetres, as follows :—$0{\cdot}15 \times 0{\cdot}1$; $0{\cdot}2 \times 0{\cdot}05$; $0{\cdot}20 \times 0{\cdot}1$; $0{\cdot}5 \times 0{\cdot}15$. All these measurements include the spines, which often measure $0{\cdot}04 \times 0{\cdot}02$; $0{\cdot}03 \times 0{\cdot}02$; and $0{\cdot}045 \times 0{\cdot}01$.

The spicules of the stem and branches are long slender spindles, usually curved or bent and covered by fairly prominent spines. They measure, length by breadth, in

213 specimens in all, but in many cases he only studied one (32) or two (21). He makes 30 new species, some of which may correspond to those here described as new, though we have not been able as yet to satisfy ourselves as to any identity. We venture to predict, however, that further study of this prolific genus, whether it be called *Spongodes* or *Dendronephthya*, with say ten specimens of each species, will *increase* the number of quite distinct species, and will *lessen* the number of closely adjacent species, reducing them to varietal forms. Even on a single colony there is often great diversity, and the impression of great lability is increased when we compare different specimens of the same species collected on the same date from the same locality.—J. A. T.

millimetres, as follows:—1·05 × 0·56; 0·55 × 0·06; 0·73 × 0·04; and 0·47 × 0·05. The longest reach a length of 1·7 millims., 1·6 millims., and 1·5 millims.

The specimens differ markedly from all the previously described species of this large and difficult genus.

Locality:—Station LXVI., off Mutwal Island, 10 to 35 fathoms; Cheval Paar, Gulf of Manaar.

Spongodes bicolor, WRIGHT and STUDER.

This species is represented by a fairly large complete colony, which consists of a short trunk and a long head, formed by a large number of branches given off on all sides. The base is formed of numerous rhizoid-like offshoots, which are attached to grains of sand, to sponge spicules, and to particles of shells.

The stem is soft and flaccid, and gives off flabby branches on all sides. The majority of the lower branches are flattened, the flattening taking place not from above downwards but from side to side.

The stem and branches have thin semi-transparent walls with numerous fine spicules scattered all over, some of them projecting so as to give the surface a pubescent appearance. The measurements of the polyps and of the spicules agree with those given by WRIGHT and STUDER (1889).

Locality:—Deep water off Galle.

Spongodes bicolor, WRIGHT and STUDER, var. **ceylonensis**, n.

The trunk of this specimen is very short, and does not seem to be distinctly marked off from the stem except in the spiculation.

Small branches are found coming off to within a few millimetres of the lower end of the trunk. The spicules are more distinct in the stem and give a net-like appearance to its surface, while the surface of the trunk is granular.

Two of the lower branches are flattened from above downwards and nearly surround the stem, but just below the two spaces left between them there are two ordinary branches.

The polyps are red, with white tentacles, and a "Stützbündel" spicule projects behind each polyp.

The colour of the trunk, stem, and branches is a yellowish-white, that of the polyps and twigs being red; the lower part of the twig may be yellowish.

This form differs from *Spongodes bicolor* in several respects, but yet comes very near it.

Spongodes bicolor, WRIGHT and STUDER, var. **dubia**, n.—Plate V., fig. 13.

Another variety is represented by a specimen measuring 71 millims. in height and 61 millims. in maximum breadth. It may be a portion of a larger colony or an entire colony in which the base is wanting.

The stem is flaccid and gives off branches almost to the base, the lower branches are flattened and give off ordinary branches from their upper surfaces.

The polyps are arranged in umbels of 10 to 13 polyps. The polyps are white, but have a red appearance, owing to the spicules; the tentacles have white or colourless spicules.

The spicules of the stem are long, slender, colourless spindles covered with spines, and varying in length from 1·55 millims. to 0·6 millim., and in width from 0·12 millim. to 0·08 millim. The spicules of the terminal twigs and polyps are slender spindles, yellowish-red in colour and thickly beset with spines. They vary in length from 0·1 millim. to 1·65 millims., and in breadth from 0·02 millim. to 0·09 millim.

As this form agrees in many respects with *Spongodes bicolor*, we have ranked it provisionally as a variety.

Spongodes aurantiaca, n. sp.—Plate I., fig. 9; Plate V., fig. 6.

In this species the trunk is long, stiff, leathery in character, and granular in appearance, but the individual spicules become evident at the upper end.

The stem is divided into two main branches, from which the primary and secondary branches arise. The four lowest branches are flattened from above downwards, and so form a complete collar to the trunk. They are also recurved, so that they hide the upper part of the trunk. Their edges are very much divided, and they carry the polyps singly on the edges. From their upper surface spring ordinary branches. The other branches stand at right angles to the stem, but the upper ones are directed obliquely upwards.

The polyps are borne singly at the ends of the twigs, and also in bundles of 6 to 7, all reaching the same level. They are white in colour and backed by strong "Stützbündel" spicules.

The colony presents a striking appearance, due to the marked contrast between the orange-coloured stem and branches and the white polyps. The trunk is orange-coloured at the upper end, but it gradually becomes a whitish-grey as the lower end is reached.

The "Stützbündel" spicules vary in length from 2·7 millims. to 3·3 millims., while the stem and branch spicules vary from 0·5 millim. to 2·1 millims. in length.

Spongodes rosea, Kükenthal—Plate V., fig. 1.

What we regard as a variety of this species is represented by a stiff colony, with a bare stalk very much shrunken, owing to the large canals and the thin partitions between them. Height of colony, 70 millims.; length of stalk, 22 millims.; diameter of same, 11 millims.

The lower branches, 6 in number, are flattened from above downwards, breaking up at their edges into single polyps and groups of polyps, and giving off cylindrical branches from their upper surfaces. Immediately above these the stem gives off a large branch which repeats the structure of the stem. Over the whole surface of stem and branches smaller branches are given off which also branch.

The colour of the stem is greyish-white below, white above, while the smaller branches are orange-coloured. The polyp-cups are a dark purple-red, the tentacles white.

The surface texture of the specimen presents two quite different aspects. On the bare stalk the surface has a granular appearance caused by the large number of very small closely packed spicules which grow larger as the upper part of the stalk is reached. On the branch-bearing part, and also on the branches, a stringy appearance is produced by the larger spicules.

The polyps occur in bundles of 4 to 8. The projecting spicules are usually red throughout, but sometimes the lower part is yellow. The spicules are as follows :—

(*a.*) *Of polyps and terminal twigs.*—Yellow, or red, or partly yellow, partly red, covered by numerous small spines; Stützbündel, 2·6 millims. × 0·17 millim.; polyp spicules, 0·03 millim. × 0·04 millim.; others, 1·5 millims. × 0·1 millim., 1·7 millims. × 0·12 millim.

(*b.*) Of the stem, upper part.—Similar to those of (*a.*), but the majority are colourless, or very faintly tinged with yellow. Spines more prominent and appear rougher.

(*c.*) Of the bare lower part of stem.—Shorter, thicker, and with more prominent spines than (*a.*) and (*b.*). Spines more numerous and of greater diameter than the above. The spicules of (*c.*) measure 0·76 millim. to 0·69 millim. × 0·16 millim., 0·42 millim. × 0·18 millim., 0·26 millim. × 0·10 millim. Many of the spicules in (*c.*) are in the form of crosses. In several an **X**-shaped marking is seen as if the 4 arms of the cross were dovetailed into one another.

Another specimen similar in appearance to the above has its branching *restricted to one plane.*

In its texture and flattened branches, &c., it agrees with the above. The tentacles are white, but owing to their state of retraction they do not show so much. The base of attachment shows the rhizoid outgrowths frequent in *Spongodes* and allied genera.

While these specimens do not rigidly correspond to the description given of *Spongodes rosea*, the resemblance is too close to warrant separation.

Localities :—Deep water outside pearl banks, Gulf of Manaar; and Trincomalee.

Spongodes armata, HOLM, var. **ceylonensis,** n.—Plate I., fig. 6.

This foliate divaricate colony consists of a cylindrical barren trunk, attached at its base by means of rhizoid outgrowths to sand and fragments of Mussel shells, and a much branched upper portion which forms an irregularly oval-shaped head. Everywhere spicules project, thus giving a spiny appearance to the head portion. The little violet coloured polyp heads contrast well with the orange coloured twigs.

	Specimen A.	Specimen B.
Length of trunk (bare part of stem) .	21 millims.	32 millims.
Diameter of same	10 ,,	13 ,,
Length of head	52 ,,	55 ,,
Maximum width of same	32 ,,	41 ,,

The trunk (or bare part of the stem) has a leathery rigid character and a rough granular appearance. It is slightly thicker at the top, and at its lower end gives off thin rhizoid-like outgrowths. In specimen B these are also given off for a short distance up the trunk.

The stem gives off larger and smaller branches, and divides at the tip into 2 or 3 branches. It appears longitudinally streaked, owing to the disposition of the large spicules. The lower branches are flattened (6 in one, 4 in the other). The others rise at right angles to the stem, the upper ones being directed obliquely upwards. Some of the lower ordinary branches are slightly flattened. The 4 to 6 flat branches are recurved and directed downwards.

Locality :—Deep water off Galle.

Spongodes dendrophyta, Wright and Studer.

This species is represented by several specimens, one of which is evidently a young form. The base of attachment consists of rhizoid-like outgrowths. The lowest branches are flattened from above downwards, and bear the polyps on the edge of the flattened portion. The appearance of the stem in the older specimens is quite granular, but this gives place in the younger form to a slightly stringy appearance, due to the spicules being larger. In the older specimens the polyps are more markedly arranged in bundles, while they have a tendency to stand singly in the younger. Several of the lower branches are colourless, and there is a great variability in the colour of the spicules.

The geographical range of this species is worthy of note, as its previous record is from the Philippines.

Locality :—Gulf of Manaar.

Spongodes splendens, Kükenthal—Plate I., fig. 2.

This species is represented by numerous stiff and rigid colonies. The following measurements are taken from two of them :—

	A.	B.
Length of trunk	29·5 millims.	17 millims.
Diameter of same	13·5 ,,	12 ,,
Length of head	69 ,,	30 ,,
Maximum width of same	61 ,,	40 ,,

The stem in its lower portion is tough and rigid in character and granular in appearance, which in the upper portion gives place to a streaked appearance due to the larger spicules being disposed for the most part longitudinally.

The lowest branches, two in number, are flattened from above downwards, and are bent downwards so as to hide the upper portion of the trunk. The other branches are more or less cylindrical and rise at right angles to the stem, the uppermost being directed obliquely upwards. The secondary branches give rise to the twigs which bear umbels of 6 to 8 divergent stipitate polyps.

The lower portion of the stem has a yellowish-white colour, the upper portion of the stem and the branches are yellow, while part of the twigs and the polyp spicules are brick red to dull red in colour. Several of the spicules consist of a colourless sheath surrounding a central core of a deep yellow to orange-yellow which extends for about half the length of the spicule.

The spicules vary very much in the specimens. The "Stützbündel" spicules vary in length from 2·9 millims. in some to 2·2 millims. in others, and even to 1·5 millims. The stem spicules vary from 0·75 millim. to 2·3 millims. in length, but in one specimen they reach 4·5 millims. in length. The polyp spicules also show considerable variation, but it does not cover such a range as in the others.

Some other specimens correspond more closely than the above do to previous descriptions of this species. It appears to us that many of the species of *Spongodes* are exceedingly variable, and we have therefore refrained from accentuating minor differences.

Locality:—Cheval Paar; pearl banks, Gulf of Manaar.

SUB-FAMILY: SIPHONOGORGINÆ.

Paranephthya pratti, n. sp.—Plate II., fig. 6; Plate V., fig. 18.

A peculiar specimen with only the basal attachment missing was included in the collection. We are indebted to Miss PRATT for a figure and the following notes.

The colony, which is apparently young, is small and measures as follows:—

Height 21 millims.; stalk 15 millims.

Breadth of stalk, 13 millims. to 11 millims., of capitulum, 24 millims. to 20 millims.

The capitulum is lobate, with deep grooves between the digitate lobes.

The lobes (7 in number) are digitate and are comparatively large. The largest is 13 millims. in height by 7 millims. to 5 millims. in diameter. The smallest is 3 millims. in height by 5 millims. to 4 millims. in breadth. Some of the lobes are beginning to branch dichotomously.

The capitula are dotted with minute tubercles, and when observed under the microscope have a curious polyzoon-like appearance. These tubercles indicate the presence of the zooids which are small, degenerate in character, and are so overgrown with minute spicules as to be only slightly contractile. They have apparently only rudiments of tentacles. The mesenteries are crowded with brown cells which are probably zoochlorellæ. In many cases there appears to be no aperture to the exterior.

The colony is extremely hard, the surface being rough and granular to the touch. The colour of the spirit specimen is medium brownish-grey, which becomes deeper towards the base of the stalk.

There is no doubt that this interesting form is near *Paranephthya capitulifera*, Wright and Studer; but it is a quite distinct species.

Chironephthya variabilis, Hickson.

This species is represented by a magnificent specimen, measuring 21 centims. by 20 centims. The base measures 3·5 centims. by 4 centims. There is a very marked "weeping willow" appearance, as almost all the twigs are pointing downwards. This is probably the finest specimen of its kind that has been hitherto obtained. There are also numerous fragments, and one or two specimens which may be complete young forms.

The colour is very variable in the different specimens and even in the different parts of the same specimen. In several fragments the general cœnenchyma is white with red spots here and there on the surface; in others it is yellowish-white with red spots. When the general cœnenchyma is white in colour, a pinkish tinge becomes gradually more marked in the branches until it finally predominates, thus giving the tips of the branches and twigs a deep pinkish-red colour. In the specimens with a yellowish-white general cœnenchyma the pinkish tinge increases as before, but in this case the tips of the branches have an orange colour. In other cases the tips of the branches may be pinkish-red with the projecting edges of the calyces an orange-yellow.

There is also great variation in the colour of the polyp spicules; in some the spicules of the crown and points are red, in others they are yellow, while in others the crown spicules are red and the point spicules orange-yellow. Considerable variation is also found in the measurements of the crown and the point spicules; so great is the range of variation, in fact, that they do not appear to be of any value as a specific distinction. The crown spicules vary in one specimen from 0·24 millim. to 0·5 millim. in length, and the point spicules from 0·3 millim. to 0·55 millim. in length, while in the same specimen the breadth of the crown spicules varies from 0·026 millim. to 0·06 millim.

Locality :—Deep water off Galle; Pearl banks, Gulf of Manaar.

Siphonogorgia pustulosa, Wright and Studer.

Locality :—Ceylon seas.

Siphonogorgia miniacea, Kükenthal.

Locality :—Ceylon seas.

Siphonogorgia köllikeri, WRIGHT and STUDER—Plate I., fig. 7.

Locality :—Deep water off Galle.

In the examination of the specimens in the collection belonging to the genera *Chironephthya* and *Siphonogorgia* the following distinction suggested by HICKSON ("Fauna of Maldives, 1900") has been adopted : "That the name *Chironephthya* be retained for the species or facies with a form and mode of branching resembling that of the genus *Nephthya*, with anthocodiæ rarely completely retracted in preserved specimens and with four principal spicules arranged *en chevron* in the points of the anthocodiæ ; and that the name *Siphonogorgia* be retained for species or facies of more massive *Gorgonia*-like form of growth, with anthocodiæ capable of complete retraction within the general cœnenchym and with spicules irregularly placed or arranged in a *fan-like* manner in the points of the anthocodiæ." While adopting this suggestion we have been impressed by the great similarity of the two genera. There are many reasons for thinking that they ought to be merged in one.

ORDER III. : PSEUDAXONIA.

FAMILY : BRIAREIDÆ.

Solenocaulon tortuosum, GRAY.

The collection includes magnificent specimens of a brilliant red *Solenocaulon*, probably a variety of *S. tortuosum*. We have studied a representative piece about 8 inches in length.

The substantial axis, measuring 5 millims. in diameter at the base of the specimen, is composed of closely packed colourless spinose needles, all of the same type, varying from 0·4 millim. to 1 millim. in length by 0·016 millim. to 0·018 millim. in breadth, and thus much longer than those measured by HICKSON. When boiled with caustic potash the axis remains coherent, but crumbles readily. In a section 20 nutritive canals are seen between the cœnenchyma and the axis across the base of the specimen.

Towards the top of the stem the axis gradually decreases in size and finally disappears. The rest of the stem forms a continuous tube with large lateral openings, the margins of which are prolonged into the slender polyp-bearing branches. These are mainly directed away from the side bearing the axis; they often measure 17 millims. in length by 2 millims. in breadth.

The cœnenchyma of the tubular stem contains (*a.*) colourless needles from 0·4 millim. to 0·7 millim. in length by 0·018 millim. in width, with few and short spines; (*b.*) shorter and broader rods (0·28 millim. to 0·4 millim. in length by 0·06 millim. to 0·07 millim. in width), both coloured and colourless, thickly beset with rough wart-like projections ; and (*c.*) coloured somewhat irregular ovals (0·1 millim. to 0·12 millim. by 0·06 millim. to 0·07 millim.), covered with blunt tubercles. The coloured spicules are pale yellowish-red ; and an orange variety occurs among the other brilliant red specimens.

The polyps are white, and are for the most part restricted to the twigs. A few occur on the stem on the side away from the axis. The polyp-spicules are arranged in a crown with slightly projecting triangular points. Each point consists of about 7 spicules, the longest median one being supported by three on each side. Below these running transversely are the rows of crown spicules. All the spicules are colourless warty spindles, varying in length from 0·2 millim. to 0·6 millim., and in breadth from 0·02 millim. to 0·08 millim. The verrucæ are truncated cones, with a height of 1 millim. to 2 millims., and a basal diameter of 2 millims. A small crab was found in the lumen of the tubular stem.

Localities :—Station LIX., 6 to 9 fathoms ; deep water outside banks, Gulf of Manaar ; Periya Paar, 9 fathoms ; deep water off Galle.

Keröeides gracilis, WHITELEGGE.

This species is represented by a complete colony and several fragments. The complete specimen stands 85 millims. in height, with a maximum width of 56 millims. The verrucæ alternate on the sides of the stem and branches. They are low and conical in shape, 1 millim. in height and in basal diameter. The cœnenchyma is thin, smooth, and filled with large closely packed compound-tuberculated spicules.

The irregularity of the spicules is fairly well marked and agrees with WHITELEGGE'S description. By transmitted light they are of a bright red brick colour.

The spicules are on the whole slightly larger than those of WHITELEGGE'S specimen. The measurements obtained were :—(1) For the spindles, 1·4 millims. to 2·2 millims. in length by 0·2 millim. to 0·5 millim. in width ; (2) Irregularly shaped spicules of verrucæ up to 1·6 millims. in length by 0·5 millim. in width ; (3) Spicules of the axis from 0·3 millim. to 0·6 millim. in length.

With the exception of the slightly larger measurements of the spicules, the specimen approximates very closely to that described by WHITELEGGE (1897), and also to that described by Miss HILES (1899).

Locality :—Deep water off Galle, Ceylon.

Previously recorded from :—Milne Bay, British New Guinea, depth 20 fathoms, and Funafuti, Ellice Islands.

FAMILY : SCLEROGORGIDÆ.

Suberogorgia verriculata, ESPER.

Several incomplete specimens, mostly about 7 centims. by 5 centims., forming networks in one plane. One colony with its base complete has a height of 9 centims. In a portion measuring 5·5 centims. by 3·5 centims., there were 22 complete meshes and 11 incomplete meshes. The meshes differ widely in size, but 7 millims. by 5 millims. is a size which occurs very frequently. The average thickness of branch is 1·5 millims. The colour is brown or drab, and the general texture of the cœnenchyma is granular.

The verrucæ are thickly crowded and occur all round the branches. They project very slightly and have a diameter of 1 millim. They are often separated about 1 millim. from one another. The verruca is a truncated cone, in some cases like a widely open crater, in other cases with eight spiculated lobes projecting inwards like small sepals in an almost open bud. A low-power view shows that there are eight opercular coverings formed from spindle-shaped spicules.

Careful dissection of the included polyp, under low power, shows a cylindrical body with eight vertical external muscle-strands and with a low conical apex. Around the base of this apex there seems to be a ring of horizontally disposed spindles in two or three rows, and from this there arise the eight triangular converging opercular coverings, with spicules more or less at right angles to those of the basal ring. But the specimens were extremely brittle, and the gentlest touch of the dissecting needle almost invariably shivered the microscopic architecture.

The extremely calcareous sclerogorgic axis is densely packed with more or less spindle-like spicules embedded in the matrix of horny fibres. It varies from 1 millim. to 2 millims. in diameter.

The cœnenchyma spicules are mostly minute spindles with numerous regularly arranged blunt tubercles; a common measurement is 0·1 millim. to 0·125 millim. in length by about 0·025 millim. in maximum thickness. There are also minute warty double clubs or capstans, with a very short middle zone and broad disc-like ends; they measure about 0·025 millim. by 0·02 millim. Some of the spindles have very few tubercles.

We have given these details to supplement the previous descriptions of *Suberogorgia verriculata*, to which, we believe, these specimens must be referred.

Locality :—Deep water off Galle.

Another specimen is 281 millims. in height and 134 millims. in maximum breadth, but this does not represent the full size of the specimen, as a part has been broken off the main stem. The branching is confined to one plane, and there is a very complete anastomosis of the branches, thus giving rise to a fine reticulate fan-shaped colony. The chief branches rise at an acute angle and are directed upwards, and assume a position roughly parallel to the main stem. The tips of the branches are clavate.

The polyps come off from all sides of the stem and branches and appear to be spirally arranged in some parts. They are completely retractile, and in the specimen they are all withdrawn within the small verrucæ.

The spicules are small spindles with prominent rough warts, larger spindles and minute double wheels or capstans. The measurements length by breadth in millimetres are as follows :—

Capstans, $0{\cdot}037 \times 0{\cdot}02$; $0{\cdot}035 \times 0{\cdot}02$; $0{\cdot}03 \times 0{\cdot}02$.

Slender spindles with few warts, $0{\cdot}09 \times 0{\cdot}018$; $0{\cdot}15 \times 0{\cdot}02$; $0{\cdot}10 \times 0{\cdot}03$.

Other spindles, $0{\cdot}10 \times 0{\cdot}03$; $0{\cdot}12 \times 0{\cdot}037$; $0{\cdot}16 \times 0{\cdot}045$.

The axis measures 6·4 millims. in diameter at the base.

We were at first inclined to record this specimen as a new species of *Suberogorgia*, but further study has convinced us that it is only a variety of *S. verriculata*.

[*Note.*—FAMILY: CORALLIIDÆ. RIDLEY reported with some hesitation the alleged occurrence of a specimen of *Corallium rubrum* on the Ceylon shore. It is interesting, therefore, to record that Professor HERDMAN found in deep water (34 fathoms) off Galle a specimen which he named *Corallium* (?). It was scarlet in colour, with yellow polyps, and measured about an inch in length. The sketch in his note-book suggests a young specimen of the noble coral, but the unsatisfactory point is that the specimen has not been found in the collection.]

ORDER IV.: AXIFERA.

FAMILY: PRIMNOIDÆ.

Primnoa ellisii, VON KOCH.

This beautiful species is represented by two specimens, the larger of which measures 68 millims. in height by 39 millims. in maximum width. The specimens agree with the description given by VON KOCH (1890), and the measurements obtained are in *absolute* accord with those given by him.

The geographical distribution of the species is interesting, ranging as it does from the Mediterranean to the Andaman Isles. The exact localities from which it has been recorded are: The Gulf of Naples and the coast of Sardinia in the Mediterranean; deep water off Galle, Ceylon; and the Andaman Sea, 275 to 45 fathoms (ALCOCK'S "Investigator" Collection).

Acanthogorgia media, n. sp.—Plate II., fig. 8; Plate III., fig. 7.

The specimens are similar to *A. ridleyi* in mode of branching and in the arrangement of the polyps but they are like *A. muricata*, HILES, in the disposition of the spicules on the calyces. But they do not seem referable to either species, or to any other whose description is known to us. In the figure on Plate III. the gracefulness of the colony has been inadequately represented.

The dimensions of the polyps are as follows:—

Height	1·3 millims.	1·1 millims.	0·8 millim.
Diameter at base . .	0·95 millim.	0·95 millim.	0·7 „
„ „ apex . .	0·8 „	0·8 „	0·6 „

The polyps and the cœnenchyma of the stem and its branches have many projecting spicules. Round the apex of the polyp a number of spicules project. The polyps are arranged in some parts opposite one another, in other parts spirally. The arrangement is complicated by the interpolation of smaller polyps between the older ones. The branching is irregular and not confined to one plane. On the whole, the branching is alternate. The distances between branches varies from 8 millims. to 2 millims., and even to 1 millim. The axis measures 0·35 millim. in its thickest part, is brownish-yellow in older, yellow in younger portions, and is chambered. The spicules are long slender spindles, with few warts, and tri- and quadri-radiate stars. Among the spicules a considerable number are seen with an abrupt bend and one arm long in comparison to the other (golf-club-like). In these there is a poor development of the warts, the long shaft being free from the warty protuberances for a considerable portion of its length, while the short head has a good number of rough warts.

The spicules measure, length by breadth, in millimetres :—

Projecting opercular spicules, 0·4 × 0·05 ; 0·45 × 0·04 ; 0·4 × 0·045.

Ordinary spindles, 0·5 × 0·036 ; 0·3 × 0·04 ; 0·6 × 0·045.

Quadri-radiate forms, 0·25 × 0·15 ; 0·25 × 0·02 ; arms about 0·1 millim. in length.

Tri-radiate forms, 0·3 × 0·25 ; the arms being about 0·12 millim. in length. Some apparently sex-radiate and quinque-radiate forms occur.

Locality :—Trincomalee.

Acanthogorgia muricata, VERRILL, var. **indica**, n.—Plate IV., fig. 11.

As a variety under this species we rank a beautiful complete colony, which has a height of 78 millims. and a maximum width of 105 millims.

The basal attachment is a flat spreading portion from which the main stem rises.

The axis is dark brown in colour, fading to a light yellow in the younger part. It is covered with close set furrows at the base, and at that point has a diameter of 3 millims., but it becomes extremely thin at the ends of the branches. The branching is very profuse and is confined to one plane, but the type of branching gives the main stem a slightly zig-zag arrangement.

The calyces are densely crowded all round the stem and branches. They measure from 2·5 millims. to 3 millims. in height and have a basal diameter of 0·9 millim. and a width of 1·1 millims. to 1·2 millims. at the crown. At the free end of the calyces there are 8 projecting spicules. The cœnenchyma on the stem and branches is very thin.

The specimen comes near *Acanthogorgia spinosa*, but differs from it in having only 8 single projecting spicules, while *A. spinosa* has 8 groups of 2 or 3. The spicules also differ slightly. It agrees closely with *A. muricata* except for slight differences in the polyps and spicules. The species *A. muricata* illustrates wide distribution ; it has been previously recorded from Barbados and Funafuti. See HILES (1899), p. 48.

Locality :—Trincomalee.

Acanthogorgia ceylonensis, n. sp.—Plate IV., fig. 6 ; Plate V., fig. 12.

This species is represented by one specimen which measures 55 millims. in maximum height and 30 millims. in maximum width. The branching is both alternate and opposite and is confined to one plane. The polyps are arranged in threes or in twos or in loose spirals. The verrucæ vary in height from 0·6 millim. to 0·7 millim. and are placed at intervals of about 1 millim. The spicules are arranged on the verrucæ in 8 rows *en chevron*. The figure (Plate IV., fig. 6) is unfortunate in exaggerating the thickness of the stem and branches.

The spicules are of two types: (1) spindles which vary in length from 0·5 millim. to 0·6 millim. and have an average diameter of 0·04 millim.; and (2) quadri-radiate forms which measure length by breadth in millimetres as follows: 0·08 × 0·06, 0·13 × 0·12, 0·14 × 0·12. We have been unable to refer this specimen to any of the described species.

Locality :—Trincomalee.

Astromuricea ramosa, n. sp.—Plate I., fig. 8; Plate V., fig. 17.

A beautiful deep crimson colony, 8 centims. in height by 4 centims. in maximum breadth, but lacking its basal portion. Most of the numerous branches spread out laterally, but a few project forwards and a few backwards. Most of the branches arise at an acute angle and rapidly attain a vertical direction, giving off short secondary branches, almost always to the outside. The almost uniform thickness is 2 millims.; there is a slight swelling at the tips.

The surface of the cœnenchyma is rough with stellate spicules; the slightly prominent verrucæ (about 1 millim. in diameter) occur all round the axis; from their summits the yellowish polyps are projecting (about 0·5 millim. in diameter). The horny axis is bright yellow, with apparent longitudinal striation; it has a basal diameter of 1 millim.

The crimson spicules are mostly irregular, warty stars, with 4, 5, 6, or more rays. Some of the measurements taken are 0·2 millim. by 0·15 millim.; 0·2 millim. by 0·2 millim.; 0·3 millim. by 0·3 millim.; 0·3 millim. by 0·2 millim.

There are some irregular triangles, numerous discs, too irregular to be called stellate, and some small double wheels.

A few straight or curved spindles of diverse dimensions occur, 0·3 millim. by 0·03 millim.; 0·4 millim. by 0·05 millim.; 0·25 millim. by 0·1 millim.; 0·2 millim. by 0·025 millim.

The species is nearly related to *Astromuricea theophilasi*, Germanos, but is quite distinct. There is superficial resemblance to *Echinogorgia pseudosasappo.*

Locality :—Off Patani (Annandale and Robinson).

Echinomuricea indo-malaccensis, Ridley.

This species is represented by a single specimen, from the upper part of which the cœnenchyma has been rubbed off. The specimen measures 57 millims. in total height.

The basal attachment consists of a flat, spreading portion, from which the stem arises. The axis is dark in colour in the older parts, but becomes lighter in the younger branches. Branches arise from all sides of the larger branches, but the primary branches arise from the stem in one plane. The arrangement of the branches gives the colony a bushy appearance.

The specimen agrees closely with the description of *Echinomuricea indomalaccensis* given by RIDLEY (1884). There are several differences, however, thus (1) the verrucæ in this specimen are fully twice as long as in RIDLEY'S, they measure 0·8 millim. instead of 0·3 millim. in height; (2) the verrucæ spicules with ramifying basal portion vary in this case from 0·7 millim. to 0·9 millim. in length instead of a maximum length of 0·65, as given by RIDLEY. For discussion of four known species, see HEDLUND (1890), pp. 14 and 15.

Locality :—Pearl banks, Gulf of Manaar.

Previously recorded from Port Curtis, 5 fathoms to 11 fathoms; Port Molle, 12 fathoms to 20 fathoms; Warrior Reef, Torres Straits, Australia.

Echinomuricea ceylonensis, n. sp.—Plate VI., fig. 6.

Colony much branched in one plane, 11 centims. in height by the same in breadth at its broadest part. The colour is reddish-chocolate to crimson. The polyps may occur all round the branches, but in one specimen they are absent from the concave side of the plane of ramification. There is no regularity in the manner in which the branches arise from the stem. The verrucæ, which project almost at right angles, are about 1 millim. in height. The whole surface of the verrucæ and of the branches is rough with the sharp projecting points of crimson spicules, which are sometimes imbricating. Within the verruca cup there is a distinct special cone of tapering spicules forming an opercular covering. The polyps are entirely retracted. The horny axis is almost black at the base, about 1 millim. in breadth; it tapers to a breadth of 0·35 millim. near the tips of the twigs, where it shows a horny yellow colour. The cœnenchyma is relatively thin. The following types of spicule occur :—

(*a*) Numerous roughly triradiate forms, with a usually tuberculate main spine and with irregular foliaceous and ramifying expansions connecting the two other rays; 0·3 millim. to 0·5 millim. in length by 0·275 millim. to 0·3 millim. in breadth at base are common measurements; (*b*) irregular approximately stellate forms; and (*c*) curved spindles and boomerangs bearing a few tubercles and spines and sometimes forked or irregularly trifid at one end.

Locality :—West of Periya Paar.

Echinogorgia pseudosassapo, KÖLLIKER.

A single specimen of a crimson-red colour. It rises from a spreading base, about 15 millims. by 5 millims., and consists of two branches, about 50 millims. and 20 millims. in height. The longer branch gives off a branch at its base and another a third of the way up; the shorter branch gives off a branch near its end. The diameter varies from 2 millims. to 3 millims. It is probably a young specimen.

The surface is very rough owing to the sharp projecting points of the large spicules.

There are practically no verrucæ. The polyps appear yellowish, and the mouth is seen in most cases as a very precise oval aperture.

The red spicules are very variable :—

(1.) Fusiform, pointed at both ends, with distant tubercles; common lengths are 0·2 millim., 0·3 millim., 0·4 millim.

(2.) Larger fusiform, with tubercles and a few teeth, up to 0·7 millim.

(3.) Large and variable "Blattkeulen," often roughly triangular, with a shaft often divided into tubercled branches and a foliar expansion with 2 to 5 teeth; some measure 0·6 millim. in length.

(4.) Irregular stellate forms, with transitions to irregular discs; 0·2 millim. by 0·3 millim. is a common size.

(5.) Triradiate to hexradiate forms, with transitions to the stellate type.

The spiculation is not quite in agreement with the description and figures given by WRIGHT and STUDER, but the differences do not seem important.

Echinogorgia multispinosa, n. sp.—Plate VI., fig. 1.

An imperfect colony, branching irregularly in one plane without anastomosis, 11 centims. in height by 6 centims. in breadth. The horny axis measures 3·5 millims. in diameter at the base. Some of the twigs bear galls. The surface of the cœnenchyma is finely granular and of a cream-white colour. Verrucæ occur mostly on the sides of the branches, and are almost quite absent from the convex surface of the plane of ramification. In some regions they are crowded, almost touching one another, in other parts they are separated by intervals varying from 2 millims. to 4 millims. A few spines project slightly round the margin of the verruca opening, and there is an opercular covering with small spicules arranged in eight rays. Under low power the surface is seen to be uniformly covered with what seem to be tuberculate spindles irregularly arranged. When these spindles are examined an extraordinary diversity of form is disclosed.

(1.) Large tuberculate or spiny spindles, straight or curved, 0·4 millim. in length by 0·1 millim. in maximum breadth; some show a prominent spine on one side.

(2.) Small tuberculate spindles, 0·2 millim. by 0·05 millim.

(3.) Small almost smooth spindles, 0·2 millim. in length by 0·05 millim.; 0·3 millim. by 0·05 millim.; 0·275 millim. by 0·04 millim.

(4.) Slender boomerangs, 0·35 millim. by 0·05 millim.

(5.) Irregular tuberculate and denticulate clubs, 0·4 millim. by 0·2 millim.; 0·45 millim. by 0·15 millim.

(6.) Foliate clubs, 0·4 millim. in length by 0·2 millim. at broadest part; 0·3 millim. by 0·2 millim.; 0·275 millim. by 0·2 millim.

(7.) Irregularly-shaped warty scales with denticulate margins, *e.g.*, 0·3 millim. by

0·2 millim.; 0·25 millim. by 0·2 millim.; 0·2 millim. by 0·2 millim.; 0·25 millim. by 0·15 millim.

(8.) Almost stellate scales, 0·25 millim. by 0·25 millim.; 0·15 millim. by 0·15 millim.

(9.) Warty triradiate forms, 0·25 millim. by 0·2 millim.; 0·2 millim. by 0·13 millim.; 0·2 millim. by 0·2 millim.

(10.) Tetraradiate forms, 0·23 millim. by 0·1 millim.; 0·25 millim. by 0·15 millim.

The variety of spicules is greater than we have seen in any other Alcyonarian.

Heterogorgia verrilli, n. sp.—Plate VI., fig. 2.

A handsome branched colony, greyish-black in colour, 20 centims. in height by 8 centims. in maximum breadth. The short common stem, from which two main branches arise, is 5 millims. in diameter. The branches are generally alternate, and there is a tendency to swelling at the tips of the twigs. The surface of the cœnenchyma appears granular and bears many sponge spicules. The verrucæ are usually, but not constantly, disposed on the sides of the branches; they are conical warts under 1 millim. in height. In some cases the upper part of the anthocodia protrudes from the cone, and is seen to bear spindle-shaped spicules. In the retracted state a whorl of spindles is seen projecting vertically outwards within the margin of the crater-like verruca. The characteristic spicules of the cœnenchyma are more or less regular, bluntly tuberculate crosses of varying dimensions, *e.g.*, 0·1 millim. by 0·1 millim.; 0·2 millim. by 0·2 millim. There are also tuberculate double clubs and rough discs of various sizes, like crosses with the arms scarcely discernible.

The specimen, apparently a Muriceid, is very difficult to locate; we have referred it to VERRILL's genus *Heterogorgia* ('Am. Journ. Sci.,' xlv. (1868), p. 413).

Bebryce hicksoni, n. sp.—Plate III., fig. 1; Plate VI., fig. 9.

An imperfect specimen, irregularly branched in one plane, about 6·5 centims. in height by 6·5 centims. in breadth. There are four branches, measuring about 2 millims. to 2·5 millims. in diameter, which is thicker than the main stem at its base (1·5 millims.). There is distinct flattening of the branches and twigs. The cortex has a smoothly granular punctate appearance and a greyish-white colour. The verrucæ, which are disposed mainly on the sides of the branches and twigs, usually with intervals of 2 millims. to 2·5 millims. separating an adjacent pair on the same side, are truncate rounded cones, crater-like when the polyps are dislodged. In many cases the anthocodiæ of the polyp project at the apex of the cone, and are supported by triangular strands of small spicules longitudinally and transversely disposed. Under low power the superficial spicules appear like rounded grains of sand or like fish-roe, each grain appearing as if it had a clear nucleus surrounded by a whitish rim. Higher magnification shows that there are multi-lobate warty spheroidal discs, some of which show a short central boss projecting inwards; the diameter of the disc varies considerably, 0·1 millim., 0·15 millim., 0·2 millim., and 0·25 millim.

In some cases the boss is borne on a distinct stalk, and this type measures 0·25 millim. in height by 0·2 millim. in the diameter of the disc. Some small spicules are capstan-like, double clubs in fact, and various transitional forms show a gradual reduction of one-half of the capstan till only a boss is left, or not even that.

In the polyps there are curved tuberculate spindles, 0·25 millim. in length.

The spicules are so characteristic that we have no hesitation in referring this specimen to the genus *Bebryce*, and it cannot be identified with *B. mollis*, VON KOCH (1887), or *B. studeri*, WHITELEGGE (1897), or *B. philippii*, STUDER. HICKSON has reported *Bebryce*, sp. (?) from the Maldives; *B. mollis* is Mediterranean; *B. studeri* was obtained at Funafuti; *B. philippii* from the Arafura Sea—a remarkable distribution.

This seems to be a somewhat variable species, and the five specimens obtained differ considerably in general appearance, in the degree of prominence assumed by the verrucæ, in their distance apart, and in the shapes and sizes of the spicules. In all cases, however, the characteristic *Bebryce* spicules are unmistakable.

In a fragment of a greyish colour, 23 millims. in length, with two short branches, the verrucæ are usually about 1 millim. apart, along one line, and seem to occur equally all round the branches. Their diameter is 1 millim., and that of the light brown non-calcareous axis is the same.

We made a study of two other specimens. The more complete of the two represents a young colony, the other is a fragment of a large colony. In both the branching is confined to one plane, the branches and twigs being given off at an angle which varies little from a right angle. The branches grow out for a short distance in this direction and then bend upwards.

The tips of the twigs and the branches are clavate, but in one or two cases they are flattened. The two specimens present a greenish appearance, due to the presence of a siliceous sponge on the branches. The sponge has covered each branch with a thick coating, through which the tips of the verrucæ are seen. The spicules of the sponge are monaxonial and are oxytylotes.

The general cœnenchyma is thin and granular in appearance, and is composed of small spherical or irregularly oval bodies covered with numerous rough warts. There are also some more definite spindles, but they are very few in number.

The axis is horny and black in the lower parts, becoming lighter in colour in the twigs and younger portions of the branches. The axis is marked by irregular ridges and has a core of lighter coloured material. This core diminishes in size with the age of the portion of the axis. It is crossed by a number of bands, thus appearing to be chambered, and a longitudinal section shows a number of curved lamellæ crossing the core at about equal distances.

The verrucæ occur in the younger portions on all sides of the twigs and branches, but in the older portions they are confined more or less to the lateral faces. They are small and seem to be conical in shape. After carefully cutting away the sponge, we found that the verrucæ were conical and truncated.

There is no differentiation between the spicules of the general cœnenchyma and those forming the verrucæ; in both cases they are mostly oval or spherical discs covered with rough warts and sometimes with an internal boss. There are also some rough warty spindles. The spicules measure, length by breadth in millimetres, as follows:—

(1.) Globular discs, 0·1 × 0·1; 0·14 × 0·14; 0·14 × 0·08; 0·11 × 0·105.
(2.) Spindles, 0·26 × 0·038; 0·12 × 0·025; 0·16 × 0·03.

The colour of the colony when devoid of the sponge is a greyish-white.

Acamptogorgia atra, n. sp.

This species is represented by a complete colony, measuring 211 millims. in height and 98 millims. in maximum width.

The axis is horny, almost black at the base, but light brown in the younger branches. The stem is almost of the same diameter throughout its whole length. It measures 4 millims. in diameter at the base and 3·9 millims. at the tip of the main branch. The branching is confined to one plane. The branches arise at a right angle, but soon turn upwards and run roughly parallel with the main stem.

The polyps are restricted to the lateral edges of the stem and branches, but here and there they appear either on the back or on the front. They stand out almost perpendicularly to the stem and branches at intervals of about 2 millims. Each branch bears close to its tip 3 or 4 polyps, none of which can be said to occupy the end of the branch.

The colony is black in colour, though it presents a greyish appearance owing to its being closely coated with a sponge.

Locality:—Ceylon seas.

Acamptogorgia spinosa, Hiles.

This species is represented by several colonies, two of which give the following measurements:—

	(A.)	(B.)
Height of colony	76 millims.	74 millims.
Maximum width of same . .	39 ,,	42 ,,

A finer, but much weathered specimen afterwards found in the collection measured 15 centims. by 15 centims.; it was branched in one plane and showed much anastomosis.

The polyps on the branches vary from 0·6 millim. to 0·7 millim. in length and from 0·5 millim. to 0·6 millim. in diameter. In a few of the polyps a height of 0·9 millim. may be reached. The spicules in the present specimens are slightly larger than in

Acamptogorgia spinosa, but even then the relation of length to breadth is almost the same. The specimens agree with *Acamptogorgia spinosa* in axis, colour, and thickness, and in the chambered central core. For description, see HILES (1899).

Locality :—Deep water off Galle.

Acamptogorgia spinosa, var. **ceylonensis**, n.—Plate I., fig. 1.

This variety is represented by one complete colony and a colony in which the base is wanting. The complete colony has the following measurements :—Maximum height 114 millims. and maximum breadth 176 millims., while the incomplete one measures 154 millims. in maximum height and 142 millims. in maximum width. The colony is fan-shaped, caused by the profuse branching which is strictly confined to one plane. Anastomosis of the branches is, however, common.

The stem is dark in colour near the base, but gradually becomes lighter in the younger parts of the stem and branches. The axis in the stem and principal branches is oval in shape, the longest diameter being perpendicular to the plane of branching, but it gradually becomes more cylindrical in shape in the younger branches and in the younger part of the stem.

The cœnenchyma is thin and allows the axis to shine through ; it presents a very rough appearance under the lens.

The verrucæ are arranged on three sides of the axis, they have a series of spines projecting round the mouth, and have a maximum height of 0·8 millim. and a maximum diameter of 0·6 millim.

A few expanded polyps were found at the end of a branch, but almost all were withdrawn within the verrucæ and showed a tentacular operculum, conical in shape, formed by the spindle-shaped spicules which lie on the aboral surface of the tentacles.

The spicules are (1) triradiate, with large irregular processes in the angles which often fuse, thus leaving plate-like portions with perforations ; (2) a modified form of the triradiate with a long arm, which gradually thickens and then gives off two smaller arms from the thicker end ; and (3) spindles and club-shaped half-spindles, curved or straight, either with very rough projections or fairly smooth.

Locality :—Deep water off Galle.

Acis indica, n. sp.—Plate II., fig. 3 ; Plate V., fig. 7.

The colony is large and fan-shaped, rising to a height of 149 millims. and having a maximum width of 167 millims. From a conical base, which has a flat spreading margin and is attached to a mass of worm-tubes, the short main stem arises. At a distance of 14 millims. from its origin, where it has a diameter of 3·5 millims., it divides into two principal branches. The branching is for the most part confined to one plane, but several of the smaller branches and twigs arise at right angles to the principal plane of branching. The branching is very profuse and at several points shows anastomosis of the branches, but this is by no means common. The branches are cylindrical, but there are traces of slight flattening in the plane of branching. The twigs arise usually at right angles to the branches, and their tips as well as those of the branches are slightly clavate.

The polyps are small and are scattered over the whole surface of the stem and branches. In no place can it be said that they are confined to three surfaces, nor can any attempt at lateral arrangement be seen. The verrucæ are very small and the polyps can be completely retracted within them. The edges of the verrucæ show a variable number of spines which project above the slightly conical operculum formed by the tentacular spicules when the polyps are withdrawn.

The superficial cœnenchyma of the stem and the branches presents a striking appearance, due to the arrangement of the large flat whitish spicules and to their being outlined against the darker ground-colour of the stem and branches.

The spicules of the general cœnenchyma are flat and multituberculate, varying very much in size and shape. The tubercles are low and rough and very numerous. Many of the larger spicules extend the whole distance between two adjacent polyps, and sometimes even exceed this length. They fall into three groups, fairly distinct in shape: (*a*) large modified fusiform spicules, which taper more or less towards the ends and measure from 0·9 millim. to 3 millims. in length by 0·25 millim. to 0·45 millim. in breadth; (*b*) squamous or scale-like spicules, often with slightly lobed margins, which measure from 0·8 millim. to 1·1 millims. in length by 0·4 millim. to 0·6 millim. in breadth; and (*c*) large modified squamous spicules, consisting of a flattened tuberculate basal portion and of a projecting part which forms the projecting spine of the verrucæ. They measure, in length by breadth in millimetres, as follows:—$0{\cdot}7 \times 0{\cdot}5$; $0{\cdot}6 \times 0{\cdot}4$; $0{\cdot}5 \times 0{\cdot}3$.

In the polyps there are slender spindle-shaped and club-shaped spicules. They are often slightly curved and either taper to both ends or are blunt and rounded at one end and pointed at the other. Many of these exhibit fairly prominent spines towards the thicker end. They vary considerably in size, being from 0·3 millim. to 0·5 millim. in length and from 0·02 millim. to 0·06 millim. in breadth. They are found chiefly in the tentacles, where they form an operculum to the retracted polyp; but an incomplete and irregular crown or collar is formed by them at the base of the tentacles.

In colour the spicules vary from white to semitransparent, while the whole colony has a whitish-brown appearance.

This species differs from *Acis pustulata* in not having violet-coloured opercular spicules and in the branches not being compressed in the plane of branching. It also differs from *Acis orientalis* in having the polyps on all sides of the stem and branches and in the branching not being confined to one plane.

Locality:—Deep water off Galle.

Acis alba, n. sp.—Plate III., fig. 9; Plate V., fig. 4.

This species is represented by a complete colony which gives the following measurements:—Height of colony, 127 millims.; maximum width of same, 115 millims.; diameter of axis at base, 2·5 millims.

The basal attachment consists of a flat plate-like expansion from which the main stem rises. The stem reaches a height of 26 millims. and then divides into two principal branches, but branching is represented between this point and the base by a stump. The branches are given off at an angle which closely approaches a right angle; they soon turn upwards, however, and run roughly parallel to the main branches. The tips of the branches and the twigs are sometimes slightly clavate. The colony presents a fan-shaped appearance, due to the branching being strictly confined to one plane.

The axis is horny, greyish-black in colour in the older parts, and amber-yellow in the twigs and younger portions of the colony. It is cylindrical and marked by a number of irregular ridges in the lower part.

The polyps occur on all the faces of the stem and branches, and are arranged so that they give the appearance of three or four irregular lines. The verrucæ are small, slightly conical in shape, with a blunt tip and fairly wide base. They are covered by spicules similar to those of the cœnenchyma. In several cases a verruca seems to occupy the tip of a branch or twig.

The general cœnenchyma is thin and granular in appearance, the surface appearing scaly owing to the arrangement of the large flat spicules.

The spicules appear to be in two layers, the outer consisting of thick irregularly shaped flattish spicules, closely covered with rough warts, while the inner layer consists of spindles often with blunt ends and more irregularly formed spicules. The measurements, length by breadth in millimetres, are as follows:—

(1.) The outer layer, $0·48 \times 0·23$; $0·5 \times 0·4$; $0·43 \times 0·29$; $0·45 \times 0·2$; $0·2 \times 0·1$.

(2.) The inner layer, $0·25 \times 0·07$; $0·18 \times 0·05$; $0·22 \times 0·08$; $0·14 \times 0·04$; $0·12 \times 0·04$.

The appearance of two layers may be due to the fact that the flattish spicules are thicker and so stand up above the level of the other spicules. If this be so, then the spicules are in one layer only.

Towards the base of the tentacle on the aboral surface two slender converging spicules are present and at their base one or more transversely placed, thus giving a triangular arrangement of spicules at the base of each tentacle.

Galls are present on several of the branches, mostly caused by cirripedes.

The colour of the colony is greyish-white.

Localities:—Trincomalee; deep water off Galle.

Acis ceylonensis, n. sp.—Plate VI., fig. 3.

A small specimen, 4 centims. in height, with five branches, three of which are broken. The stem measures 2 millims. in diameter at the base and is scarcely reduced in thickness higher up. Verrucæ occur all round and have the form of truncated cones, about 0·5 millim. in height and about 1 millim. in diameter at the base. The intervals between them vary greatly, from 2 millims. to almost nil. The surface is covered with pebble-like spicules predominantly oval in shape and neatly fitted together like a mosaic of rounded fragments, which show almost no trace of overlapping or imbrication. Smaller oval scales occur outside the verrucæ and spindles project very slightly from within.

The large cœnenchyma spicules are mostly warty irregular ovals, but some are almost rectangular and others are like flint axe-heads.

They give the following measurements in length and breadth in millimetres :— 0·55 × 0·35 ; 0·5 × 0·32 ; 0·4 × 0·3.

Various kinds of spindles occur : (*a*) large thick forms, very warty, measuring 0·3 millim. by 0·15 millim., 0·45 millim. by 0·175 millim. ; (*b*) long thin curved or straight forms, with smaller tubercles or almost smooth, measuring 0·5 millim. by 0·03 millim., 0·45 millim. by 0·03 millim. ; and (*c*) minute warty spindles, 0·06 millim. by 0·02 millim. ; 0·08 millim. by 0·02 millim.

Besides these forms there are others which approach the club-type, and are probably modifications of the large spindles.

Locality :—Deep water off Galle.

Acis ceylonensis, n. sp., var. **imbricata,** n.

Another specimen, measuring 4 centims. in height, with only hints of branches, showed a general superficial resemblance to *Acis ceylonensis*, n. sp., except that the large cœnenchyma spicules were much less regular in form and were much imbricated. An examination of the spicules showed the following forms :—

(1.) Large, modified fusiform, elaborately tuberculate, of very various dimensions, *e.g.*, 0·5 millim. by 0·25 millim. ; 0·65 millim. by 0·4 millim. ; 1 millim. by 0·5 millim. ; without the monticular prominences characteristic of *Acis orientalis*.

(2.) Large rounded or almost oblong tuberculate scales, of various dimensions, *e.g.*, 0·35 millim. by 0·4 millim. ; 0·5 millim. by 0·45 millim.

(3.) Tuberculate clubs, with the ends often much swollen, often 0·45 millim. in length by 0·2 millim. in maximum width ; 0·35 millim. in length by 0·2 millim. in maximum width.

(4.) Tuberculate spindles, about 0·35 millim. to 0·4 millim. in length by 0·1 millim. in breadth, some 0·25 millim. in length by 0·05 millim. in breadth.

This specimen obviously differs markedly in the details of its spiculation from that which we have named *Acis ceylonensis*, but it may be sufficient to erect a variety within the species. Until more data accumulate it seems quite impossible to tell how far marked differences in spiculation can be relied on as specific.

Locality :—Trincomalee.

Acis orientalis, Ridley.

This species is represented by three complete specimens, of which the largest measures 136 millims. in height by 86 millims. in maximum breadth. The specimens agree with the description given by Ridley [1882 (II.), pp. 126–128].

The terminal branches reach a length of 45 millims. to 50 millims., and the tips of the branches and twigs are clavate, measuring 3·5 millims. to 4 millims. in diameter, and are occupied by three polyps.

The axis measures 3 millims. at the base, but in branches which have a diameter of 2·6 millims. it measures only 0·5 millim. or 0·45 millim. in diameter.

The spicular measurements agree very closely with those given by Ridley (1882), the differences being so slight as not to be of any importance. We may perhaps, having found other Ceylonese species of *Acis*, quote Ridley's note :—"The occurrence of this otherwise West-Indian genus in the Indian Ocean, and in its western portion in particular, has a peculiar significance for the student of geology, as showing that a communication probably existed between these two areas at a period later than that at which the genus was differentiated from the main stem of the family."

Locality :—Deep water off Galle.

Previously recorded from Mauritius, 80 fathoms.

Muricella ramosa, n. sp.—Plate III., figs. 2 and 3.

The colony is branched in one plane, and forms a beautiful network with abundant anastomoses. The branches and twigs are given off, sometimes opposite, sometimes alternate, at an angle which varies little from a right angle. One of the specimens, though not complete, measures 170 millims. in height and 273 millims. in maximum width.

The axis is black in colour in the lower part, but becomes brownish-yellow in the tips of the branches and in the twigs. It is rather irregular in shape, being somewhat oval shaped, the longer diameter being at one place in the plane of branching, at another place at right angles thereto. The general cœnenchyma is thin and practically composed of warty spindles which may be either straight, curved, or slightly **S**-shaped.

The verrucæ are small and vary greatly in appearance. A number of spicules horizontally arranged form the lower part of the verruca, and a number of longitudinally disposed spicules form the upper part. The appearance of the upper set of spicules varies according to the stage of retraction of the anthocodial part of the polyp. The spicules composing the verrucæ do not differ from those of the general cœnenchyma except in size. They are smaller, but are as closely covered with warts as the other spicules.

The polyps are arranged on the stem and branches in what appear to be short spirals, but on some of the twigs they assume a more or less bilateral disposition.

The spicules are thick spindles, either straight or curved, or slightly **S**-shaped, covered with numerous rough warts. Their measurements, length by breadth in millimetres, are as follows:—$1·6 \times 0·2$; $0·8 \times 0·14$; $1·3 \times 0·2$; $0·9 \times 0·16$; $0·25 \times 0·06$; $0·1 \times 0·02$; $2·1 \times 0·26$.

In the complete colony the outer spicules *often stretch the whole distance between the polyps.* In certain conditions of the polyps there appear to be 8 projecting spicules on each calyx.

Localities:—Deep water outside pearl banks, Gulf of Manaar; and deep water off Galle and onwards up West Coast of Ceylon.

Muricella ceylonensis, n. sp.—Plate VI., fig. 4.

The colony is branched in one plane, with a strong tendency to anastomosis even between twigs of different main branches. It measures 12 centims. in height by 8 centims. in breadth. Most of the twigs arise at right angles from the main branches and almost all the short ones remain perpendicular. Many arise in opposite pairs, others are alternate, and in other regions the twigs may be restricted for an inch or more to one side of the branch. A common interval between the origin of two adjacent branches on the same side is 4 millims. The verrucæ stand out prominently at right angles to a height of about 0·5 millim., and the interval between two on the same side is on the average 1 millim. The surface of the colony is covered with huge white spicules readily visible to the naked eye. Spicules slightly curved at the base run up the sides of the verruca, and their tips project at the mouth. The black horny axis measures 2 millims. in diameter at the base, it tapers to a diameter of 0·1 millim. at the tips of the twigs, and in these delicate parts it shows a brownish tint. The general colour of the colony is grey. In another specimen measuring 8 centims. by 6 centims. the colour was whiter owing to the more densely packed large spicules; there was *no hint of anastomosis*, and the perpendicular mode of branching was not so pronounced.

The spicules, which are longitudinally disposed, are straight or curved, densely tuberculate spindles, the largest of which seem here and there to be disposed in definite strands or lines. They vary in size from 3·5 millims. to 0·35 millim.

Compared with *M. ramosa* this species is much less thickly branched; it shows much less anastomosis, it bears polyps at wider intervals, and has larger spicules.

Muricella nitida, VERRILL.

This species is represented by a colony with a maximum height of 105 millims. and a maximum width of 80 millims. The base consists of a broad flattened portion from which the fan-shaped colony rises. The axis is dark brown, almost black in colour in the lower parts, but it becomes yellowish in the upper portions of the branches and in the twigs. It has a basal diameter of 2 millims.

The branches, which are confined to one plane, come off at an angle which approaches a right angle and then bend upwards, so that they appear to be parallel to one another. The younger branches and twigs often present a pinnate appearance, which is sometimes disguised by a larger development of one of the branches. The stem and branches are flattened in the plane of branching, and the tips of the twigs form blunt broad expansions due to the two divergent terminal polyps.

The polyps are more or less confined to the lateral edges of the branches; they are all withdrawn, but their tentacular portions are yellowish in colour.

The spicules vary in length from 0·9 millim. to 1·65 millims., and in breadth from 0·1 millim. to 0·2 millim.

The colour of the colony is a deep coral-red; and the spicules of the cœnenchyma are visible to the naked eye.

The specimen presents close resemblances both to *Muricella perramosa* and *M. nitida*, but because of the greater resemblance in the arrangement of the polyps and the more marked coral-red colour, it was thought best to place it under *M. nitida*.

Locality :—Ceylon seas.

Muricella complanata, WRIGHT and STUDER.

This species is represented by a fragment of a colony, consisting of the lower part of the stem with basal attachment, and a branch bearing secondary branches or twigs. The basal attachment consists of a slightly conical spreading portion, from the summit of which the stem arises. The stem measures 2·2 millims. near the base, and at a distance of 11 millims. from the base the first branch, which is represented by a fragment, was given off. The secondary branches or twigs are given off at right angles, and may reach a length of 25 millims. to 37 millims.

The polyps are arranged on the lateral edges of the stem and branches, and are directed some to the front and some to the back. On the whole they are arranged alternately, but this is not quite constant. The polyps measure 0·95 millim. in height by 0·74 millim. in width, and are contained within verrucæ which measure 0·35 millim. in height by 0·8 millim. to 1 millim. in width at the base.

The stem is of a violet tint with yellow polyps and verrucæ, but this tint gives place gradually on the twigs to an orange-yellow. The tips of the twigs end in two divergent polyps, and this expansion measures 3 millims. in width.

The spicules of the cœnenchyma vary in length from 0·7 millim. to 1·3 millims., and in breadth from 0·1 millim. to 0·16 millim. They are straight spicules covered with warts.

This specimen, though not agreeing with *Muricella complanata* in every detail, may be included in this species, which is variable in the colour and the size of its spicules.

We studied a second specimen of a more pronounced violet colour and with much larger spicules. It was a complete colony which is attached to a piece of coral, and measures 68 millims. in height and 53 millims. in maximum width. The basal attachment consists of a flattened portion spreading over the surface of the coral. The stem measures 2 millims. at the base, and at a height of 17 millims. the first branch is given off. The branching is confined to one plane, the primary branches being given off almost at a right angle. They in turn give off secondary branches or twigs at an angle which approximates even more closely to a right angle.

The verrucæ are placed on the lateral edges of the stem and branches, and are arranged more or less alternately. They are conical and abruptly truncated, with usually a few of the spicules projecting at the opening. The spicules in the calyces are much smaller than those of the general cœnenchyma.

The colour of the whole colony is a beautiful violet tint, with the tentacles of the polyps yellowish in colour.

The spicules of the cœnenchyma are spindle-shaped, either straight or curved and sometimes broad and flat in comparison to their length, or bluntly rounded at the two ends. They can be divided into two fairly distinct types :—

(1.) The larger spicules with rough warts, which vary from 0·7 millim. to 2·7 millims. in length and from 0·075 millim. to 0·32 millim. in width ; and

(2.) The smaller spicules with warts more pointed than rough, which vary in length from 0·11 millim. to 0·55 millim., and in width from 0·03 millim. to 0·05 millim.

Another very beautiful form with large violet and colourless spicules seems at first sight very different from the foregoing species and variety. This is mainly due, however, to the fact that there is a prominent opercular covering of small but very conspicuous rose-red spicules sometimes disposed in eight rays.

Localities :—West of Periya Paar, Gulf of Manaar ; deep water off Galle and onwards up West Coast of Ceylon.

FAMILY : PLEXAURIDÆ.

Plexaura prælonga, var. **typica** (RIDLEY).

Plexauroides prælonga (WRIGHT and STUDER).

This species is represented by one specimen, which reaches a height of 425 millims. The branching is confined to one plane and forms an irregular dichotomy. The main stem is 4 millims. in diameter at its base, tapering to 3 millims. at its termination, thus agreeing with the measurements given by WRIGHT and STUDER.

The verrucæ are numerous and irregularly scattered and the polyps are completely retractile. The cœnenchyma is comparatively thin and very friable. The spicular measurements are the same as those given by WRIGHT and STUDER. The colour is a deep brownish-red in spirits.

Locality :—Outside pearl banks, Gulf of Manaar.

Previously recorded from Port Curtis, 5 fathoms to 11 fathoms ; Port Denison, 4 fathoms ; and Station 186, Cape York, 8 fathoms. (See WRIGHT and STUDER (1889), '"Challenger" Reports,' vol. xxxi. : RIDLEY (1884), '"Alert" Expedition,' p. 339, Plate xxxvi., fig. F, and Plate xxxviii., fig. *g*, *g'*.)

Plexaura prælonga, Ridley, **var. elongata**, n.

Several incomplete specimens, dull crimson in colour, with two or three elongated cylindrical branches, 3 millims. to 4 millims. in diameter and up to 30 centims. in length. The axis, blackish-brown, 1 millim. to 2 millims. in diameter, is entirely horny. The surface of the colony is covered with the pore-like apertures of the polyps; around each aperture the spicules are disposed in a ring 0·3 millim. to 0·5 millim. in diameter.

The most characteristic spicules are very variable discs, "Blattkeulen," 0·4 millim. to 0·5 millim. in length, with a rounded foliaceous expansion (0·3 millim. in breadth) at one end and an irregular ramification at the other. The surface of the disc bears a few large blunt tubercles. When the thin foliaceous expansions are broken off, the rest of the spicule may be described as irregularly stellate. Actually stellate forms also occur, and 3- to 6-rayed forms are represented. A few tuberculate spindles occur here and there.

As regards types of spicules, this form resembles *Plexaura prælonga*, but the details of the "Blattkeulen," the rough cortex and the crimson colour, and some other features, mark it as quite distinct from Ridley's varieties *typica* and *cinerea*.

Plexaura antipathes, Klunzinger, **var. flexuosa**, n.

To a variety of this species we refer two specimens, the larger of which measures 120 millims. in height and the same in width. The colonies are bush-shaped and very profusely branched, with the branching not confined to one plane. The branches are sometimes thickened during a part of their length, while all are swollen at the tip into a knob or club-shaped portion, which measures from 2 millims. to 3 millims. in diameter.

The polyps are scattered over the whole surface of the stem and branches. No projecting calyces are present, but the position of the polyp is marked by an oval or circular opening, round which the cœnenchyma is slightly raised.

The axis is thick at the base, measuring 3·5 millims. in diameter, but it becomes slender and thread-like at the tips of the branches. The colour is a dark brown, very little difference being seen throughout the whole ramifications of stem and branches. The base consists of a broad, flat, spreading portion, from which in one specimen several stems rise in addition to the main stem.

The spicules are short, many branched, rod-like needles or small spherical bodies, which bear many protuberances. They measure, length by breadth in millimetres, as follows:—0·12 × 0·08; 0·12 × 0·10; 0·14 × 0·08; 0·15 × 0·10; 0·20 × 0·08.

The colour of the colony is a dirty greyish-white, with a light brownish tinge in many places.

Though differing slightly from *Plexaura antipathes*, yet the differences are not sufficient to warrant the formation of a new species. See Hiles (1899), pp. 51–2; Whitelegge (1897), pp. 317–8.

Locality: Gulf of Manaar.

Lophogorgia lutkeni, WRIGHT and STUDER.—Plate III., fig. 6.

This species is represented by many pieces of colonies; the largest piece measures 33 centims. in height by 38 centims. in breadth, and has three main branches. It measures 18 millims. across at the base, narrows to 12 millims., and expands again to 28 millims. where the branches arise. The axis is dark brown in colour with a lighter coloured central core. It is very calcareous as well as horny and measures fully 2 millims. at the lower end of the branch which we studied. It has two shallow grooves which correspond to the two grooves on the stem and the branches. The branching is usually confined to one plane and is fairly profuse. In the largest specimen one of the branches comes off from the main stem almost at right angles to the plane ot branching, but it bends over almost directly and comes to lie in that plane. In this specimen, also, several of the secondary branches rise in a similar manner to the above. In the other specimens, however, the branching is strictly confined to one plane. The stem and the branches are flattened in the plane of branching and are marked on the flat sides by a narrow winding groove or furrow which is continued along the flattened surfaces of the secondary branches. The tips of the branches and twigs are almost cylindrical. In the twigs the nutrient canals occur all round, but in the larger branches and in the stem they correspond to the grooves on the flattened surfaces.

The polyp-bearing surface is divided into two lateral bands by means of the two grooves. On both of the bands the polyps occur in irregular rows. Verrucæ can scarcely be said to be present, as the general cœnenchyma seems only to be slightly raised at the point where the polyp issues. On the polyp being retracted, the edge of the pore-like opening curves in and forms a star-shaped figure in which the rays are slightly variable. The slight thickening at the point of issue of the polyp seems more marked in some of the specimens than in others.

The polyps are either completely or partially withdrawn into the general cœnenchyma; the expanded part in the case of those partially withdrawn is white in colour. On the body of the polyp there are eight bands of spicules running up towards the base of the retracted tentacles. In each band the spicules, which are numerous, are arranged *en chevron.*

The spicules are spindle-shaped, but slightly flat in appearance, and sometimes curved and with fairly large prominent projections. They measure (*in situ*) from 0·18 millim. to 0·2 millim. in length. They are colourless.

The general cœnenchyma of the stem and the branches is thick, measuring about 1 millim. in depth, and friable in texture. In colour it is yellowish, with darker brownish patches scattered over the whole surface. It is composed of short spindle-shaped spicules with rough wart-like projections arranged in whorls, the whorls varying in number with the size of the spicules.

They measure, length by breadth in millimetres, as follows:—0·1 × 0·04; 0·12 × 0·04; 0·14 × 0·05; 0·14 × 0·02; 0·13 × 0·035; 0·14 × 0·06.

The specimens agree with the description of *Lophogorgia lutkeni* in most respects, *e.g.*, the branching, the flattening, the absence of verrucæ, the disposition of the polyps and nutrient canals. On the other hand, there are some peculiarities: (1) there is a distinct groove and not a wavy line; (2) the spicules of the general cœnenchyma are smaller in the Ceylon specimens; and (3) the pore-like openings left by the retracted polyps form star-like figures, not slits.

These differences do not seem important enough to warrant us in separating it from *L. lutkeni.*

To this species two other fragments belong. The larger measures 168 millims. in height and has a diameter of 5 millims. at the lower end of the main stalk. These two specimens differ from those described above in having no projections of the cœnenchyma at the point of issue of the polyps. The openings left by the polyps when withdrawn are more like slits than in the former specimens. The specimens are also more brick-red in colour. In every other respect they agree with the specimens above described. As the two sets of specimens come from the same locality we are furnished with a good example of individual variation.

Locality :—Cheval Paar, Gulf of Manaar.

Lophogorgia rubrotincta, n. sp.—Plate IV., fig. 12.

The base of the colony is expanded for 25 millims. on a shell; the branching is approximately in one plane; the measurements are about 100 millims. in height by a maximum of 30 millims. in breadth; the longest branches are about 30 millims. in length; the primary branches arise irregularly on the two sides of the main stem and some give off secondary branches. As regards spicules and polyps, it seems to be a *Lophogorgia.* Most of the cœnenchyma spicules are rough spindles; 0·1 millim. by 0·04 millim. is a common measurement, but many are much smaller. On the median line of each flattened surface of the stem and its branches there is a line of red spicules making a characteristic feature in contrast to the general orange-yellow. If it be not worthy of recognition as a new species, it is a very distinctive variety.

Lophogorgia irregularis, n. sp.—Plate VI., fig. 7.

An irregularly branching specimen of a dirty white colour, about 3 centims. in maximum breadth by 1·5 centims. in height. The extraordinarily quaint mode of branching may be described as somewhat antler-like, but the tips of the branches are mostly bent downwards. The branches expand, constrict, and re-expand in a peculiar way, and there is considerable flattening in the general plane of branching. The polyps occur all over, completely retracted within slightly prominent rounded verrucæ, which are closest together and best defined towards the ends of the branches. Many of the verrucæ measure about 1 millim. in diameter, but the aperture of the polyp on the apex of the gently rounded elevation is usually very much less (about 0·25 millim.).

The axis is black in colour and seems to be non-calcareous. It measures 2 millims. in breadth at the base, soon expands to 4 millims., and then narrows again. It is markedly flattened. Towards the ends of the branches, which measure about 3 millims. in greatest breadth, the axis is thread-like, brown in colour, and very flexible. The cœnenchyma is thick, its texture recalls that of *Iciligorgia;* several sections through a branch showed three large longitudinal canals symmetrically disposed close round the axis.

The spicules are broad spindles, 0·2 millim. by 0·1 millim.; narrow spindles; clubs; and double clubs.

Locality:—Pearl banks, Gulf of Manaar.

Leptogorgia australiensis, Ridley, var. **flavotincta.**—Plate IV., fig. 10.

This species is represented by numerous complete specimens, which differ considerably in size, the largest being 154 millims. in height and 130 millims. in maximum breadth. In all the specimens the cœnenchyma is rubbed off near the base, thus exposing the axis to view. The axis rises from a flat spreading basal portion, it is black in colour and slightly oval in shape, measuring 2·2 millims. in diameter at the base, but becoming lighter in colour and thread-like in form in the tips of the branches and in the pinnæ. It is horny in texture and very tough. The branching is confined to one plane, and each of the branches has a pinnate appearance. On the main stem and branches there is a distinct groove running up both the surfaces, thus dividing the polyp-bearing part into two lateral bands. In some parts it seems as if the groove had disappeared and left a ridge in its place. Some of the specimens show galls.

The verrucæ are arranged on the two lateral faces of the branches and the pinnæ in two alternating rows. They are scarcely elevated above the level of the general cœnenchyma, and their openings are slit-like in shape, the slit running parallel to the long axis of the branch.

In every respect the specimens agree with the description given by Ridley (1884). The spicules in the present specimens seem on the whole to be smaller than those measured by Ridley either for the species itself or for any of the varieties, varying, as they do, from 0·09 millim. to 0·16 millim. in length, and from 0·04 millim. to 0·05 millim. in breadth. Few of the spicules, however, attain the latter dimension in breadth.

The colour of the specimen, not agreeing exactly with any of the colours given for the species, may be best described as deep crimson. The yellow verrucæ stand out conspicuously in the younger branches, and also in two young colonies (Station I.) 30 millims. in height.

Localities:—Cheval Paar, Gulf of Manaar; Station I., off Negombo, 12 to 20 fathoms; deep water off Galle and onwards to Colombo.

Previously recorded from Torres Straits (see Ridley, 1884, p. 342, Plate 36).

Leptogorgia australiensis, RIDLEY, var. **perflava**—Plate IV., fig. 10.

This variety is represented by a complete colony which has a maximum height of 80 millims. and a maximum width of 88 millims. The type of branching agrees very closely with that described, even to the pinnate arrangement of some of the pinnæ themselves. The groove or furrow is more tortuous than in RIDLEY'S description, and in several places it shows the transition between a groove and a ridge. The size and the arrangement of the verrucæ, and their manner of opening by longitudinal slits, are all in close agreement with RIDLEY'S descriptions. The axis just above the flat spreading basal portion has a diameter of 1·35 millims.

The spicules are spindle-shaped, with whorls of warts, distinct free spaces being visible between the whorls near the middle portion of the spicule. Their measurements, length by breadth in millimetres, are as follows:—0·12 × 0·04; 0·15 × 0·05; 0·11 × 0·04; 0·16 × 0·04; 0·17 × 0·03; 0·08 × 0·04.

In this specimen the spicules show a greater range in size than is found in the specimen described by RIDLEY.

Neither in this variety nor in the variety described above can any trace be found of the double-headed spicules which VERRILL has described. They are almost certainly, as RIDLEY has suggested, pieces of broken fusiform spicules.

A point of some interest in regard to the varieties described above is, that the spicules of the crimson variety are wholly crimson and the spicules of the yellow variety are wholly yellow. In no case can any trace of both red and yellow spicules be found in one specimen. RIDLEY, however, found that red spicules occurred in the cortex of the yellow varieties, and that in the cortex of the main branches of the red form there were almost, if not quite, as many yellow as red spicules. We have examined our specimens very carefully, and it may be that we have here the initiation of a more definite splitting up of the species into distinct colour-varieties.

Leptogorgia (?) sp.

We have been unable to come to a definite decision in regard to an interesting form which we rank provisionally with the genus *Leptogorgia*. It is represented by an incomplete specimen showing two branches arising from a common basal portion. The longest branch is 84 centims. in length, 2 millims. to 2·5 millims. in breadth, and gives off two short branches at an acute angle. The branches are flattened, the edges show a crenate row of gentle elevations and depressions indicating the position of the verrucæ and the minute intervals between them. The colour is greyish with a tint of vandyck brown; the texture of the cœnenchyma appears smooth to the naked eye, finely granular under the hand lens. The axis measures 0·85 millim. across at its base, and a surprising feature is its markedly calcareous composition.

The spicules are:—(*a*) Small warty double spindles, measuring in length by maximum breadth in millimetres, 0·08 × 0·025; 0·1 × 0·025; 0·15 × 0·03; 0·16 × 0·04; and (*b*) minute warty double clubs, 0·03 × 0·02; 0·05 × 0·03; 0·075 × 0·03; 0·08 × 0·03.

Stenogorgia ceylonensis, n. sp.—Plate II., figs. 1 and 1A; Plate V., fig. 9.

This new species is represented by two complete colonies, which measure as follows:—

	(A.)	(B.)
Height of colony	125 millims.	73 millims.
Maximum width of same . . .	117 „	76 „

The colonies are fan-shaped and, on the whole, branched in one plane. The basal attachment consists of a broad, flat, plate-like portion which spreads over the surface of the object to which it is attached. From the basal portion the short main stem arises and soon divides into a number of principal branches. These give off secondary branches, which in their turn give rise to twigs of similar structure. The branches are, on the whole, given off in one plane, but several of the smaller branches and twigs come off in a different plane. The tips of the branches and twigs consist of flat expansions formed by two divergent terminal polyps; the expansion in many cases measures as much as 4 millims. from side to side.

The axis is horny, rigid in the lower part, but flexible and light brown in colour in the younger branches and twigs.

The verrucæ are very abundant on the branches and twigs, a little less numerous on the principal branches. They are cylindrical in shape, and measure, length by breadth in millimetres, as follows:—$1{\cdot}9 \times 1{\cdot}2$; $1{\cdot}5 \times 1{\cdot}1$. They occur on all sides of the branches and twigs, and may be said to occur in short spirals which are closely crowded on the branch or twig. When the polyps are withdrawn the verrucæ present all the phases between a mere pore with a lobed margin and a minute 8-rayed star, in proportion to the extent of the retraction.

The cœnenchyma is thin and is easily rubbed off. It is mainly composed of short rough spindles closely covered with warts and spines. They are light yellow to deep yellow in colour, and measure, length by breadth in millimetres, as follows:— $0{\cdot}4 \times 0{\cdot}08$; $0{\cdot}5 \times 0{\cdot}10$; $0{\cdot}41 \times 0{\cdot}079$; $0{\cdot}5 \times 0{\cdot}08$.

The colour of the colony is a chocolate-brown.

Locality:—Trincomalee.

Gorgonia capensis, HICKSON.

Several complete specimens and many fragments belong to this species. Two of the complete specimens measure 428 millims. and 439 millims. respectively in length. The basal attachment is in the form of a flat, plate-like expansion, from which the thread-like axis arises.

The axis is dark brown to black in colour, very tough and flexible, never measuring more than 0·5 millim. in diameter. In the larger complete specimen it has a basal diameter of only 0·15 millim. The branching is not profuse, the one specimen having two branches, the other only one, though in some of the broken fragments several branches are present.

The cœnenchyma is moderately thick, both on the main stem and on the branches, the terminations of which are knob-like. The colour is practically white, not yellow as in HICKSON'S specimens.

Verrucæ are absent, the position of the polyps being marked by oval-shaped openings.

The spicules agree in measuring not more than 0·2 millim.

From these specimens it has been possible to corroborate HICKSON'S discovery of viviparity in this species, but the disc-like embryos only measured 0·4 millim. by 0·39 millim. in size. Here we may be allowed to note our discovery of embryos in *Juncoptilum* sp., from ALCOCK'S Indian Ocean collection.

Localities:—Station I., off Negombo, 12 fathoms to 20 fathoms; deep water off Galle and onwards to Colombo, hauls off Kaltura and off Mount Lavinia.

Previously recorded from 10 miles south of Cape St. Blaize (HICKSON, 1902).

Rhipidogorgia (?) sp.

A large fan-shaped reticulate colony was found, but so much weathered that secure identification was impossible.

FAMILY: GORGONELLIDÆ.

Scirpearella aurantiaca, n. sp.—Plate IV., fig. 7; Plate V., fig. 15.

The collection included several portions of what seems a new species of this genus. We have studied a fork-shaped fragment which has a total length of 366 millims. The lower part of the colony is wanting, but the axis at the point where it divides measures 2 millims. in diameter. It is cylindrical in shape, very calcareous and smooth in the one branch, but marked by two or three slight winding grooves in the lower part of the other. The general colour of the branches is yellowish-white. A larger specimen, 470 millims. in length, bore a small comatulid on one of its branches.

The verrucæ occur on all sides of the branches. They are conical in shape, truncated at the tip, and measuring 2 millims. in maximum height and 1·5 millims. in basal diameter. In colour they resemble the stem in the lower part, but the tip is orange-yellow, thus standing out against the general colour of the branches. The edges of the oral end curve inwards, and all stages from an opening with an 8-lobed margin to a simple pore-like opening and finally to a completely closed tip may be seen.

The polyps are all completely withdrawn into the cœnenchyma. The general cœnenchyma is yellowish-white in colour, granular in texture, and only of medium thickness. It is practically composed of spindles and double clubs.

The spicules are small in size, and measure, length by breadth in millimetres, as follows:—

(1.) Spindles, 0·06 × 0·02; 0·08 × 0·02; 0·085 × 0·03.

(2.) Double clubs, 0·055 × 0·03; 0·07 × 0·04; 0·06 × 0·04.

This specimen does not agree with any described species of *Scirpearella*, but comes nearest to *Scirpearella rubra*, with which, however, we cannot identify it.

Locality :—Deep water outside pearl banks, Gulf of Manaar.

Scirpearella divisa, n. sp.—Plate VI., fig. 8.

A fragment of a reddish-orange colony with four branches, 7 centims. in height, about 2 millims. in diameter. The verrucæ are very low and gently rounded; towards the end of the highest branch, where they are closely crowded and very distinct, the arrangement appears to be in four rows with a suggestion of a spiral; in the older parts the verrucæ are very inconspicuous, not close together, and somewhat irregularly disposed. There are two enormous cirriped galls, the broadest almost 1 centim. across. The cœnenchyma is finely granular, almost smooth to the naked eye. The axis is very calcareous, light yellow in colour, with ten shallow grooves on the part examined. It measured there about 1·4 millims. in diameter out of the total branch diameter of 2 millims. Thus the thickness of the cœnenchyma is very moderate.

The spicules are chiefly minute, warty, double clubs, measuring 0·04 millim to 0·06 millim. in length, but usually 0·05 millim.; most are yellowish, a minority colourless. The bare middle part of the double club is very short. There are also yellowish and uncoloured warty spindles, measuring 0·1 millim. in length by 0·02 millim. in maximum breadth.

Scirpearella sp. *α*.

One specimen with a length of 307 millims. The stem is divided at a distance of 39 millims. from the flat base, and is flexible. Prominent verrucæ occur all round the stem in rows. The axis is deeply grooved in the lower part, but the grooving is hardly noticeable higher up.

The fragment approaches *Scirpearella moniliforme*, but differs in colour and in predominance of warty clubs over spindles, and in not having shallow verrucæ.

Scirpearella sp. *β*.

Another fragment, measuring 205 millims. in length. Verrucæ scarcely prominent, polyps white, a longitudinal white line is seen on one side. The axis is horny and very calcareous, faintly and irregularly marked by grooves.

The spicules, length by breadth in millimetres, are as follows :—

Stellate forms, $0{\cdot}06 \times 0{\cdot}05$; $0{\cdot}07 \times 0{\cdot}06$.

Double clubs, $0{\cdot}06 \times 0{\cdot}03$.

Spindles, $0{\cdot}06 \times 0{\cdot}02$; $0{\cdot}08 \times 0{\cdot}025$.

This does not agree with any of the formerly described species.

Scirpearella sp. *γ*.

Another fragment which measures 258 millims. in length is included in the collection.

The stem has a groove on one side, and on the side directly opposite there is a bare strip. The polyps are in three rows on each side of the groove. The verrucæ are very small.

The following measurements were taken :—

Diameter of stem at lower end, 3·2 millims.

„ axis „ „ 2 „

„ stem at upper „ 2 „

The spicules measure, length by breadth in millimetres, as follows :—

Spindles, 0·06 × 0·03 ; 0·07 × 0·03.

Double clubs, 0·05 × 0·04 ; 0·06 × 0·04.

Double spindles, 0·06 × 0·04 ; 0·05 × 0·035.

Scirpearia, sp. (?)—Plate IV., fig. 1 ; Plate V., fig. 16.

This specimen is a fragment without the base. It measures 410 millims. in length and divides at a distance of 38 millims. from its basal end into two long whip-like branches.

The axis is deeply grooved. There is a median bare space on each side. The polyps are darker in colour than the stem.

The spicules measure, length by breadth in millimetres, as follows :—

Double clubs, 0·06 × 0·04 ; 0·063 × 0·04. Darker coloured, 0·08 × 0·025 ; 0·07 × 0·02. In its spicules it is quite distinct from any *Juncella.*

It may seem of little service to suggest problematical species based on a study of fragments, but as we have given some description of each, our procedure is probably preferable to that of some other students of Alcyonacea, who have given names nude of any description.

Our impression is that the elongated forms of *Scirpearella*, *Juncella*, and the like, so monotonous in general appearance, so perplexingly diverse when one gets beneath the surface, are subject to great variability. The same remark applies to *Spongodes*, *Acis*, *Muricella*, *Verrucella*, and many other Alcyonarians.

Juncella gemmacea (Valenciennes)—Plate IV., figs. 4 and 5.

There are several specimens of this species in the collection. The finest one was 3 feet 7 inches in length, with a yellow basal expansion 3 centims. across, and with a stem measuring 9 millims. in diameter at the base. The stem increased to 12 millims. in diameter, and 10 millims. was a fair average. The lateral lines were spirally twisted. Another specimen measures 193 millims. in length and tapers from 7 millims. in diameter at the base to 4·5 millims. at the tip ; another measures 292 millims. in length with a basal diameter of 4 millims. The thickest piece measured 9 millims. in basal diameter, the axis alone amounting to 5 millims., and had an apical diameter of 3 millims. The side-line on either side of the stem is distinct. The axis is longitudinally grooved.

The spicules agree with those described and figured in the '"Challenger" Report, and are (*a*) unsymmetrical double clubs, and (*b*) double stars. The measurements, length by breadth in millimetres, are of (*a*), 0·12 × 0·04; 0·11 × 0·04; 0·10 × 0·04; and of (*b*), 0·10 × 0·06. A few single clubs and rough needles were seen.

The colour of the specimens in spirit is bright red with tints of orange when closely examined; the polyps appear white.

Locality:—Gulf of Manaar; Vankali Paar; Muttuvaratu.

Previously recorded from Red Sea; Torres Straits; Queensland and Mermaid's Straits, N.W. Australia.

Juncella juncea, PALLAS.

The collection includes numerous fragments of various species of *Juncella*, more numerous than we could examine; some of these belong to *Juncella juncea* which RIDLEY reported from Ceylon (1883).

Juncella fragilis, RIDLEY.

This species is represented by several fragments, in which the axis is marked by longitudinal grooves or striæ. In some of the fragments the verrucæ measure nearly 2 millims. in height and the axis has a diameter of 1 millim., while in the other fragments the verrucæ are much smaller and the axis measures 2 millims. in diameter. The spicular measurements in the one set of fragments are almost identical with those previously given for *Juncella fragilis*, but in the other set they measure as follows, length by breadth in millimetres:—

Unsymmetrical clubs, 0·08 × 0·03; 0·065 × 0·03.

Double clubs, 0·08 × 0·04; 0·075 × 0·03.

Juncella fragilis (RIDLEY), var. *rubra*, n.

This species is also represented by one complete specimen on which this new variety has been founded. The specimen shows no trace of branching, and measures 508 millims. in length. It is long and flexible, and tapers very gradually throughout its entire length to the pointed apex. The cortex is thick and red coloured, with numerous reddish-brown verrucæ. There is no trace of a lateral line or groove throughout the entire length of the stem, but the cortex has been rubbed off the lower part.

The verrucæ are numerous and closely appressed, measuring about 1 millim. in height. The axis is grooved and very flexible, measuring 3 millims. in diameter at the base and becoming hair-like near the tip where the stem measures 2 millims. in diameter. The base consists of a broad flat plate which has a diameter of 14 millims.

The spicules are double clubs and double stars, which measure, length by breadth in millimetres, as follows:—

Double clubs, 0·08 × 0·03; 0·087 × 0·04.

Stars, 0·05 × 0·03; 0·06 × 0·03.

The specimen approximates closely to the description of *Juncella fragilis* given by RIDLEY (1884). The only marked differences are in the colour and in the diameter of the axis at the base. The larger diameter can be easily accounted for by the large size of the specimen, 508 millims. But it seems useful to record a new colour variety.

Locality:—Gulf of Manaar.

Previously recorded from Port Denison, Queensland; 4 fathoms.

Juncella trilineata, n. sp.

Height of specimen 238 millims. It is sparingly branched in one plane, the first branching occurring at a height of 67 millims. There is a distance of 16·5 millims. between this and the next branching. The colony is exceedingly flexible and very graceful. The base is wanting, but the stem at its lower end measures 3·5 millims. in diameter.

Polyps arise in three different bands, leaving three narrow bare strips, each of which has in its centre a slight rib or keel. Under each bare strip lies a large longitudinal canal. The axis shows longitudinal grooves.

The polyps, which measure from 1·1 millims. to 1·5 millims. in height, are arranged in transverse rows of 3 or 4, but many smaller polyps occur which break this regularity.

The spicules resemble those of *Juncella gemmacea* in several of their forms. Unsymmetrical clubs, length by breadth, 0·08 millim. by 0·03 millim.; 0·065 millim. by 0·03 millim.; 0·07 millim. by 0·04 millim.; 0·07 millim. by 0·03 millim.

Double stellate forms, 0·08 millim. by 0·04 millim.; diameter of spindle, 0·02 millim.
,, ,, ,, 0·09 ,, ,, 0·035 ,, ,, ,, 0·02 ,,

Locality:—Patani, Siam.*

Verrucella rubra, n. sp.—Plate IV., fig. 13; Plate V., fig. 8.

A fragment of a colony, which has a total height of 98 millims. and a maximum width of 69 millims., appears to require the establishment of a new species. The base and the lower part of the colony is wanting, and many of the branches seem to be without the upper portion.

The axis, which measures 2·25 millims. in diameter at the lower end, is greyish-brown in colour, with a white central core, very calcareous, rigid, and brittle.

The branching of the colony is very profuse and is confined to one plane. The branches and twigs are given off at a right angle or at a close approximation thereto. There does not appear to be any fixed arrangement in the branching.

* This specimen, along with two others (*Astromuricea ramosa*, n. sp., and *Telesto trichostemma*), was given to me on a visit to Professor HERDMAN'S laboratory by Mr. NELSON ANNANDALE, who asked that it might be incorporated in this Report.—J. A. T.

The verrucæ are small, low, conical, wart-like bodies. They are confined on the whole to the lateral faces, but on the older branches, and on some parts of the stem and of the twigs, they seem to be scattered over three surfaces.

The general cœnenchyma is thin and easily rubbed off (in several places the axis is laid bare); it is mainly composed of double clubs, spindles, and double spindles. The spicules are covered with large rough warts, which are arranged in whorls. The spicules measure, length by breadth in millimetres, as follows:—

Double clubs, $0·10 \times 0·047$; $0·09 \times 0·05$; $0·09 \times 0·06$.

Spindles, $0·10 \times 0·035$; $0·08 \times 0·03$; $0·09 \times 0·035$.

Double spindles, $0·07 \times 0·04$; $0·08 \times 0·04$; $0·06 \times 0·035$.

The colour of the specimen is a bright crimson.

Locality:—Gulf of Manaar.

Verrucella flexuosa, KLUNZINGER, var. **aurantiaca,** n.—Plate III., fig. 4; Plate IV., fig. 8.

This form is represented by several complete specimens and many fragments. One complete colony has a height of 210 millims. and a maximum width of 180 millims.; another is 74 millims. by 80 millims. The colonies rise from a flat portion which spreads over the surface of a stone. In the largest specimen branching begins at the base, in a smaller the stalk rises to a height of 30 millims. before it gives off the first branch. In the lower portion of the stalk, which has a diameter of 2 millims., there are no polyps present. The verrucæ begin to appear at a height of 14 millims. from the base, but they are not abundant in the older basal region. There are numerous galls.

The branching is profuse and confined to one plane. The branches are given off at various angles—acute for some of the main branches, and almost always a right angle for the minor branches or twigs.

The tips of the branches and the twigs are sometimes slightly flattened in the plane of branching. The branches and the twigs come off very irregularly.

The verrucæ on the younger portions of the branches and on the twigs are somewhat more numerous towards the lateral edges, but on the stem and the older portions they occur all round. The verrucæ are conical in shape and truncated, measuring about 0·75 millim. in height and having a basal diameter of 1 millim.

The general cœnenchyma is granular in appearance, not of great thickness, and composed of spicules in the form of spindles and double clubs. They measure, length by breadth, in millimetres, as follows:—

Spindles, $0·08 \times 0·03$; $0·07 \times 0·02$; $0·10 \times 0·04$; $0·08 \times 0·02$.

Double clubs, $0·065 \times 0·04$; $0·08 \times 0·04$; $0·08 \times 0·045$.

The specimens described here approach very closely to *Verrucella flexuosa*, KLUNZINGER, but as this species appears to be very variable, it may be useful to class them as an orange variety.

In another specimen the branching was not at all in one plane; in another there was abundant anastomosis.

Locality :—West of Periya Paar.

Verrucella flexuosa, var. **gallensis,** n.—Plate III., fig. 9; Plate V., fig. 11.

This variety is represented by a slightly damaged colony and several large and small pieces of colonies. The complete specimen has a height of 47 millims. and a maximum diameter of 53 millims. The basal attachment consists of a flat plate-like spreading portion from which the main stem rises. The stem is rigid and brittle, very calcareous in nature, and rises to a height of 13 millims. before it gives off the first branch. The branches are given off at right angles and they in their turn give off branches in a similar manner. The tips of the twigs and branches are occupied by two divergent polyps which gives them a slightly flattened appearance. The branches are given off in an irregularly alternate manner from the main stem and from the larger branches. The branching is confined to one plane. The colour varied from rose-red to vermilion.

The verrucæ are blunt and conical shaped, measuring 0·7 millim. in height and having a basal diameter of 0·8 millim. to 1 millim. They are confined to the lateral surfaces of the stem and branches, but are directed a little more to one surface than to the other. They are arranged in such a way that the verrucæ on the one lateral face alternate with the verrucæ on the other face.

The general cœnenchyma is very thin and is composed of spindles, double clubs and double spindles.

This variety is represented by a large number of fragments, mostly small. The branching in some of the fragments is confined to one plane, but in others the branches are given off on all sides. The axis is cylindrical, white in colour and very calcareous. In the several fragments it shows considerable differences in diameter.

The verrucæ are small, conical shaped, with a wide base. They measure 0·5 millim. in height and have a basal diameter of fully 1 millim. They occur all round the main stem or branch and also on the other branches, but on portions of the older branches and on the younger branches they are more or less confined to the lateral surfaces.

The general cœnenchyma is thin and is chiefly composed of spindles and double clubs. They are covered by whorls of rough warts. In the double clubs there is a very short bare shaft in the middle. Their measurements, length by breadth in millimetres, are as follows :—

Spindles, 0·10 × 0·04; 0·08 × 0·03; 0·10 × 0·03; 0·12 × 0·03.

Double clubs, 0·08 × 0·06; 0·10 × 0·04; 0·07 × 0·04; 0·085 × 0·04.

Localities :—Deep water off Galle; Gulf of Manaar.

Verrucella sp. (?).

A small fragment, from which several branches are given off in one plane, measures 63 millims. in height.

The axis is very calcareous and brittle.

The polyps on the main stem or branch are more or less restricted to the lateral edges, but on the younger branches they occur on the four surfaces in such a way that they all alternate and appear as if arranged in a spiral manner. They are contained in verrucæ which are small, slightly conical and truncated at the top. The polyps themselves are all withdrawn into the verrucæ, but they present yellowish-white apices at the opening of the verrucæ. Towards the base of the tentacles on the aboral surface two or three pairs of spicules are arranged *en chevron*, and at their bases a few are arranged transversely so as to form a collar. These spicules are short warty spindles, either straight or slightly curved.

The cœnenchyma is thin and is composed of two layers of spicules, the outer layer being coloured and giving the characteristic colour to the colony, while the inner layer is colourless.

In the coloured layer the spicules show a considerable range in shades, varying from a light to a deep amber tint.

The spicules are spindle-shaped, thick in comparison to length, or slender, and covered with rough warts. The coloured, or outer layer, contains the bigger spicules. Their measurements, length by breadth in millimetres, are as follows:—

(*a.*) Coloured, $0·3 \times 0·075$; $0·4 \times 0·08$; $0·22 \times 0·05$; $0·11 \times 0·05$; $0·10 \times 0·03$; $0·08 \times 0·02$.

(*b.*) Colourless, $0·14 \times 0·04$; $0·175 \times 0·04$; $0·10 \times 0·035$; $0·28 \times 0·025$.

Order V.—STELECHOTOKEA.

Section I.—ASIPHONACEA.

Family: TELESTIDÆ.

Telesto rubra, Hickson.

This species is represented by two fragments, one of which (A) measures only 30 millims. in height.

Specimen A agrees closely with the description given by Hickson. Thus, in the basal portion of the youngest calyces, the spicules are fused to form tubes, the axis has eight longitudinal ribs, and prolonged boiling in caustic potash does not disintegrate it.

Specimen B seemed at first sight to have a black axis, but this was found to be due to *débris* which had collected in the hollow tube.

The whole surface of specimen (A) is covered by an encrusting sponge, which has completely destroyed the cœnenchyma. The spicules of the sponge are monaxonial and triaxonial.

Locality:—Trincomalee.

Telesto (Carijoa) trichostemma, WRIGHT and STUDER.

This species is represented by one specimen, which agrees with the description given by WRIGHT and STUDER.

The spicules are of two distinctly marked types :—

(1.) Long slender spicules with few lateral processes, often bifurcated at the end;

(2.) Strong, relatively broader spicules, with prominent lateral processes which interlock and form a felted covering.

They measure, length by breadth in millimetres, as follows :—

(1.) 0·3 × 0·02 ; 0·28 × 0·019 ; 0·15 × 0·012 ; 0·26 × 0·014.

(2.) 0·2 × 0·03 ; 0·25 × 0·02 ; 0·23 × 0·03.

The distance between the bifurcations at the ends of the spicules of type (1) often measured 0·02 millim.

Locality : Patani (Siam). This was one of Mr. NELSON ANNANDALE'S three specimens already referred to.

SECTION II. : PENNATULACEA.

FAMILY : UMBELLULIDÆ.

Umbellula, sp.

The collection included* a small specimen, doubtless a young colony, of a species of *Umbellula*. As the specimen is a poor one, we have not studied it in any detail. We may refer to our forthcoming report on Professor ALCOCK'S "Investigator" collection of deep-sea Alcyonacea from the Indian Ocean, which includes numerous Umbellulids of large size.

FAMILY : VIRGULARIIDÆ.

Virgularia multiflora, KNER.

The specimen representing this species is fragmentary. It consists of a piece of the rachis, which seems to come from the lower portion of the colony. It measures 51 millims. in length and has 20 pairs of pinnules. The pinnules are crescent-shaped, 3 millims. in breadth and 2 millims. in height, with 11 polyps on each. The axis is white, almost perfectly cylindrical, with a pitted appearance on the surface and with a diameter of 1·2 millims. The specimen agrees very well with the description given by KÖLLIKER. The following comparison will show the close similarity between the specimens :—

	KÖLLIKER'S.	HERDMAN'S.
Breadth of pinnule	3·3 millims. to 4 millims.	3 millims.
Height " "	2 millims.	2 "
Number of polyps in a pinnule .	11 to 15	11.
Diameter of axis	1·29 millims.	1·2 millims.

Locality :—Trincomalee.

* From Station LX., Gulf of Manaar, 20 to 30 fathoms. See Professor HERDMAN'S "Narrative," this Report, Part I. (1903), p. 75.

Virgularia loveni, Kölliker.

This species is represented by three fragments, the largest of which measures 106 millims. in length, and appears to consist of nearly the whole rachis, while the other two fragments represent the upper portions of two specimens.

The axis shows slight differences in form ; in one it is cylindrical, in another quadrangular, with two of the sides rounded, while in the third it returns to the cylindrical shape, but with one surface slightly flattened. It is covered by transverse ridges or by tubercles, which gives it a pitted appearance. On the prorachidial face of the rachis there is a well-defined narrow groove. The diameter of the axis is 1·5 millims. ; the rachis measures 106 millims. in length by 5·3 millims. in width.

The pinnules are folded so as to form a double S-shaped figure. They are almost touching one another near the tip, but lower down they stand considerably apart (3·5 millims.). They vary from 3·5 millims. to 4·8 millims. in breadth, and from 2 millims. to 2·5 millims. in height. The polyps are well defined, arranged in one row on the pinnule, and vary in number from 19 to 24.

The specimens agree with the description of *Virgularia loveni* given by Kölliker (1872), although there are a few slight differences.

Locality :—Trincomalee.

Virgularia, sp.—Plate IV., fig. 2.

The collection includes two fragments which approach *Virgularia loveni*. As they may be young forms, in regard to which little is known, and as they are only fragments, we have been content to give a brief description. The measurements are stated in the following table :—

	Rachis.		Pinnules.		Number of polyps on pinnule.	Number of rows.	Axis diameter.	Stalk diameter.
	Length.	Width.	Breadth.	Height.				
	millims.	millims.	millims.	millims.			millims.	millims.
(A.) . . .	53	4·5 to 5·5	4·8	2·5	23	1	1·5	2
(B.) . . .	56	4·5 „ 5·5	4·7	2·4	24	1	1·5 (white in colour).	2

The pinnules are folded so as to form a double S-shaped figure. The polyps are well defined. There is a distinct groove on the prorachidial surface which measures 0·4 millim. from edge to edge.

At the tip the pinnules are almost touching, but lower down the distance between them is 3·4 millims.

The axis is almost rectangular in one specimen, with two shorter sides slightly rounded. In the other it is almost circular, but one surface is slightly flattened. In both cases it is covered by tubercles, which gives it a characteristic appearance. The tip of the axis is blunt.

A third specimen gave the following measurements :—

Total length.	Stalk.		Rachis.		Number of polyps.	Number of rows.	Zooids.
	Length.	Width.	Length.	Width.			
millims. 57	millims. 22·7	millims. 1·5	millims. 34·3	millims. At base 2, half-way up 3, near top 5.	26	1	Occurring over the whole surface of rachis. Brownish colour.

Specimen is club-shaped and tapers gradually from base till it reaches maximum width at a point near the tip of rachis.

Abundant spicules both in the stalk and in the rachis.

Calyx ridged.

A distinct groove runs the whole length of the rachis.

Locality :—Trincomalee.

Virgularia tuberculata, n. sp.—Plate II., figs. 5 and 9.

This species is founded to include six fragments which it was found impossible to place under any of the known species. The fragments are very incomplete and are not in good preservation. The two largest specimens are 110 millims. and 81 millims. in length.

The axis is cylindrical and presents a characteristic pitted appearance, due to the tuberculated structure of the surfaces. The tubercles appear at some parts to be irregularly arranged, at other parts to be arranged in whorls. The colour of the axis is a deep coral red shading into a yellowish-red. The diameter is 0·6 millim.

One of the fragments represents the lower part of the rachis, while other two represent the upper extremity. In the lower part the pinnules are small and appear as ridges, which run across the lateral surfaces of the rachis. The polyps are borne in one row on the edge of the pinnule and number six on each pinnule. Higher up the pinnules become more mature, larger, and separated by a longer interval. They present a quite different appearance, becoming slightly crescent-shaped. The polyps are somewhat barrel-shaped and are quite distinct, except for a small portion at their bases, which are fused together to form the pinnule.

The cœnenchyma is very thin, but on the pararachidial surface it is produced into two ridges, on which the siphonozooids are found. Their arrangement cannot be exactly ascertained, but they seem to form an interrupted line on each of the ridges, and also occur either singly or in small groups below each pinnule.

The polyps on the separated parts vary from barrel- to flask-shape in the retracted condition, and measure in this state from 0·5 millim. by 0·4 millim. to 0·65 millim. by 0·4 millim. In their expanded condition they are more cylindrical in shape and measure 0·9 millim. by 0·4 millim. They still present a slightly swollen appearance about the middle of their length.

The six fragments represent parts of the rachides of at least three different specimens. In no case is there any part of the stalk left, so that it is impossible to give any idea of its shape and size.

Locality :—Trincomalee.

Family : PENNATULIDÆ.

Halisceptrum periyense, n. sp.

The collection included a couple of specimens of what appears to be a new species of *Halisceptrum*. Both specimens were complete and the natural colour is recorded by Professor Herdman as pink and white.

The lower portion of the stalk is curved and stands at right angles to the axis of the rachis, with its lower extremity marked by a ball-shaped swelling. The stalk passes almost imperceptibly into the lower portion of the rachis, which forms a long spindle-shaped swelling marked by two narrow **V**-shaped lines of pores, one on each lateral surface. The upper part of the rachis bears the pinnules, which show a marked difference in appearance. On the upper portion they are fairly large and show well-marked polyps on a wavy outline, while on the lower part they are reduced to straight ridges across the lateral faces of the rachis. The proportion of the mature to the immature pinnules is rather striking, there being in one specimen 14 mature to 53 immature, and in another 10 mature to 36 immature.

The pinnules in the immature state have the polyps arranged in one row, but soon the pinnule begins to get folded and the polyps begin to alternate, thus giving the appearance of multiple rows of polyps. The distance between the origins of the pinnules is 2·5 millims. in the case of the mature, but the immature lie almost touching one another. The pinnules are translucent, and they show a stringy appearance when held between the eye and the light.

The prorachidial surface of the rachis is free from pinnules and is marked by a distinct narrow groove. This groove fades away and disappears entirely between the immature polyps.

We add a table of measurements of the two specimens. There is in each a single row of polyps on the pinnules, but they alternate in arrangement so as to appear like two or more rows.

	Stalk.		Rachis.		Pinnules.		Number of polyps on each lower pinnule.	Distance between origins of pinnules.
	Length.	Width.	Length.	Width.	Breadth.	Height.		
	millims.	millims.	millims.	millims.	millims.	millims.		millims.
(A)	41	3	78	6·5	3·3	3·1	29 to 31	2·5
(B)	36	2·2	49	6	3	2·8	28 „ 30	2·5

Locality :—Periya Paar, Gulf of Manaar, 9¾ fathoms.

Halisceptrum gustavianum (Herklots).

This species is represented by one complete specimen. Of the 23 millims. forming the stalk the lower 11 millims. consist of nothing but the axis which tapers to a point. At the upper end of the 11 millims. the axis has a diameter of 1·3 millims. and is cylindrical in shape.

In the rachis the stalk becomes grooved and approximates to a quadrangular shape. A groove is distinctly seen in the prorachidial face of the rachis, but this fades away and disappears in the lower part of the rachis.

The pinnules show a large number of polyps which appear to be arranged in a number of rows. In the immature pinnules the polyps are in a single row, but they soon begin to alternate, and in the mature pinnules they seem to be in six rows. The number of mature pinnules is very small compared with that of the immature, the numbers being 16 pairs to 40 pairs.

Pinnules : Breadth, 2·5 millims. ; height, 2·5 millims.

Distance between origins of pinnules, 4 millims.

Length of whole colony, 86 millims.

Locality : Station LII., Gulf of Manaar, 3 to 6 fathoms.

Pteroeides lacazei, var. **spinosum**, Kölliker.

This species is represented by a fragment only of the upper portion of the rachis, measuring about 36 millims. in length, with 15 pinnules on one side, 16 on the other.

The principal measurements are as follows :—Width of rachis, 48 millims. ; breadth of pinnule, 20 millims. ; height of pinnule, 12 millims. ; number of main rays, 12.

There is a single row of zooids running down the centre of the meta-rachidial surface.

The wart-like termination of the rachis is almost completely hidden between the two uppermost pinnules. The rachis seems to have been swollen towards the tip and the fragment seems to be a part of the swelling.

The zooid plate is basal. The pinnules are marked by a number of V-shaped black markings on their margins. The polyps are situated both on the upper and on the lower surface of the pinnule, but they are more abundant on the upper surface.

This specimen resembles *Pteroeides lacazei*, var. *spinosum*, in having one row of zooids, in the termination of the axis, in the number and composition of the main rays and in the texture of the pinnules.

Locality :—Station XXI., Back Bay, Trincomalee, 8 to 12 fathoms; Station LXIII., West of Periya Paar, 40 fathoms.

Family : VERETILLIDÆ.

Cavernularia obesa, Valenciennes.

This species is represented by a number of specimens obtained from shallow water in the northern part of the Gulf of Manaar. The largest specimen is evidently only the upper portion of a large colony. The part measures 61 millims. in height, and has a diameter which varies from 10 millims. near the tip to 17 millims. near the lower end. In shape it is irregularly elliptical.

The autozooids are scattered over the surface, and the parts not occupied by the autozooids are thickly beset with siphonozooids. The position of the autozooids, which are all retracted, is marked by bluish- to brownish-black spots.

A cross-section in the lower part shows four large central canals which run parallel to the long axis of the specimen and are apparently continuous. Radiating from the central part thus formed numerous canals can be seen, some of which run down to the central canals, others end blindly, and others join with one another. Some of the larger canals seem to open into one or other of the four central canals.

The spicules are perfectly smooth rods, with blunt ends, some cut abruptly across, others slightly tapered and rounded.

Another specimen, which is quite complete, probably belongs to the same species. It has a total length of 53 millims. and a rachidial diameter of 7 millims. near the tip. The rachis is slightly elliptical in cross-section, but becomes almost cylindrical near the tip. The whole surface not occupied by the autozooids is covered by numerous minute wart-like bodies which represent the upper parts of the siphonozooids.

The autozooids occur scattered over the whole surface, and all are almost completely withdrawn. The incurved tentacles are just visible on the surface as brownish- to bluish-black circles. There is a marked difference between the autozooids in size, but this is probably due to a difference in the state of retraction.

The stalk is marked off from the rachis by an abrupt diminution in size, and it, with the lower part of the rachis, is marked by a number of grooves which run parallel to the length of the specimen.

Localities :—Station LII., near Vankali Reef, Gulf of Manaar, 3 to 6 fathoms; and Cheval Paar.

Stylobelemnoides, n. gen.

Veretillid with polyps over the whole surface; spicules long, rod-like spindles; axis cylindrical; calyces with 8 double rows of spicules.

Stylobelemnoides herdmani, n. sp.—Plate III., fig. 5; Plate IV., fig. 3.

The specimen is a broken club, 32·5 millims. in length, 2·8 millims. in breadth at thickest upper part, 2 millims. at lower end. The axis is straw coloured, square, with somewhat prominent angles, 0·85 millim. in thickness. The whole surface of the club is covered with small rod-like spicules, which form tubular calyces with 8-lobed apertures. The polyps are arranged all round the club, in two intersecting (but not exact) spirals. They form nine irregular rings. The siphonozooids fill up the interstices, and no bare streak is left.

The radial disposition of the polyps indicates a Veretillid; that they cover the whole surface indicates a Veretillean. As the limy bodies are long rod-like spindles, the specimen must be near *Stylobelemnon.*

But it differs from *Stylobelemnon* in many ways: *e.g.*, the axis is round not square; the calyces show 8 double rows of spicules; and the spicules are much larger, 2·25 millims. in length.

Under a magnification of 32 diameters the surface is seen to be closely covered with small straight spicules, among which the siphonozooids can be seen.

The polyp calyces are built up of similar spicules very closely packed together, and lying with their long axes parallel to the length of the calyx, thus forming a stiff protective case.

The spicules are present both in the cutis and in the deeper tissue.

Locality :—Trincomalee.

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EXPLANATION OF PLATES.

PLATE I.

Fig. 1. Expanded polyps of *Acamptogorgia spinosa*, var. *ceylonensis*, n. × 25.
" 2. *Spongodes splendens.* × 20.
" 3. *Eunephthya purpurea*, n. sp. × 20.
" 4. *Nephthya ceylonensis*, n. sp. × 20.
" 5. *Spongodes pulchra*, n. sp. × 20.
" 6. *Spongodes armata*, var. *ceylonensis*, n. × 20.
" 7. *Siphonogorgia köllikeri.* × 4.
" 8. *Astromuricea ramosa*, n. sp. × 12.
" 9. *Spongodes aurantiaca*,* n. sp. × 20.

PLATE II.

Fig. 1. *Stenogorgia ceylonensis*, n. sp. × 12.
" 1A. Branching of *Stenogorgia ceylonensis*, n. sp. Nat. size.
" 2. *Paraspongodes striata*, n. sp. × 1½.
" 3. *Acis indica*, n. sp. × 15.
" 4. *Capnella manaarensis*, n. sp. × 15.
" 5. *Virgularia tuberculata*, n. sp. × 20.
" 6. *Paranephthya pratti*, n. sp. × 25.
" 7. *Paraspongodes striata*, n. sp. × 15.
" 8. *Acanthogorgia media*, n. sp. × 20.
" 9. *Virgularia tuberculata*, n. sp. × 12.

PLATE III.

Fig. 1. *Bebryce hicksoni*, n. sp. × 12.
" 2. Branching of *Muricella ramosa*, n. sp. Nat. size.
" 3. *Muricella ramosa*, n. sp. × 8.
" 4. *Verrucella flexuosa*, var. *aurantiaca.* × 2½.
" 5. *Stylobelemnoides herdmani*, n. gen. et sp. × 5.
" 6. *Lophogorgia lutkeni.* × 1½.
" 7. *Acanthogorgia media*, n. sp. × 20.
" 8. *Clavularia margaritiferæ*, n. sp., spreading on an oyster shell. × 2.
" 9. *Acis alba*, n. sp. × 12.

PLATE IV.

Fig. 1. *Scirpearia* sp. Nat. size.
" 2. *Virgularia* sp. × 1½.
" 3. *Stylobelemnoides herdmani*, n. gen. et sp. × 2.
" 4, 5. *Juncella gemmacea.* Nat. size.
" 6. *Acanthogorgia ceylonensis*, n. sp. × 3. The stem and branches have been made much too substantial.

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* This has been by mistake printed *S. flabellifera* on the plate.

Fig. 7. *Scirpearella aurantiaca*, n. sp. Nat. size.
,, 8. *Verrucella flexuosa*, var. *aurantiaca*, n. Nat. size
,, 9. *Verrucella flexuosa*, var. *gallensis*, n. Nat. size
,, 10. *Leptogorgia australiensis*. × 2.
,, 11. *Acanthogorgia muricata*, var. *indica*, n. Nat. size
,, 12. *Lophogorgia rubrotincta*, n. sp. × 2.
,, 13. *Verrucella rubra*, n. sp. Nat. size.

PLATE V

Fig. 1. *Spongodes rosea*.
,, 2. *Muricella ramosa*, n. sp.
,, 3. *Acanthogorgia muricata*, var. *indica*, n.
,, 4. *Acis alba*, n. sp.
,, 5. *Eunephthya purpurea*, n. sp.
,, 6. *Spongodes aurantiaca*, n. sp.
,, 7. *Acis indica*, n. sp.
,, 8. *Verrucella rubra*, n. sp.
,, 9. *Stenogorgia ceylonensis*, n. sp.
,, 10. *Spongodes pulchra*, n. sp. (From stem and branches only.)
,, 11. *Verrucella flexuosa*, var. *gallensis*, n.
,, 12. *Acanthogorgia ceylonensis*, n. sp.
,, 13. *Spongodes bicolor*, var. *dubia*, n.
,, 14. *Capnella manaarensis*, n. sp.
,, 15. *Scirpearella aurantiaca*, n. sp.
,, 16. *Scirpearia* sp.
,, 17. *Astromuricea ramosa*, n. sp.
,, 18. *Paranephthya pratti*, n. sp.

PLATE VI.

Fig. 1. *Echinogorgia multispinosa*, n. sp. × 15.
,, 2. *Heterogorgia verrilli*, n. sp. $\frac{2}{3}$ nat. size.
,, 3. *Acis ceylonensis*, n. sp. × 12.
,, 4. *Muricella ceylonensis*, n. sp. $\frac{2}{3}$ nat. size.
,, 5. *Bellonella indica*, n. sp. × $2\frac{1}{4}$.
,, 6. *Echinomuricea ceylonensis*, n. sp. $\frac{2}{3}$ nat. size.
,, 7. *Lophogorgia irregularis*, n. sp. Nat. size.
,, 8. *Scirpearella divisa*, n. sp. Nat. size.
,, 9. *Bebryce hicksoni*, n. sp. $\frac{2}{3}$ nat. size.

FIG. 1, ACAMPTOGORGIA SPINOSA, var. ceylonensis, n.; FIG. 2, SPONGODES SPLENDENS; FIG. 3, EUNEPHTHYA PURPUREA, n.sp.; FIG. 4, NEPHTHYA CEYLONENSIS, n.sp.; FIG. 5, SPONGODES PULCHRA, n.sp.; FIG. 6, SPONGODES ARMATA, var. ceylonensis, n.; FIG. 7, SIPHONOGORGIA KÖLLIKERI; FIG. 8, ASTROMURICEA RAMOSA, n.sp.; FIG. 9, SPONGODES FLABELLIFERA, n.sp.

G. Davidson del. (exc. fig 6. E. M. Pratt) E. Wilson, Cambridge

Figs. 1, 1 a, Stenogorgia ceylonensis, n.sp.; Fig. 2, Paraspongodes striata, n.sp.; Fig. 3, Acis indica, n.sp.; Fig. 4, Capnella manaarensis, n.sp.; Fig. 5, Virgularia tuberculata, n.sp.; Fig. 6, Paranephthya prattii, n.sp.; Fig. 7, Paraspongodes striata, n.sp.; Fig. 8, Acanthogorgia media, n.sp.; Fig. 9, Virgularia tuberculata, n.sp.

G Davidson del

Fig. 1, Bebryce hicksoni, n.sp.; Figs. 2, 3, Muricella ramosa, n.sp.; Fig. 4, Verrucella flexuosa, var. aurantiaca; Fig. 5, Stylobelemnoides herdmani, n.g. et sp.; Fig. 6, Lophogorgia lutkeni; Fig. 7, Acanthogorgia media, n.sp.; Fig. 8, Clavularia margaritiferæ, n.sp.; Fig. 9, Acis alba, n.sp.

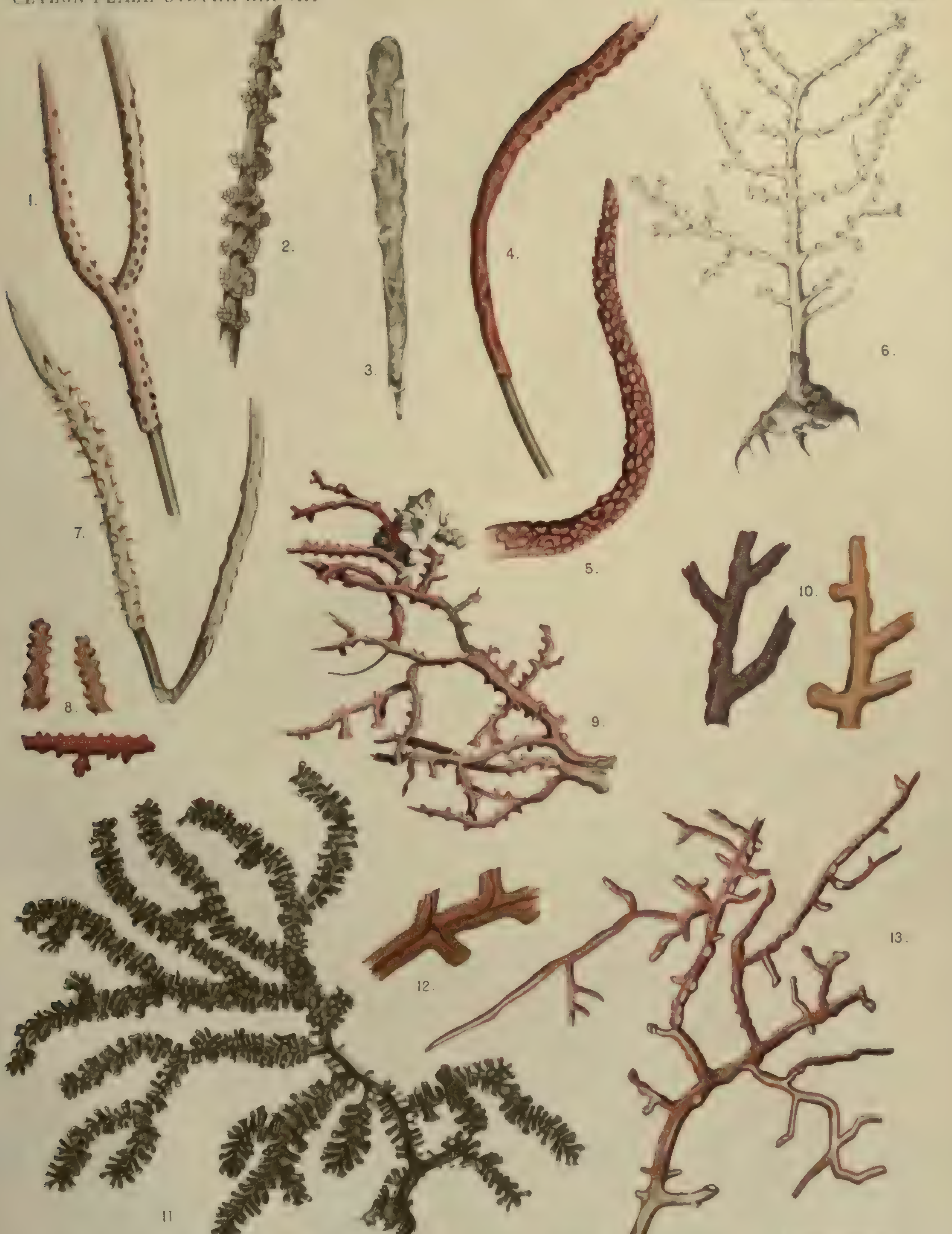
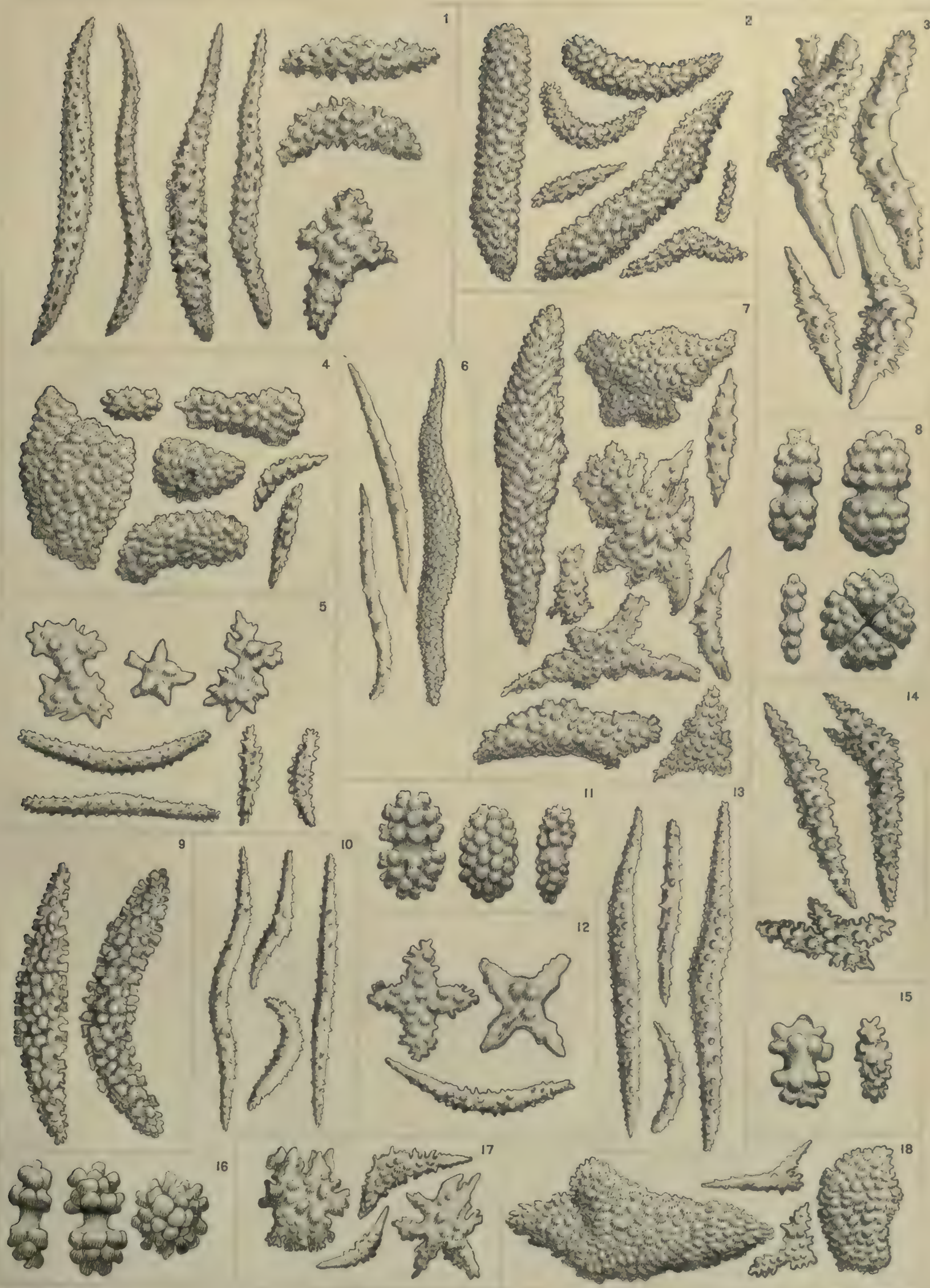


Fig. 1, Scirpearia, sp.; Fig. 2, Virgularia, sp.; Fig. 3, Stylobelemnoides herdmani, n.g., et.sp.; Figs. 4, 5, Juncella gemmacea; Fig. 6, Acanthogorgia ceylonensis, n.sp.; Fig. 7, Scirpearella aurantiaca, n.sp.; Fig. 8, Verrucella flexuosa, var. aurantiaca, n.; Fig. 9, Verrucella flexuosa, var. gallensis, n.; Fig. 10, Leptogorgia australiensis; Fig. 11, Acanthogorgia muricata, var. indica, n.; Fig. 12, Lophogorgia rubrotincta, n.sp.; Fig. 13, Verrucella rubra, n.sp.



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SPICULES
(For list of Species see Explanation of Plates)

FIG. 1, ECHINOGORGIA MULTISPINOSA, n.sp.; FIG. 2, HETEROGORGIA sp.; FIG. 3, ACIS CEYLONENSIS, n.sp.; FIG. 4, MURICELLA CEYLÔNENSIS, n.sp.; FIG. 5, BELLONELLA INDICA, n.sp.; FIG. 6, ECHINOMURICEA CEYLONENSIS, n.sp; FIG. 7, LOPHOGORGIA IRREGULARIS, n.sp.; FIG. 8, SCIRPEARELLA DIVISA, n.sp.; FIG. 9, BEBRYCE HICKSONI, n.sp.

REPORT

ON THE

OPISTHOBRANCHIATE MOLLUSCA

COLLECTED BY

PROFESSOR HERDMAN, AT CEYLON, IN 1902.

BY

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[WITH SIX PLATES.]

THERE are about 50 species of Opisthobranchs in the collection, and of these 16 are now described as new to science.

The Report is divided into two sections, I. NUDIBRANCHIATA and II. TECTIBRANCHIATA, with an Appendix containing (1) *Onchidium* and (2) *Marsenia.*

I. NUDIBRANCHIATA.

The collection of Nudibranchs made by Professor HERDMAN in Ceylon and handed over to me for identification amounts to 30 species. Of these 9 must be described as new, 12 are fairly well known tropical species, 4 are now identified with species previously described by ABRAHAM or by QUOY and GAIMARD, but of which little was known, and 5 are too small to identify satisfactorily.

The list of species is as follows :—

Hervia ceylonica, n. sp.
Galvina producta, n. sp.
Eolis sp. ?
,, sp. ?
Doto sp. ?
Melibe fimbriata, A. and H.
Scyllæa pelagica, L.
Pleurophyllidia formosa, KEL.

Linguella cinerea, n. sp.	*Casella cincta*, BGH.
Hexabranchus marginatus (Q. and G.).	*Ceratosoma cornigerum*, GRAY.
Discodoris labifera (ABR.).	,, *ornatum*, BGH.
Platydoris inframaculata (ABR.).	*Doris* sp. ?
,, *speciosa* (ABR.).	,, sp. ?
,, *herdmani*, n. sp.	*Doriopsis aurea*, Q. and G.
,, (?) *spinulosa*, n. sp.	*Phyllidia varicosa*, LEUCK.
Halgerda punctata, n. sp.	,, *nobilis*, BGH.
Thordisa (?) *caudata*, n. sp.	*Ægires villosus*, n. sp.
Chromodoris reticulatus, PSE.	*Trevelyana bicolor*, A. and H.
,, *tenuilinearis*, n. sp.	*Kalinga ornata*, A. and H.

It is, perhaps, premature to institute comparisons between the Nudibranch fauna of Ceylon and those of other localities, as so little is known comparatively of the distribution of the group in the warmer seas, and as the identification of spirit specimens from written descriptions is attended with great uncertainty.

The capture of four species of Eolids and a *Doto* on the hanging oyster cages is of interest, as it seems to show that absence or rarity of these families in tropical seas is, perhaps, due more to the difficulty of finding them than to their actual scarcity, the larger and more showy Dorids attracting the attention of collectors to the exclusion of more insignificant forms.

There has been but little work done in the past on Ceylonese or Indian Nudibranchs. Dr. KELAART, in 1859 (**3**) (**4**), described 33 species of *Doris* from specimens collected in Ceylon, but his descriptions are based mainly on the colour and texture of the living animal. ALDER and HANCOCK (**5**), in examining a collection of Nudibranchs from Madras, re-discovered six of KELAART's species with the aid of his original drawings, and added 32 more, besides recording three others previously described.

Of more recent works should be mentioned a paper by COLLINGWOOD on Nudibranchs from the Eastern seas (**8**) and a list of the Dorididæ in the British Museum Collections by ABRAHAM (**7**), who there describes the external characteristics of a number of spirit specimens. Reference should also be made to the work of Sir CHARLES ELIOT, who has published papers on the Nudibranchs and Tectibranchs of Samoa, the Maldives and Laccadives, and East Africa (**11**) (**12**) (**13**).

Most, however, of the adequate descriptions of Oriental Nudibranchs are due to the long-continued work of Dr. RUDOLPH BERGH, culminating in the magnificent series of papers in SEMPER's 'Reisen im Archipel der Philippinen.'

In working out the collection no attempt has been made to investigate the anatomy of the specimens beyond what seemed to be necessary for their identification.

In conclusion, I should like to express my thanks to Professor HERDMAN for his kindness in allowing me to work out this collection and use his notes, and for the facilities which he afforded me, and also to Mr. E. A. SMITH for kindly allowing me to examine the Nudibranchs preserved in the British Museum Collections.

NUDIBRANCHIATA CLADOHEPATICA

Family: ÆOLIDIIDÆ.

Sub-family: CRATENIINÆ.

Hervia ceylonica, n. sp.—Plate I., figs. 1 to 5.

Amongst the Nudibranchs obtained from oysters hung over the ship's side, in the Gulf of Manaar, were 12 specimens of a small Eolid, length 8 millims., which seems to belong to the genus *Hervia*. This genus is closely allied to *Cratena*, and is distinguishable externally by the large tentacles, smooth rhinophores, grouped papillæ, and produced anterior angles of the foot; and internally by the single series of arched teeth strongly denticulate on either margin.

The specimens here described have the body pale and semi-translucent, the papillæ with fawn-coloured hepatic contents, probably faded, long and slender, with distinct white cnidogenous sacs. They are arranged in 5–6 irregular transverse rows, the first row widely separated from the rest. The tentacles are long, very thick at the base, and tapering evenly to a point. The rhinophores are short, slender, and smooth, the eyes being visible at their base. The anterior angles of foot are moderately produced, the tail slender and moderately long (Plate I., fig. 1).

The jaws are of the usual shape in the Cratenidæ, with rather short cutting edge, irregularly denticulate. The radula has a single row of arched teeth, with an acute apex and 5 strong lateral denticulations on either side (Plate I., fig. 2).

The genital organs did not show any sign of armature.

Bergh refers three species to this genus, two from the Mediterranean, and one, *H. rosea*, Bgh., from Amboyna; and in addition to these Alder and Hancock (5) have described another species from Ceylon, under the name of *Eolis militaris*, which appears to be undoubtedly a *Hervia*, though Bergh (9), probably by an oversight, refers it to *Coryphella*. It is distinguishable from the present species by its much larger size and the possession of 7 lateral denticulations on the radula teeth.

Kelaart has given names to 8 species of *Eolis* from Ceylon, but his descriptions are so vague as to be practically worthless.

Sub-family: TERGIPEDINÆ.

Galvina producta, n. sp.—Plate I., figs. 6 to 9.

In company with the last-mentioned species was one specimen whose characters, with one exception, agree with those of the genus *Galvina*.

Length, 9·5 millims., papillæ inflated, tapering, constricted below the tips, which are somewhat opaque, hepatic contents vesicular-looking, rhinophores moderately long, tentacles short, anterior angles of foot produced.

Colour, faded, a light transparent brown without markings; hepatic contents whitish-yellow; jaws and teeth as in the genus *Galvina.* The median teeth of the radula robust, with short point, and 5, sometimes 6, lateral denticles. This species differs from the other members of the genus in having the anterior angles of the foot produced, but otherwise it is a typical *Galvina.* All hitherto recorded Galvinæ are either Atlantic or Mediterranean, with the exception of *G. exigua*, which BERGH (**15**) has recorded from the Pacific. This adds the Gulf of Manaar.

Eolis, spp. ?

There are two other small Eolids, representing two different species, in the collection, both from the oyster cages hung over the ship's side in the Gulf of Manaar, which are too small to identify. One of these, length 4 millims., is, perhaps, a *Hervia.* It has the anterior angles of the foot produced, the tentacles long and slender, the rhinophores small; the papillæ are crowded, long and slender, with acute white cnidogenous tips and dark greenish-black contents. The body colour is a transparent reddish-yellow.

The other specimen, length 4 millims., has the papillæ in 5 distant transverse rows; the larger papillæ are ringed in a manner that recalls the genus *Zatteria*, described by Sir C. ELIOT (**11**, p. 62) from Zanzibar specimens. The rhinophores are moderately large and rugose, the tentacles small and the anterior angles of the foot produced.

FAMILY: DOTONIDÆ.

Doto, sp. ?

One specimen of a *Doto*, length 2·5 millims., too small to identify, was obtained from the above-mentioned oyster cages in the Gulf of Manaar. Externally it bears a close resemblance to *D. pinnatifida*, MONT., the form, coloration, and black spots on the papillar tubercles being in agreement with that species.

BERGH (**9**, p. 795) has recorded a species of *Doto* (*D. indica*) from Mauritius, to which it is possible that the specimen should be referred.

FAMILY: TETHYMELIBIDÆ.

Melibe fimbriata, ALD. and HANC.

There are three specimens of this species from separate localities on the West Coast of Ceylon. One from off Negombo, one from Periya Paar, 9 fathoms, and one from Chilaw Paar, 11 fathoms. As usual, they are in a very imperfect state, having lost several of their dorsal papillæ.

Professor HERDMAN notes in his diary the colour of the living animal as follows: "Pale amber brown, in front, with brownish papillæ and white spots—clear, gelatinous." This species, as was first pointed out by ALDER and HANCOCK (**5**), and subsequently confirmed by Sir CHARLES ELIOT (**11**), differs from the rest of the genus in having no trace of labial or buccal armature.

M. fimbriata is found throughout the Indian Ocean.

FAMILY: SCYLLÆIDÆ.

Scyllæa pelagica, LINN.

Amongst the nudibranchs found on the oyster cages which were kept hung over the ship's side from February 15 to March 15, 1903, in the Gulf of Manaar, were two specimens of *Scyllæa* which agree fairly closely, both in general appearance and also in form of radula and jaws, with *S. pelagica.* Externally they also rather closely resemble *S. marmorata*, ALD. and HANC., from Madras, agreeing with it in the rounded dorsal wings and slight development of the caudal ridge, but it seems to me that there are hardly sufficient grounds for regarding the latter as a distinct species.

The colouring of the Ceylon specimens, the largest of which measures 3·0 centims., is mainly due to large irregular areas of light-brown stellate chromatophores, amongst which are vacant pale blotches. There are scattered dark spots formed by aggregations of stellate chromatophores which seem to correspond to sub-dermal patches of pigment and also a few small ocellated spots, the centre formed of contracted brown chromatophores, possibly of a different colour during life, and the surrounding paler area of very finely-branched chromatophores. These ocelli occur on the sides and in a row down the centre of the back.

The body bears a few small colourless tubercles. The buccal mass and, more noticeably, the œsophagus are pigmented with brown stellate chromatophores.

FAMILY: PLEUROPHYLLIDIIDÆ.

Pleurophyllidia formosa, KEL.—Plate I., figs. 14 to 16; Plate II., fig. 1.

One specimen from northern part of the Gulf of Manaar.

Length of preserved specimen 5·2 centims., width 4 centims., width of foot 2·3 centims. Colour an opaque greyish-brown, paler on the sides of the foot, with remains of black pigment between the dorsal ridges and on the dorsal surfaces of the tentacle shield.

The form of the animal corresponds closely to the figure given by BERGH (**10**, plate i., fig. 1). The tentacle shield is broad, with thin projecting upper margin. The back is marked with about 36 slightly raised longitudinal lines, larger and smaller ones irregularly alternating.

The gill lamellæ are about 5 millims. in length, and lie in a crowded transverse band, which runs at about right angles to the direction of the anterior lateral lamellæ. The lateral lamellæ are numerous, about 50, and run transversely from the body almost to the margin of the mantle, the direction of the anterior ones being somewhat diagonal.

The jaws (Plate I., fig. 14) are powerful, of a dark horn colour, and of the usual form. The radula (Plate I., figs. 15 and 16) consists of 70 rows of 140–1–140 teeth. The median tooth is very broad (0·3 millim. × 0·12 millim.), with four lateral denticles and a strong, rather blunt median point with toothed margins, the basal pair of denticulations being very large. The 1st lateral tooth is strong, with a broad somewhat rectangular base and an irregularly serrulate or smooth outer margin. In the 2nd tooth the margins are smooth and the point entire. The 3rd tooth has a small sub-apical denticle on the outer margin. This denticle is found on all the teeth outwards till the outermost one is reached; it increases in size outwards, so that the lateral teeth are for the most part bifid or, in a few cases, trifid. The outermost tooth is simple. This specimen differs slightly as to its radula from that examined by BERGH, in which the apical denticulation begins on the 5th tooth and is absent from the 3–6 outermost. It agrees, however, in other respects. The other Ceylon species, *P. ceylanica*, has, like *P. formosa*, the lateral teeth bidentate, but differs in having a much smaller number of lateral teeth and in having the outermost teeth finely serrulate.

Linguella cinerea, n. sp.—Plate I., figs. 10 to 13.

A single specimen of this species was dredged 10 miles north of Cheval Paar.

Length about 1·5 centims., width 1·4 centims., width of foot 0·9 centim.

Mantle moderately smooth, of a greenish-grey colour, which is denser on the head and front of cloak. The margin of the cloak studded with distant tubercles marked with a ring of grey, becoming larger towards the centre of the back and merging into irregular raised areas separated by deeply pigmented grey furrows.

Lateral margin of underside of mantle with a band of opaque yellow cnidopores, 2 to 3 deep. Lateral lamellæ about 32, slightly oblique.

Radula of 35 rows, formula 46–1–46. The central tooth (Plate I., fig. 10) has a median spine with 3 lateral serrulations, and 3 lateral denticulations. The 1st lateral tooth with about 9 denticulations on the outer edge. The teeth increase in length outwards, the number of denticulations decreasing (Plate I., fig. 12), and the two outermost teeth being smooth (Plate I., fig. 13).

The jaw plates (Plate I., fig. 11) of the usual form, strongly curved (in the figure they are flattened out), of a dark horn colour.

This species seems outwardly to come rather near to *L. sarasinica*, BGH., from Ceylon, but differs in not having the tubercles densely crowded on the mantle edge. The radula also is very different both in form and number of teeth.

NUDIBRANCHIATA HOLOHEPATICA.

DO RIDIADÆ CRYPTOBRANCHIATÆ.)

SUB-FAMILY: HEXABRANCHIDÆ.

Hexabranchus marginatus, Q. and G.

There are in the collection two specimens of *Hexabranchus*, both from Periya Paar, which I think it is probable belong to this species. One specimen is very small, length only 1·1 centims., the other is somewhat larger, length 3·5 centims., but both fall far short of the size usually attained by members of the genus, and are probably immature.

Professor HERDMAN'S notes, referring to the larger specimen, are "scarlet and white, swimming species," and "red blotched with white, especially at sides of mantle." The spirit specimen is somewhat depressed, of a dirty semi-translucent white colour. The mantle wide and thin and frilled at the margins, total width 2·4 centims., free margin 0·55 centim. The free edge of the mantle in front of the head is 2·5 millims. wide and has a smooth entire margin.

Rhinophores far apart, of the usual shape, with about 28 lamellæ. Tentacles large, flattened, with crenated margins. Branchiæ in 6 groups surrounding the short tubular anus.

The jaws are powerful, with about 8 transverse ridges.

The radula has about 32 rows of teeth, the formula being 46–0–46. The innermost 2–3 teeth on each side are imperfect.

The identification of species of *Hexabranchus* from preserved specimens is, as both BERGH and ELIOT (12) have remarked, a matter of difficulty, but in this instance there seems little doubt that the specimen is *Hexabranchus marginatus*, as the white marginal blotches, crenate margin to tentacles, and distinct anal tube, as well as the agreement of the radula, seem to indicate.

COLLINGWOOD'S *Albania formosa* (**8**, p. 132), from Formosa, seems to be undoubtedly the same species, as also, perhaps, ALDER and HANCOCK'S "Undescribed species of a new genus apparently related to *Goniodoris*," from Madras (**5**, Plate XXXIII., fig. 20).

SUB-FAMILY: DISCODORIDIDÆ.

Discodoris labifera (ABR.).—Plate I., figs. 17 and 18.

There are three small specimens of *Discodoris*, one from the pearl banks off Aripu and two from Cheval Paar, which I doubtfully refer to the above species. The animal is quite unrecognisable from ABRAHAM'S original description (**7**); but on examination of what appeared to be the type specimen in the British Museum, I found that, making allowance for difference of size, it agreed fairly well in external features with the Ceylon specimens. The British Museum specimen is undoubtedly a *Discodoris*, as the partially protruded buccal armature is distinctly visible, though there is no mention of this in ABRAHAM'S description. There are also in the British Museum collection some unnamed specimens from South Africa which apparently belong to the same species.

The Ceylon specimens measure about 1·6 centims. in length, and the width of the most symmetrical is 0·95 centim. The colour of the Aripu and one of the Cheval Paar specimens is a dirty greyish-brown. The other Cheval Paar specimen, though much distorted, has preserved its colour and texture better than the rest. It is of a slaty blue-grey colour above and below. The mantle has a number of moderate brownish spots, absent from the centre and extreme margin. The underside of the mantle and foot are finely dotted with brown. The mantle is covered with fine tubercles, somewhat pointed, giving it a slightly pilose appearance; this is not so marked in the other specimens. The branchiæ are 6 in number, compoundly pinnate. The branchial opening is placed far back and has the form of a transverse slit. The jaws are of the usual form, made up of blunt rods; colour, a pale brownish-straw. Radula with 18 rows, the last two immature, formula 26–0–26, the teeth increasing in size gradually outwards (Plate I., fig. 18), the outermost four teeth again rapidly decreasing (Plate I., fig. 17).

ABRAHAM's original specimen of *D. labifera* came from the Seychelles Islands.

SUB-FAMILY: PLATYDORIDIDÆ.

Platydoris inframaculata (ABR.).—Plate II., figs. 2 to 7; Plate III., figs. 8, 9.

Amongst the Nudibranchs obtained at Galle is one well-preserved specimen of *Platydoris*, which is, I think, referable to the above. The general appearance, markings, and tuberculation of the mantle of the type specimen from Amboyna preserved in the British Museum agree fairly well, but it is impossible to decide with certainty upon the identity of closely allied species of *Platydoris* without an examination of the radula and the usually very characteristic armature of both penis and vagina.

The ground colour of the Ceylon spirit specimen is pale reddish-brown, the mantle having a few irregular dark rusty markings formed by minute reticulations round the tubercles; the lower surface of the mantle bears large circular purplish-black blotches, rather larger and fewer than in the type specimen. The mantle is much depressed and covered with minute, close-set, spiculose tubercles. The rhinophore pores are slightly raised. The branchiæ are 6 in number, large, 3-pinnate surrounding the long, tubular anus, partially retracted into a wide, deep collar (Plate II., fig. 3). The total length of the animal is 4·7 centims., width 3 centims., width of foot 1 centim.

The radula consists of 44 rows; there are 70 lateral teeth on each side and no median tooth. The teeth are simply hooked, increasing in size outwards (Plate II., fig. 4; Plate III., figs. 8 and 9).

The retracted penis (Plate II., figs. 5 and 7) is armed internally with numerous hook-bearing discs, crowded and rather large below, becoming smaller and more distant as it passes upwards, and taking the form of small prickles on the glans. The vaginal wall bears 6 stout, chitinous discs (Plate II., fig. 6) arranged in opposing pairs. These discs are peltate, the boss being formed of 5–6 rounded nodules, and the whole surface being finely granulated. They measure 0·65 millim. in diameter. The size of the largest penial discs is about 0·19 millim. by 0·155 millim.

Platydoris speciosa (ABR.).—Plate II., figs. 8 to 12, and Plate III., fig. 10.

The type of this species from Amboyna is, like the preceding, preserved in the British Museum, and has been described by ABRAHAM (7), but nothing is known of the form of its radula or genital organs. A specimen of *Platydoris* from the Gulf of Manaar appears to belong to this species. Its length is 5·7 centims., width 4·5 centims., width of foot, much contracted, 0·9 centim. The mantle is very wide, covered above with closely-set, minute tubercles with radial spicules. The ground colour of the specimen is an opaque muddy brownish-grey. The mantle is marked above with collections of small, purplish-brown spots, irregularly placed over the whole surface.

The lower sides of the mantle are marked with large, purple-brown, circular blotches, with smaller ones on the side of the body. The rhinophore pores have their margin slightly raised. The branchial pore is 6-lobed, stellate, tightly closed over the retracted branchiæ. The walls of the pore are moderately high. The branchiæ are 6 in number, compoundly pinnate surrounding the long tubular anus, the margin of which is crenulated.

The radula (Plate II., figs. 8 to 10; Plate III., fig. 10) contains 46 rows, with about 58 teeth on either side of the naked rachis. The teeth are simple, hooked, decreasing in size slightly towards the centre of the radula. Compared with those of the previous species, they are somewhat smaller and much more slender.

The penis (Plate II., figs. 11 and 12) is armed as usual with hooked discs, rather large and closely set below, much smaller surrounding the glans, which bears a few still smaller spines. The armature of the vagina, owing to an accident during examination, could not be noted.

This, or the preceding species, may perhaps prove to be identical with the *Doris formosa* or *Doris elliotti* described by ALDER and HANCOCK from Madras, but this cannot be determined without an examination of specimens in their natural colours.

Platydoris herdmani, n. sp.—Plate II., figs. 13 to 17.

A single specimen of this species was taken at Galle, and three others, without recorded locality, are in the collection. Length 3 centims., width 1·4 centims., width of foot, edges approximated, 0·4 centim., height 0·5 centim., length of foot 2·1 centims.

The mantle is large, minutely tuberculate, with its edges thin and very much frilled. Its centre is marked by a large, irregular, pale reddish-brown blotch, spotted with darker, and breaking up into smaller spots towards the margins of the mantle.

The extreme margin of the mantle is marked by a series of black sub-dermal spots, equally visible from above and below. The under side is very faintly dotted with pale brown, the margins of the foot being marked with darker brown.

The ground colour is a waxy flesh colour. The texture of the body is stiff and brittle, the spicules are numerous, small, slightly roughened, and arranged in dense, closely-packed, stellate clusters. The branchial and rhinophoral pores are raised and closed, not distinctly stellate. The tentacles are comparatively large and conical. The foot is very narrow, with its margins approximated in all the specimens.

The radula consists of 44 rows with no median tooth and about 70 lateral teeth on each side increasing gradually outwards from the centre. The outermost tooth is rudimentary, without a lamina, the 2nd is fringed, the 3rd broad and flattened with a slightly denticulate edge, the 4th normal.

The penis is armed with comparatively few small, distant, hooked plates which are not found on the glans. The vagina bears four large chitinous hooks arranged in pairs one above the other on opposite sides of the lumen. This species belongs to quite a different group of the genus from that of the two preceding. It appears to be distinct from any described species, though approaching somewhat to *P. angustipes*, Bgh., from the Antilles.

Platydoris (?) spinulosa, n. sp.—Plate II., figs. 20 to 23; Plate III., figs. 1 to 3.

There is one specimen of an apparently undescribed Dorid from 10 miles north-east of Cheval Paar, which I have provisionally referred to the genus *Platydoris*, though it differs from it in some particulars.

Its length is 2·8 centims., width 1·9 centims., height 0·8 centim. The mantle is wide with straight entire margin, covered above with moderate unequal tubercles placed fairly widely apart on the centre of the back and more closely near the margin, but not crowded anywhere. The largest tubercles lie in an irregular ring, 3 to 4 deep, parallel to and some distance from the edge of the mantle, the centre and margin being occupied by smaller tubercles. The tubercles are rounded or slightly conical, spiculose, the ends of the spicules protruding distinctly. There are also larger spicules arranged in reticulating bundles between the tubercles.

The foot is contracted and rather narrow, the front margin bilaminate and divided. The tentacles are very small, pointed and recognisable with difficulty.

As to colour, Professor Herdman has made a note in his diary on a specimen from this locality which I think there is little doubt refers to the species in question. "Flat red Doris, 1 inch, spotted with dark purple on under-side, wide mantle." There is little trace of colour remaining, the ground colour is white above and below, and the larger tubercles surrounding the centre of the mantle have each a faint light brown ring, the under-side is rather thickly spotted with darker brown, the spots having a deep nucleus and a fainter halo; their diameter varies from 0·5 millim. to 1·5 millims. The rhinophores are white, the branchiæ yellowish, shaded with brown internally at their base, rachides white. The branchiæ are 6 in number, tri-pinnate, the branches small, the rachides long and thick, joined at the base and each with a median groove exteriorly. The branchial pore is raised, circular but not produced into a tube. The rhinophoral pores are slightly raised.

The radula (Plate III., figs. 1 to 3) differs somewhat from that usually found in *Platydoris* on account of the rapid decrease in size inwards of the innermost 14 teeth.

The number of lateral teeth on each side is 48, the 6 or 7 outermost being fringed instead of simply hooked. The penis seems to have been armed as in *Platydoris* with hooked plates, but the preparation was unfortunately mislaid before examination. The vagina (Plate II., figs. 22 and 23) is very strongly armed with two longitudinal rows of peltate discs, very convex, the boss formed of a single powerful spine; there are about 16 discs on each side opposite each other, but not arranged in pairs. They are largest in the centre of the rows and become much smaller towards each end.

The stomach (Plate II., fig. 21) is of an unusual structure, the intestine leaving it medio-dorsally instead of anteriorly, as is usual. The radula sac is long and curved upwards on the left side of the œsophagus (Plate II., fig. 20).

This species differs from the usual type of *Platydoris* in the long radula sac, form of the radula, structure of stomach and larger size of dorsal tubercles. It agrees with it in its general flattened form and genital armature. It is probable that an examination of further specimens will make it clear that a generic distinction exists.

SUB-FAMILY: DIAULULINÆ.

Halgerda punctata, n. sp.—Plate III., figs. 4 to 7.

There are in the collection (Gulf of Manaar) two specimens of a moderately large glabrous Dorid with the mantle raised into tubercles, more or less connected by ridges, for which I propose the above name. I have placed it in the genus *Halgerda*, as it agrees in most points with the single known species *Halgerda formosa*. Professor HERDMAN'S notes describe what must be this species as follows:—"Dorid, W. of DONNAN'S Paar, 29 faths., March 11th, 1902; pale whitish-grey, rather translucent, with yellow papillæ on mantle, and purple spots on foot and a few also on mantle."

The ground colour of both the preserved specimens is white on both sides of the mantle, and on the foot. The mantle is flecked with a few black spots, which measure from 0·5 millim. to 1·5 millims. in diameter, appearing to be of tougher consistency than the rest of the body, and to extend to a slight depth. In one specimen there are only four such spots, very small, near the posterior end, but in the other they are more numerous, about twenty, arranged more or less symmetrically. There is a pinkish tinge on the apices of some of the tubercles. The under-side of the body of both specimens is marked with black spots similar to those found on the notæum, but more numerous, especially on the specimen which is more spotted above. The size is about the same in both specimens: length about 3 centims., width 2·8 centims., height 1·5 centims. The mantle is glabrous, moderately tough, and bears numerous large blunt tubercles arranged in more or less diagonal lines connected by ridges which form an irregular triangular network. This arrangement is much more distinct in one specimen (figured on Plate III., fig. 4) than in the other, which has much fewer tubercles, and in which the ridges are almost obsolete. The branchial opening is circular and measures about 0·6 millim. in diameter, its edges are thin and raised into a collar with smooth even margin. The rhinophoral pores are oval, placed longitudinally with even edges somewhat raised. The pseudo-peritoneum is of a blackish-brown colour. The foot is moderately wide: in the preserved specimen it is much contracted and measures 0·45 centim. across. It is bi-lipped in front, the anterior lip bifid. The head is small, the tentacles very small and apparently tubercular.

The branchiæ (Plate III., fig. 6) are 4 in number and tri-pinnate, the anterior pair larger, the posterior pair shorter and divided deeply into two main branches. The rachides are rather thick, white on the outer side and black interiorly. The lamellæ are black. The anus is rather long and tubular, white with a black crenulate margin. The rhinophores are stout, with black lamellated tips and thick white base.

The radula sac is unusually long and curved towards the left side. The radula consists of 50 rows of hooked teeth; the lateral teeth on each side number about 50, a median tooth being absent. The 20 innermost teeth (Plate III., fig. 5) are very small, increasing outwards; the 3 outermost teeth (Plate III., fig. 7) are small and thin, but not fringed or denticulate. There is no buccal armature, but the buccal tube has a stiff chitinous lining in which were embedded several grapnel-shaped sponge spicules.

The penis and vagina are as far as could be made out unarmed. The stomach and gut were both crowded with tapering rod-shaped spicules roughened at the apex and slightly bent at the base.

This species agrees with BERGH's diagnosis of the genus *Halgerda* in the following particulars: The smooth leathery mantle raised into tubercular ridges, the bi-lipped foot, small tentacles, small number of branchiæ, absence of jaws, long curved radula sac, radula without median tooth and with the innermost teeth markedly smaller, unarmed penis and vagina. The genus *Dictyodoris*, though placed by BERGH in a different sub-family, also approaches it in some respects.

Halgerda formosa from Mauritius differs from the species now described in having more numerous and apparently narrow dorsal ridges, and in having two outermost teeth of the radula on either side denticulate. It is marked with crimson spots and yellow lines, and Professor HERDMAN states that the black spots found on *H. punctata* are purple during life.

Thordisa (?) caudata, n. sp.—Plate II., figs. 18 and 19.

I have provisionally placed this species in the genus *Thordisa*, though one of the most noticeable features of the genus, the villose mantle, is absent.

A single specimen was taken to the south-east of Cheval Paar in February, 1902. The length of the animal is 2·9 centims., width 1·1 centims., height 1·6 centims.; the contracted foot is 0·8 centim. wide. The colour is a creamy white without markings, the rhinophores grey, the branchiæ white.

The body is elevated, evenly rounded; the mantle well developed posteriorly, slightly longer than the foot, the postero-lateral margins bent inwards towards the foot; the distance from the branchial opening to the end of the mantle 0·8 centim. The branchial opening is oval, transversely placed, measuring 5 millims. by 3 millims., its edges raised into a low smooth collar. The edges of the rhinophore pores are slightly raised. The texture of the mantle is firm and spiculose, it is covered with rather small but not very crowded low truncated or flattened tubercles with the ends of the spicules showing through their surface. The front margin of the foot is bilobed, the head is small, the tentacles very small and flattened.

The radula (Plate II., figs. 18 and 19) consists of about 38 rows. The lateral teeth on each side number 39. The 10 innermost teeth are rather small, hooked, and have a minute denticulation on the outer side. The three outermost teeth are small, the two outermost being fringed and the next simply hooked.

There are both salivary and ptyaline glands present on the buccal mass.

The penis and vagina are unarmed, but it is possible, since the genital organs bear a great resemblance to those of *Jorunna*, that the presence of a stylet may have been overlooked.

SUB-FAMILY: CHROMODORIDINÆ.

Chromodoris reticulatus, PEASE.

One specimen of the above (= *Chromodoris alderi*, COLLINGWOOD) was taken at a depth of 45 fathoms in the Gulf of Manaar, in February, 1902.

The colour when living, as noted by Professor HERDMAN, was "white speckled with red-brown; bright yellow border. Gills dark red and white; long white tail."

The colour of the preserved specimen is a pale orange-yellow, with fine reddish markings and reticulations, the latter rather wider towards the margin. Branchiæ simply pinnate, light red, with two deep red lines running up the inside of the rachis. Rhinophores dark red. Margin of mantle with faint narrow orange line. General colour effect reddish-orange, darkest anteriorly. Length of preserved specimen 2·8 centims., width 1·8 centims., height 1·8 centims., width of foot 1·1 centims. The free margin of mantle is narrow, turned up posteriorly, with median posterior notch. Branchiæ 24, arranged in two spirals as in *Casella*. Pseudo-peritoneum tough, white, but without nodules.

The radula corresponds very well with the figures given by BERGH for *C. reticulatus*, and the labial armature is formed of bifid rods, as noted by him.

I think that there is little doubt but that this species is both the *C. reticulatus* of PEASE (**6**, p. 205), and the *D. alderi* of COLLINGWOOD (**8**).

The figure given by COLLINGWOOD is more like it than that which BERGH gives after GARRETT, and shows the notch at the end of the mantle which BERGH does not allude to. The number of branchiæ is given by BERGH as 9 to 15, and by COLLINGWOOD as 12, but this seems to be of no specific importance in the genus.

I have no drawing of the form assumed by the animal when alive, but the shape of the preserved specimen approaches so near to *Casella* that, taken with the manner of arrangement of the branchiæ, it raises a doubt as to whether the distinction between the genera *Chromodoris* and *Casella* can be preserved or rather whether the line of separation has not been drawn in the wrong place.

Chromodoris tenuilinearis, n. sp.—Plate III., figs. 11 to 15.

There is a single specimen of the above, taken on the Cheval Paar.

The length of the preserved specimen is 2·5 centims., its width 0·6 centim. and its height 0·8 centim. The mantle is smooth, long and narrow, slightly wider than the foot and not reaching as far as it posteriorly. The foot has its margins adpressed and extends behind the body for 0·4 centim.; width of the body 0·5 centim.

The ground colour is a dirty transparent white. The mantle is marked by intersecting diagonal broken lines of a pale greyish-green colour (Plate III., fig. 11). The sides of the foot are marked with traces of similar lines.

The branchiæ are 8 in number, long, slender and limp, simply pinnate, issuing from a collar about 1 millim. high. The rhinophores are long, slender and colourless.

The radula consists of 66 rows, formula 71–0–71. One or two of the innermost teeth on each side are trifid, the rest bifid. There is a trace of a median tooth on the rachis. The outermost tooth is a flat plate with median notch, the 2nd tooth is slightly hooked and distinctly bifid.

The jaws are strong, divided into 3 parts, one median and two lateral. They are made up of hooked plates regularly arranged in alternating rows.

There was no further examination of the animal made. The markings are of a rather unusual type in the genus *Chromodoris*, in which they usually consist of brightly-coloured lines parallel to the sides of the mantle or longitudinally arranged, or else of spots.

The armature of the jaws and radula are paralleled in several species, notably in *C. semperi*, Bgh. (**9**, p. 482, plate lii., figs. 1 and 2; plate liii., figs. 13 and 14), in which they are almost identical.

Casella cincta, Bgh.

One specimen from Muttuvaratu Paar, length 2·3 centims., has its colour fairly well preserved. It is of a dark claret or plum colour, fairly uniform, with a dark green margin to the mantle and, less evidently, to the foot.

The branchiæ are about 28 in number, simply pinnate, reddish with a dark green rachis. They are arranged apparently in two spirals, one on each side of the anus. Anterior to the anus is one gill plume distinctly larger than the rest.

The rhinophores are finely laminate, plum coloured, with a tinge of green at the tips.

The radula contains about 140 rows, formula about 63–1–63. The teeth are hooked, with from 8 to 10 fine lateral denticulations on the outer side. The innermost lateral tooth is denticulated on both sides.

The labial armature is formed of bent rods with pointed tips slightly hooked.

Professor HERDMAN'S notes contain a sketch of the animal in a living state which shows very well the characteristic shape, and very closely corresponds with the figure of *C. cincta* given by BERGH (**9**, plate lxxviii., fig. 9). Professor HERDMAN describes the colours in the living animal as follows :—" Pink with green edgings; edge of foot and mantle white, then a marked green line, then inside that a yellow band, then a pink and white dotting covers the rest. Branchiæ in two spirally arranged tufts; four large processes in front."

Ceratosoma cornigerum, GREY (?).

It is difficult to name with any certainty preserved specimens of *Ceratosoma* unless the colour of the living animal has been noted, as the radula and jaws of all the described species are almost identical and the external form is liable to a considerable amount of variation. There are in the collection three specimens of *Ceratosoma*, all very small, under 2 centims., which I have doubtfully referred to the above species. They vary considerably in the length of the dorsal horn, but agree in having the line of separation between the back and sides marked by a not very prominent ridge, which is not produced into lateral lobes. They are of a uniform cream colour, one specimen, from south-east of East Cheval, being distantly spotted with opaque white dots. The other two specimens were taken at Talaivillu Paar and ½ mile south-east of Dutch Modragam Paar, respectively.

[**Ceratosoma ornatum,** BGH.]

In Professor HERDMAN'S notes there is a description with accompanying sketch of a species of *Ceratosoma*, but the specimen to which it refers has apparently not been preserved, or has disappeared from the collection. There is no doubt, however, that the species is *C. ornatum*, which has been described by BERGH from a specimen taken in Amboyna (**9**, p. 946).

Professor HERDMAN'S description, which is fuller than that given by BERGH, is as follows: "Spotted all over with yellow on a pale mauve ground, deeper on dorsum, getting to white on foot, with deep mauve or purple edgings to the front and lobes. Horn with mauve edgings on pale ground; tail with yellow spots on mauve. Head with yellow spots on white. Front of foot with mauve spots on white. Rhinophores brown at base, violet at tip, laminated. Anus violet edged. Gills white at base, yellow in middle, brown at tip. Off Galle, 34 fathoms, February 18th, 1902."

The capture of a small violet-spotted specimen on March 8, 1902, towards the north of the Gulf of Manaar, is also noted, but the specimen is absent. This may be an undescribed species, as none of the described species are violet spotted, except as subsidiary to other coloration.

Doris, spp. ?

There are several small very much depressed Dorids from the east of the Gulf of Manaar and the south end of Cheval Paar which I have not been able to identify. They appear to belong to two closely allied species. One is represented by 8 specimens from the Gulf of Manaar and 2 from Cheval Paar. The largest specimen measures 1·1 centims. by 0·8 centim. The back is covered with uniform, blackish-brown, very minute marbling or reticulation. The ground colour of the Manaar specimens is a mahogany-brown, probably owing to the action of spirit; of the Cheval specimens, pale brownish-grey. The radula in the largest specimen consists of 45 rows of 18–0–18 teeth; in a specimen measuring 0·8 millim. by 0·5 millim. it is 39 rows of 16–0–16. The innermost 6 or 7 teeth are bifid at the apex, the rest are simply hooked. From the margin of the radula the first 4 teeth increase in size, and from the fourth to the centre again decrease regularly and rapidly.

The foot is moderately broad; its front margin not distinctly bilobed, but sharply folded inwards in the middle line, the fold being flattened and fitting into a recess in the under-surface of the notæum. The tentacles, which are minute and pointed, appear to be attached to the sides of this recess. The notæum is tough and densely spiculose; the branchial pore is small and 6-lobed. An examination of the gonads failed to show any armature.

The other species resembles the above in form and in structure of the front of the foot, but the markings are more minute and diffuse. It is represented by 2 specimens from Cheval Paar, the largest measuring 1·2 centims. by 1 centim., most of this size being taken up by the wide margin of the notæum.

The radula consists of 42 rows of 24–0–24 teeth, and, except for the inner teeth being simple instead of bifid, closely resembles the first-mentioned species.

FAMILY: DORIOPSIDÆ.

Doriopsis aurea (Q. and G.).

The Doriopsidæ are only represented by a single species, *D. aurea*, of which one specimen was taken off Karativo on March 10th, 1902.

The colour, when alive, as noted by Professor HERDMAN, is "orange red with brown orange spots, those along margin of mantle pale blue." The same coloration, though much fainter, was noticeable in the spirit specimen, the orange red having become yellow.

QUOY and GAIMARD, in the "Voyage de l'Astrolabe" (1, p. 265, plate xix., figs. 4 to 7), give a figure and description of *Doris aurea*. It is described as orange-red with white spots (blue spots ringed with white in the figure) scattered over the back, "parsemé en dessus" (in the figure they are represented as in three rows, one median and two lateral), branchiæ 5, compoundly pinnate; back elevated; smooth rhinophores with 15 lamellæ and a distinct longitudinal ridge (in figure); length a little over

2 inches. It was taken in fairly deep water off Jervis Bay, Tasmania. The description, though not perfectly in agreement with the Ceylon specimen, yet is sufficiently near to make the identification most probable.

Doris aurita, GOULD (**2**, p. 299, fig. 394), is similarly coloured, but has 8 branchiæ. The same type of coloration is also found in a Tectibranch, *Pleurobranchus punctatus* and it would be interesting to discover whether these similar markings, occurring in different groups, were associated with a similar habitat, or were merely fortuitous.

FAMILY: PHYLLIDIIDÆ.

Phyllidia varicosa, LMK.

There is a single specimen of the above, taken on Muttuvaratu Paar. The colour of the spirit specimen is as follows:—Mantle of a deep bluish-black; tubercles with a halo of faint bluish-white; their tips with a purplish tinge. The tubercles are roughly of two sizes, large and small; there is a line of tubercles down the centre of the mantle, each large tubercle alternating with two small ones, the edges of their halos just touching. There are 2 ill-defined rows of more distinct large tubercles on either side, the smaller tubercles being scattered irregularly around them. The margin is occupied with very small crowded tubercles arranged irregularly 2 to 3 deep.

The underside of both mantle and foot is a dark greyish-black. There is no median black line on the sole of the foot.

This species is widely distributed throughout the Indian Ocean and has, according to BERGH, been recorded from Ceylon by KELAART (**3**) under the name of *Phyllidia ceylanica.*

Professor HERDMAN'S notes contain references to the capture of another *Phyllidia*, probably this species, at Periya Paar. It is described as being of a "rich dark green colour with prominent bright yellow papillæ; edge of mantle yellow all round; foot dark green."

Phyllidia nobilis, BGH. (?).—Plate III., figs. 16 and 17.

There is in the collection a small specimen of *Phyllidia* or *Phyllidiella*, taken off Talaivillu in April, 1902. I have been unable to distinguish satisfactorily between these two genera, and have been compelled to adopt Sir C. ELIOT'S view (**12**) that the distinction cannot be maintained.

The length of the spirit specimen is 2·5 centims., width 1·25 centims., width of foot 0·7 centim. The tentacles are short, pointed, placed close together at base, divergent, laterally grooved. The lateral branchial lamellæ are about 60 in number, triangular. The margin of the mantle is white, moderately narrow, bearing very small tubercles. Inside this is a very narrow black line bearing a few tubercles, entire in front, slightly broken behind. The centre of the mantle is of a bluish-white colour bearing white knobbed tubercles and marked by 3 black bands which take the form of a three-pronged fork directed backwards. The outer branches of the fork are parallel to the margin and on the outer side bear three short branches projecting at right angles and nearly reaching to the margin. The innermost prong of the fork is shorter than the 2 outer and bears 3 white tubercles. A very slight alteration of the white bands in *P. nobilis*, as figured by BERGH, would produce the pattern here described. It may be, however, that it should be referred to the variety of *P. varicosa* figured by BERGH (**9**, plate xxv., fig. 7). The underside of the Ceylon specimen is of a pale bluish-grey with 3 to 4 lateral ill-defined black spots.

(DORIDIDÆ PHANEROBRANCHIATÆ.)

SUB-FAMILY: POLYCERINÆ.

Aegires villosus, n. sp.—Plate III., figs. 18 to 22.

One specimen (Plate III., fig. 18) of the above, length 0·9 centim., was taken to the north-west of Cheval Paar. The body is elevated, with a medio-dorsal bunch of long clavate processes or elongated tubercles (Plate III., fig. 19) surrounding the branchial pore; two of these processes are slightly branched. There are two irregular lateral lines of slightly clavate tubercles on each side of the body, and small tubercles are crowded on the nape of the neck. There are longitudinal patches of purplish-brown pigment lying between the tubercles on the back and sides. The ends of the tubercles are shaded with brown. The ground colour is a dirty greyish-white. The surface of the body and tubercles is densely spiculose, the spicules projecting and giving the animal under slight magnification a densely pilose appearance.

Rhinophore sheaths (Plate III., fig. 20) with 3 outer moderately long tubercles, and 1 small inner tubercle. The radula shows that the specimen is evidently immature, it contains only 12 rows with 16 simply hooked teeth (Plate III., fig. 22) on each side. The jaws are not developed, but the chitinous collar shows slight lateral thickenings and a well-marked upper jaw (Plate III., fig. 21).

This genus has previously been known only from the Atlantic and Mediterranean.

Trevelyana bicolor, ALD. and HANC.

One specimen of what appears to be this species was found on Galle coral reefs in August, 1902; length, 1·2 centims. The colour has been lost and the skin is transparent, showing the internal organs. The liver occupies the posterior two-thirds ot the body and is of a bluish-grey colour. The branchiæ are 12 in number arranged in a circle round the anus on the centre of the back. The area of skin surrounding the branchiæ is more opaque than elsewhere, which seems to suggest that it is of a different colour during life. There is a branching white arrangement, probably vascular, anteriorly on the surface of both sides of the body. The rhinophores are retracted. The size and number of branchiæ of this specimen seem to point to its being *T. bicolor*. The radula was not examined.

Kalinga ornata, ALD. and HANC.—Plate III., figs. 23, 24.

A small specimen, length 2·5 centims., was taken 10 miles north of Cheval Paar. Professor HERDMAN has made the following note on its coloration when alive: "Pale grey, nearly transparent, with red internal organs showing through, and beautiful red papillæ on surface of body. Rhinophores lamellated at tip and coming from fringed sheaths. Colourless papillæ on body. Branchiæ tri-pinnate."

BERGH (**9**, pp. 959 to 962) has given a full account of the anatomy of this species with the exception of the radula, which was missing in his specimen owing to the pharynx having been everted through the front of the foot. Curiously enough, Professor HERDMAN'S specimen had suffered an almost similar misfortune, the whole buccal mass having been everted through the mouth opening, so that the radula lay along the under-surface of the everted organ. The teeth (Plate III., figs. 23 to 24) are very numerous and all similar. Their shape is remarkable, each tooth having three long curved pointed cusps. They are arranged in about 130 rows, the radular formula being 90–0–90. There is no median tooth, but the rachis bears at intervals a few very small spurious teeth. The innermost tooth on each side differs slightly from the rest in having the inner spine slightly shortened; the outermost tooth is a flat plate, the 2nd and 3rd have traces of a single hook, the 4th has two hooks, and the 5th three. The teeth increase in size gradually from the margin inwards to the centre. The teeth in the specimen examined were widely separated from each other, perhaps owing to the stretching of the radula.

II. TECTIBRANCHIATA.

There are in the collection 17 species of Tectibranchs, 7 of which are here described as new to science.

Of those already known, two, *Philine aperta* and *Doridium depictum*, are well-known Atlantic or Mediterranean species; two, *Aplysia cornigera* and *Dolabrifera maillardi*, have been identified on the strength of the resemblances of the shells, as nothing seems to have been published on the animals themselves; the rest are fairly well-known Indian Ocean or Pacific species. The list of species is as follows:—

Philine aperta, LINN.
Doridium marmoratum, SMITH.
,, *depictum* (REN.), var.
Aplysia cornigera, SOW.
,, *elongata*, PSE.
,, *intermedia*, n. sp.
Phyllaplysia albomaculata, n. sp.
,, *pellucida*, n. sp.
Aplysiella mollis, n. sp.
Dolabrifera maillardi, DESH.
,, *marginata*, n. sp.
Dolabella scapula, MARTYN.
Notarchus indicus, SCHWEIG.
,, *ceylonicus*, n. sp.
Pleurobranchæa brocki, BGH.
Pleurobranchus citrinus, R. and L.
,, *hornelli*, n. sp.

In an Appendix, I place:—

Onchidium verruculatum, CUV., and *Marsenia perspicua* (LINN.).

FAMILY: PHILINIDÆ.

Philine aperta, LINN.—Plate IV., fig. 1.

This is one of the most abundant species in the collection. It is represented from the Gulf of Manaar, Galle, deep water off Galle, Trincomalee, off Kaltura, the pearl banks off Aripu, and south of Modragam—in all 42 specimens, of which 33 came from the Gulf of Manaar. The specimens vary considerably in appearance owing to their different degrees of contraction, but the shells are identical in texture and almost so in shape. The shells (Plate IV., fig. 1) are of a moderately elongated oval form with a smooth somewhat opalescent surface, and agree with *P. angasi*, from Australia; but I do not think that the slight difference in form between these shells and those of British specimens of *P. aperta* can be regarded as amounting to a specific distinction. There was no constant difference to be noted between the gizzard plates and those of the typical *P. aperta*, though in most cases the ventral plate was more asymmetrical and the ends of the lateral plates more produced.

The radula was as in *P. aperta*.

BERGH (**12**) has recorded *P. aperta* as occurring not uncommonly in the Gulf of Siam, and it seems not improbable that it has a cosmopolitan distribution, and is represented by local races in many places; as such perhaps may be :—*P. vaillanti*, *P. erythræa* (though that species is said to be distinguished by the peculiar serration of its gizzard plates), *P. angasi*, *P. orientalis*, *P. caurina*, *P. vitrea* and *P. coreanica*.

Doridium marmoratum, SMITH.

One specimen from the Gulf of Manaar should, I think, be referred to *D. marmoratum*. Its length is 2·2 centims., width 1·1 centims.; length of head shield 1·3 centims., width 1·1 centims. The ground colour is a dark brownish plum with numerous small pale oval or circular spots, those on the foot being rather larger than those on the rest of the body. The margins of the foot and the front margin of the head shield are marked with a bluish-black line. The sole of the foot is slightly darker than the rest of the body. The lateral margins of the foot are closely adpressed to the sides of the animal. The head shield appears to be emarginate posteriorly, owing to its posterior extremity being turned up. The gill protrudes through the mantle slit on the posterior end of the body, probably owing to an injury, as the specimen is in rather bad condition, the pharynx having been everted through a rupture in the front of the head shield and the shell crushed to fragments. *D. marmoratum* has only been recorded from Torres Straits (**7**).

Doridium depictum (REN.), var.

A small specimen dredged on Periya Paar, in 9 fathoms, had the following coloration, as noted by Professor HERDMAN, while alive, "brown, mottled with pale green, and having two yellow lines from the head backwards; front edge of foot blue, lobe of mantle over gill paler, with edging of violet." In the spirit specimen the markings are as described, but the blue and green colours have disappeared; the ground colour is a pale brown.

The length of this specimen is 1·45 centims., width 1·05 centims., length of head shield 0·9 centim., width 0·85 centim. The shell was very much broken. The foot is pale, without markings, its margins are only slightly incurved.

There is nothing in the form of the animal to separate it from *D. depictum* of the Mediterranean, and, as that species is known to be extremely variable as regards coloration, I have recorded the Ceylon specimen as a variety.

Family: APLYSIIDÆ.

There appears to be a great amount of uncertainty as to the extent of the genera *Dolabrifera*, *Aplysiella* and *Phyllaplysia*, each author using the names with a different meaning. The distinctions have been based mainly on the form of the animal, which must vary considerably in the same species in preserved specimens. I have not material sufficient to throw any light on the matter, and have for convenience merely used the names in the following manner:—

Aplysiella.—Specimens with short median mantle slit, swollen body and broad foot.

Phyllaplysia.—Specimens with depressed body, median mantle slit and broad foot; shell in this and the preceding genus resembles that of *Aplysia.*

Dolabrifera.—Specimens with moderately depressed body, broad foot, posterior mantle slit and bat-shaped shell.

The circum-œsophageal nerve ring shows the same type in all, the commissures being short, the cerebro-pedal being almost as long as the cerebro-visceral. In the two species of *Dolabrifera* which occur in the collection there is a resemblance in the radulas in the fact that the inner cusp of the lateral teeth is always smaller than the outer.

Aplysia cornigera, Sow.—Plate IV., figs. 2 to 7.

It is impossible, on account of the many vague descriptions, with or without figures, which have been published, to say with certainty what name should be applied to what appears to be the common Ceylon species of *Aplysia.* I have identified it as *A. cornigera*, Sow, on account of the resemblance to the shell of that species, of which only the shell is known. It is represented in the collection by seven specimens, two from the Gulf of Manaar, two from the pearl banks off Aripu, one from the pearl banks off Manaar and two without definite locality.

The coloration of these specimens is a groundwork of fine reticulating brownish-olive lines, with clear spaces here and there, as in *A. punctata*. There are also small black spots, about 1 millim. in diameter, scattered over the surface of the body. The amount of pigment on the inner side of the pleuropodia varies; usually there is very little, and it is almost absent in some specimens.

The length of a well-preserved specimen was 6·3 centims. The pleuropodia were free to within from 5 millims. to 8 millims from the end of the foot. The excurrent mantle siphon was moderately produced, from 5 millims. to 10 millims. in length. The tentacle flaps were mostly flattened, but varied according to the amount of contraction. The mantle foramen was closed in some specimens, but the mark of its position was apparent; in others it was about 2 millims. in diameter. The markings and clear spots showed a sort of radial arrangement round the foramen. The hyaline gland (Plate IV., fig. 6) consisted of a group of large globular cells lying beneath the sub-dermal muscle layer and penetrating it at intervals. There was no sign of a single common duct. The gland in appearance resembled a bunch of grapes attached laterally to the muscle layer, and would seem to be intermediate in form between the two types of gland described by BLOCHMANN (**6**) as occurring in *Aplysia*, since the cells appeared to open separately on the surface or else two or three into a common opening.

The shell (Plate IV., fig. 4) is thin, with a fragile calcareous layer; the inside is opalescent, of a delicate pale pink tint; the outside is glossy, pale whitish-brown, with distant growth ridges.

The radula (Plate IV., figs. 2, 3, 5) consists of about 40 rows of 21–1–21 teeth of the usual form; the 16th and 17th from the centre have rudimentary hooks and the four outermost teeth consist of flat plates. The labial armature is made up of blunt rods.

A. pulmonica, GOULD, from Samoa, may perhaps prove to be the same as this species, but seems to be separated by having the pleuropodia fused for a larger proportion of their length.

Aplysia elongata, PEASE—Plate IV., figs. 9 to 12.

A specimen of the above was taken on Jokkenpiddi Paar in April, 1902.

The length of the preserved specimen is 1·2 centims., height 0·9 centim. The colour is an opaque whitish fawn with brownish markings irregularly arranged, leaving vacant spots, and in addition a fairly uniform but rather distant spotting of opaque white pigment. The eyes are distinctly visible, the skin over them being devoid of pigment. They lie lateral to and a short distance from the base of the rhinophores. The rhinophores (Plate IV., fig. 10) are tubular and split for about $\frac{3}{4}$ of their length; they resemble greatly a hare's ear in appearance. The tentacles are much shorter than the rhinophores and are split to the base. The inside of both rhinophores and tentacles is strongly pigmented. The pleuropodial lobes are short, meeting behind the mantle siphon; they are slightly pigmented with light brown on the inside. The mantle is transparent and colourless except for a black line along the margin of the mantle foramen. The latter is large and oval, measuring 5·5 millims. by 3·5 millims. The shell (Plate IV., figs. 11 and 12) is large, strong, opaque and deep, with well-marked growth ridges and overhanging adnate callus hood; it measures 9·5 millims. by 7 millims. Judging by the size of the shell and the way in which it has been forced out of the mantle cavity, the whole animal is very much contracted.

The radula (Plate IV., fig. 9) is of an orange-yellow colour and contains 34 rows of 13–1–13 teeth, the 4 outermost being imperfect.

This specimen agrees very closely with *A. elongata* from the Sandwich Islands, the very large mantle foramen and large strong shell with well marked callus being very characteristic.

Besides the above there are in the collection 2 specimens from Chilaw Paar which are most probably young examples of *A. elongata.* They resemble the Jokkenpiddi specimen in form, but differ in being semi-transparent and colourless except for a narrow black edge to the rhinophores, tentacles, front of foot, mantle foramen and posterior part of pleuropodia. The shell is membranous with a very delicate white calcareous layer which has mostly disappeared.

The radula has only 27 rows, the teeth being as in the larger specimen; the lengths of the two Chilaw specimens are 1·3 millims. and 1·1 millims. respectively.

Aplysia intermedia, n. sp.—Plate IV., fig. 8.

There is a single well-preserved specimen of *Aplysia* from S. Cheval Paar which does not fit in with any of the published descriptions. It combines the opposite characters of a large mantle foramen and long free pleuropodia.

Length of the preserved specimen 1·8 centims., width 1·4 centims., height 1 centim., length of foot 1·6 centims., distance from fusion of pleuropodia to end of foot 2·4 millims., mantle pore 4·25 millims. by 3 millims., length of mantle siphon 2 millims. Colour of living animal, green; colour of spirit specimen, greyish; general effect made up of fine recticulating broken black lines of the usual *Aplysia* type, following no regular plan; mantle with black specks rather concentrically than radially arranged. The mantle foramen has not a black edge.

The tentacles are large, produced anteriorly into broad labial flaps. The shell is large (1·1 centims. long), thin and membranous; calcareous layer only present as a few small patches at the apex of the shell.

The radula (Plate IV., fig. 8) consists of 30 rows of 16–1–16 teeth, the 3 outermost being without hooks. The teeth resemble those of *A. elongata* in form.

Phyllaplysia albomaculata, n. sp.—Plate IV., figs. 13 to 16; Plate VI., fig. 6.

I have thought it best to create new species for this and the two following forms, rather than run the risk of identifying them incorrectly with any of the many vaguely described species which are in existence. The single specimen of *P. albomaculata* was taken south of Adam's Bridge, 30 fathoms, in March, 1902. Professor HERDMAN notes concerning it: "Olive brown spotted with white, foot paler, little spiky papillæ on mantle," accompanying his note with a sketch which shows the living animal in configuration and proportions almost exactly as in the preserved specimen.

The total length is 2·8 centims., width 1·5 centims., height 0·7 centim.

The form of the animal (Plate VI., fig. 6) is an oval, produced anteriorly to form the head. It is very much depressed. The foot is conterminous with the body laterally and posteriorly; anteriorly it extends beyond the head on either side.

The branchial slit is situated rather nearer the right side, the margins not closing over the slit. The tentacles and rhinophores are of moderate size, tubular and slit as usual. The eyes are distinctly visible in front of the rhinophores. The surface of the back is dotted with little spiky papillæ, simple or compound. The shell (Plate IV., fig. 15) is calcareous, very fragile, white with a slight brownish tinge, striated by growth lines and with a small but well-marked embryonic spine (Plate IV., fig. 16).

The radula (Plate IV., figs. 13 to 14) has 32 rows of 44–1–44 teeth. The teeth, as is usual in the genus, have two broad spatulate cusps and a small basal denticulation. In the 2nd and 3rd innermost teeth the inner cusp is distinctly larger than the outer; in the 4th they are about of equal size, and from the 5th outwards the outer cusp is the largest. The nature of the buccal armature was not noted.

Phyllaplysia pellucida, n. sp.—Plate IV., figs. 17 to 21; Plate VI., fig. 12.

There are, in the collection, 2 specimens of a smooth flattened *Phyllaplysia* from Chilaw Paar, for which I propose the above name. They are of a gelatinous consistency, semi-translucent and colourless. The length of the largest specimen (Plate VI., fig. 12) is 1·7 centims., width 1·5 centims., height 0·7 centim.

The foot is as wide as the body. The head is very much contracted, with short tentacles and rhinophores. The branchial slit, length 6 millims., lies rather nearer the right side, the right margin overlapping the left, except posteriorly, where the slit is open. The surface of the body is smooth. The eyes are not visible in the preserved specimens.

The radula (Plate IV., figs. 17, 19 to 21) consists of about 30 rows of 30–1–30 teeth. The teeth are of the usual form, with two main cusps and a smaller accessory one. From the 1st to the 10th tooth from the centre the innermost cusp is the largest, and from the 11th to the 25th the outermost. The five outermost teeth are slender, curved, and simple. The labial armature (Plate IV., fig. 18) is made up of square rods with denticulate inner margins.

The shell (Plate V., fig. 1) is of the same form as in *Aplysia*. It is thin and membranous, with a very slight calcareous layer which comes off at a touch. It measures 7·8 millims. by 5·3 millims. An embryonic spine was not noted, but it may have crumbled away.

Aplysiella mollis, n. sp.—Plate IV., figs. 22 to 26; Pl. V., figs. 2, 3; Pl. VI., fig. 11.

There are two specimens from South Cheval Paar.

The length of the larger specimen is 2·4 centims., width 1·2 centims., width of foot 1·3 centims., height 1·0 centim., length of branchial slit 1·0 centim., front of head to commencement of branchial slit 1·2 centims.

The colour of the preserved specimens is white, semi-opaque. They are of soft, wrinkled, and of a somewhat flabby consistency.

The animal (Plate VI., fig. 11) is moderately swollen, *Aplysia*-like in form, with short branchial slit. Over the surface of the back are scattered small spiky papillæ, much fewer in one specimen than in the other. The rhinophores are moderately long, of the usual form. The tentacles are short, split as usual, and flattened. There is a slight development of labial flaps. The eyes are distinctly visible.

The shell (Plate V., figs. 2 and 3) is shaped as in *Aplysia*. It is membranous, with a very brittle, opaque white calcareous layer covered with small nodules.

The radula (Plate IV., figs. 22 and 24 to 26) consists of 33 rows of 48–1–48 teeth, the inner cusp being the larger in the 1st to 4th tooth from the centre and the outer cusp the larger from the 5th tooth outwards. The outermost 5 or 6 teeth are narrow, curved, and simple. The labial armature (Plate IV., fig. 23) is made up of rods, bent and bifid at the tips.

Dolabrifera maillardi, Desh.—Plate V., figs. 4 to 10.

One specimen from Muttuvaratu Paar, 8 fathoms, March 1902.

The original species of Deshayes was only described from the shell which came from Réunion (**5**). His description and figure agree fairly accurately with the shell of the Ceylon specimen. The preserved specimen (Plate V., figs. 4 and 5) is smooth, somewhat plump, moderately elongate, of a dirty white colour. Its length is 1·9 centims., width 1·3 centims., height 0·9 centim. Professor Herdman's notes contain a sketch of the living animal and state, "Port-wine colour, with a limited number of white spots having each a spiky papilla rising from its centre."

The foot is as broad as the body, with its margins slightly frilled. It does not extend beyond the body posteriorly. The body is elevated posteriorly and slopes forward somewhat, as in *Dolabella*. The branchial slit is short and narrow, length 0·6 centim. It commences at about the posterior third of the body and runs backwards. The tentacles and rhinophores are tubular and slit externally.

The radula (Plate V., figs. 6, 7, and 10) consists of 35 rows of about 62–1–62 teeth. The median tooth has a central cusp, and two lateral cusps on each side. The innermost teeth of the lateral rows have two large hooked cusps, and a small basal cusp on the outer side. This basal cusp is found on about the 20 innermost teeth, after which it disappears. The outermost teeth are long, slender, and bifid at the tips.

The shell (Plate V., figs. 8 and 9), length 4·6 millims., has an embryonic spine just below the apex, the apex itself being formed by a flattened plate or callus.

The labial armature is made up of blunt rods.

This species may perhaps prove to be identical with one of the many forms described by PEASE from the South Pacific (3), (4).

Dolabrifera marginata, n. sp.—Plate V., figs. 11 to 15.

One specimen dredged on South Cheval Paar.

The length of the preserved specimen is 1·95 centims., width 1·3 centims., height 0·75 centim. The form of the body is ovate, somewhat narrower in front, the body passing into the head without a distinct neck (Plate V., fig. 11). The branchial slit is situated far back, about 4 millims. from the posterior end of the body. The slit is 7 millims. in length, open at both ends, the right pleuropodial margin being lapped over the left in the centre. The genital furrow is well marked. The margin of the foot extends beyond the body laterally and posteriorly, forming a frill 1·5 millims. wide. The body is smooth, the skin being somewhat tense. The rhinophores and tentacles are short, tubular, and slit as usual. The eyes are visible in front of the rhinophores.

The shell (Plate V., fig. 15) is very thin and membranous, of the same form as in *D. maillardi*, but perfectly transparent except for a chalky powder over parts of its surface which rubs off at a touch. The apex of the shell was injured in extraction, so it could not be ascertained whether an embryonic spine was present or not. It is probable that this species has not been already described, as the shell is not well fitted for preservation in a conchological cabinet.

The radula (Plate V., figs. 12, 13, 14) is of the same type as in *D. maillardi*, but the lateral teeth are not so slender. It consists of 37 rows of 57–1–57 teeth.

Dolabella scapula, MART.—Plate V., figs. 16 and 17.

There are three specimens of this, the common species of *Dolabella* of the Indian Ocean; one from South-east Modragam and two from south of Adam's Bridge.

The coloration of the preserved specimens consists in a faded yellowish-white ground colour mottled over the body and foot with irregular olive-brown blotches. Professor HERDMAN notes of another specimen from S. of Cheval, 6½ fathoms: "Chestnut brown in general effect, yellowish basis mottled with red and brown, many yellow tags or spines all over, broad flat foot rather paler." In the preserved specimens the body was covered sparsely with short fringed papillæ, longest on the margin of the posterior disc. These papillæ were most numerous in the largest specimen, which measured 4·8 centims. in length, and almost absent from the smallest.

Some of the published descriptions state that *D. scapula* is uniformly coloured, but this is probably a matter of individual variation. The shell of the Ceylon specimens agrees with that of *D. scapula*, having kindly been compared with specimens in the British Museum by Messrs. E. A. SMITH and E. R. SYKES.

The radula consists of 44 rows of about 120–1–120 teeth, those near the centre being simply hooked (Plate V., fig. 17), while towards the margin the hook becomes a long scythe-shaped blade (Plate V., fig. 16).

Notarchus indicus, Schweig.

I have, on account of the resemblance of the radula to the figures given by Bergh (**11**, plate vii.), referred to this species 20 little immature specimens of *Notarchus*, from Ceylon. The largest of these measured 1·2 centims. in length. The label indicating the exact locality where they had been taken has unfortunately been lost.

Notarchus ceylonicus, n. sp.—Plate V., figs. 18 to 23.

There is in the collection one specimen of *Notarchus*, from ½ mile east of Dutch Modragam Paar, for which I propose the above name.

The form of the body (Plate V., fig. 18) is ovate, very plump, and inflated, except as regards the head. The foot is moderately wide and pointed behind. There is no shell. The branchial slit is short, length 6 millims. The length of the animal is 3·3 centims., width 2·1 centims., height 1·6 centims., width of foot 1·1 centims.

The surface of the body and head bears numerous small fringed papillæ which occur more thickly on the head, probably owing to its contraction. The rhinophores and tentacles are fringed with similar papillæ. Very small labial processes are present.

The radula (Plate V., figs. 20 to 23) consists of 30 rows of 33–1–33 teeth, the first 8 rows being imperfect. The first 5 teeth from the centre have four lateral denticles on the outer edge, the following 9 three denticles, the basal denticle being small and blunt, and becoming hard to recognise at a little distance from the centre. The next 4 teeth have two lateral denticles. From the 18th to the 24th tooth the distal denticle only persists, and the 9 outermost teeth are smooth and scythe-shaped, thus differing from those in *N. indicus*, which are serrulate.

Family: PLEUROBRANCHIDÆ.

Pleurobranchæa brocki, Bgh.—Plate V., figs. 24 to 28.

It is with some doubt that I refer to this species a well preserved specimen ot *Pleurobranchæa*, which was taken 5 miles north of Cheval Paar in March, 1902.

The colour of the preserved specimen is an opaque brownish-yellow, due evidently to its preservation in spirit. On the mantle and upper surface of the hinder parts of the foot there are rusty-brown markings in coarse irregular reticulations, occupying to some extent the furrows on the mantle.

The form of the body (Plate V., figs. 24 and 25) approaches the Mediterranean species *P. meckelii.* The total length is 3·2 centims., width (of foot) 1·7 centims., height 1·1 centims., length of mantle 2·6 centims., width 1·5 centims., length of foot behind body 0·7 centim., length of gill from genital papilla 1·2 centims., height of caudal papilla 3·5 millims.

The mantle is not very large, reaching beyond the body, both laterally and posteriorly, for about 1 millim. and rather more over the gill. The foot is somewhat wider than the mantle laterally, and reaches considerably beyond it posteriorly. The tail is somewhat pointed and bent upwards, terminating in a little conical caudal papilla. The frontal margin of the mantle is beset with two rows of minutely tuberculate papillæ; there are 7 of these in the upper row and 6 in the lower. There are also very small scattered intermediate tubercles along the margin, which is laterally produced on either side into a tentacular appendage. The gill has 36 lamellæ, each of them pinnate; it reaches to the level of the end of the mantle.

The rhinophores as usual rise from the mantle and are split down the outer margin.

The surface of the mantle is not distinctly tubercular, but is furrowed and rough, owing perhaps to contraction. The foot, mantle and body walls are very muscular and tough. The intercrossing of the muscle bands gives the appearance of a woven material, particularly on the inner surface of the foot after removal of the viscera.

The genital openings are separate. The vaginal pore has a short tubular opening at the commencement of the gill rachis. The penis is retracted, its opening directed forwards and lying about 1 millim. in front of the female opening. The anus lies dorsal to the membrane which attaches the free end of the branchial plume.

The jaws are made up of hexagonal rods (Plate V., fig. 27), the edges of the inner marginal rods being very irregularly denticulate. Teeth of radula (Plate V., figs. 26 and 28) in about 29 rows, formula 56–0–56. No sign of a median tooth was seen. Form, as figured by BERGH for *P. brocki* (**11**). Shell absent.

The colour of the Ceylon specimen differs considerably from that described by BERGH, which was of a reddish-brown with darker reticulations. VAYSSIERE mentions a specimen of the same colour, but says that the pigment is superficial, and easily rubbed off, which may account for its absence on this occasion.

Pleurobranchus (Berthella) citrinus (RUPP and LEUCK.).—Plate VI., figs. 7 to 10.

There are 3 specimens of *Pleurobranchus* apparently belonging to this species which were taken at Jokkenpiddi Paar, Cheval Paar and to the South-east of East Cheval respectively. They differ slightly in colour and appearance, the Jokkenpiddi specimen being of an opaque brownish-yellow and considerably more contracted than the others, which are white, rather translucent and plump. The South-east of East Cheval Paar specimen, which is the best preserved of the 3, measures 1·7 centims. by 1·05 centims. Its height is 0·5 centim. The mantle is elevated, somewhat inflated, a little wider than the foot, covering the head, and slightly emarginate in front. Its colour is a transparent white with opaque white dots. When examined under a lens of moderate power, the white spots are seen to be subdermal opaque flask-shaped structures tapering towards the surface and surrounded by distinctly marked clear hexagonal areas. The surface of the mantle is smooth. The gill is short and compact, length 0·7 centim., without rachidian tubercles. The lamellæ number about 25. The front of the foot is divided into two lips by a transverse furrow, the lower lip being the largest. The furrow does not extend laterally. The labial flap is produced on either side into 2 very short tentacles split laterally at their extremities.

The rhinophores are close together and rather short, tubular and split as usual. The genital openings are close together at the commencement of the gill, but not surrounded by a common investment. The penis is retracted.

The shell, length 0·5 centim., lies well forward at about the anterior third of the body; the apex is pale, with embryonic spiral well marked; the expanded portion is of a horny yellow colour, strong, with well-marked longitudinal and transverse striæ. The teeth are of the usual type in *Berthella*, as defined by VAYSSIÈRE (**9**), knife-shaped, with strongly denticulated edges. They bear about 14 denticulations.

The colour of the living animal as noted by Professor HERDMAN is "brilliant orange, with white dots in little systems on the back." This differs somewhat from RUPPEL'S description of *P. citrinus* as "pale lemon yellow, with large whitish irregular spots," but as they agree otherwise there does not seem sufficient grounds for separating them. *P. angasi*, SMITH, from Port Jackson, agrees in many ways with this species, but has only 16 gill lamellæ. The figures of *P. oblongus*, AUD., given by SAVIGNY, are very like the Ceylon specimens and the figure of the shell of that species shows an evident attempt to represent an embryonic spiral.

KELAART (2) has recorded this species as being of common occurrence in Ceylon; he gives the colour as orange spotted with white.

Pleurobranchus hornelli, n. sp.—Plate VI., figs. 1 to 5.

There are in the collection some specimens of *Pleurobranchus* which I have not been able to identify with any of the described species, and for which I accordingly propose the above name. These are 7 specimens, 6 of which were taken by Mr. HORNELL from a buoy-rope at Galle in July, 1902, and one on Galle coral-reef in August, 1902. Their colour, as far as is preserved, is a dirty white ground colour, with the mantle covered with fairly close reticulations of brownish-purple. The length of the largest specimen is 1·8 centims., width 1·2 centims., height 1·0 centim. The mantle is about equal to the foot in front and behind, and a good deal wider laterally. It is tuberculate, but the tubercles are indistinct, being crowded together so as to produce a level surface (Plate VI., fig. 5), the margins of the tubercles being only noticeable on account of the previously mentioned purple reticulation which occupies the space between them. In the Galle coral-reef specimen, which seems in a different state of preservation from the rest, the apex of each tubercle is raised into a small papilla.

The foot is moderately broad, with the front margin divided into two lips by a transverse furrow. The upper lip is much thinner and somewhat shorter than the lower. The furrow is continued laterally down one margin as far as the commencement of the gill and to an equal distance on the other side. The pedal gland is well developed in the Galle coral-reef specimen, but hardly noticeable in the others.

The tentacular shield is well developed, but not produced into tentacles laterally. The anterior portion of the lateral margins is grooved. The rhinophores are moderately long and split as usual. The gill is moderately long, 1 centim. in the largest specimen, reaching to the end of the body, bipinnate, the rachis with two rows of tubercles, pinnæ 25–26, pinnules about 16.

The genital openings are close together at the base of the gill and appear to be surrounded by a common investment. The shell (Plate VI., fig. 1) is very thin, with an opaque white calcareous coating very fragile and easily rubbed off. It seems to be very faintly striated in the lines of growth. It is situated at about the anterior third of the mantle and is distinctly visible through it as a white patch ; its length in a specimen of 1·5 centims. is 2·9 millims. by 1·9 millims. The shell has an ill-defined membranous edge without calcareous coating. The radula in one specimen examined consisted of 46 rows of about 70–0–70 teeth, the inner teeth being simply hooked (Plate VI., fig. 3), the outermost rod-like (Plate VI., fig. 2), slightly bent. The jaws are rather broader than usual, measuring 1·12 millims. by 2·35 millims. ; they are made up of plates of the usual form (Plate VI., fig. 4), with two lateral denticles at the apex, a large distal and a smaller proximal one.

APPENDIX.

Family : ONCHIDIIDÆ.

Onchidium verruculatum, Cuv.—Plate VI., figs. 13 to 22.

There is one specimen of this widely distributed species, very well preserved, from the Gulf of Manaar. The length is 3·1 centims., width 3·4 centims., height 2 centims., width of foot 1·5 centims. The colour of the preserved specimen is grey, with irregular purplish-brown blotches over the back.

The back is completely covered with simple and compound tubercles of differing sizes. The simple tubercles are most numerous and vary in size from an extreme minuteness to about 1·2 millims. in diameter. The compound tubercles measure about 1·5 millims. in diameter and are made up of from 5 to 7 simple tubercles. On the posterior fourth of the back are about 10 branchial tubercles, which appear to be made up of from 20 to 40 short papillæ crowded together. These apparently represent frondose processes in the living animal. There are only 6 ocular tubercles in the Ceylon specimen, all situated on the anterior half of the body. They bear from 2 to 5 ocelli in a slightly depressed pit on their summit. The general effect of the tuberculation resembles that seen in *Archidoris tuberculata.*

The loop of the intestine follows the same course as figured by Plate for the species, being much less curved than in the closely allied *O. tumidum.*

The male gonads (Plate VI., fig. 17) agree fairly closely with PLATE'S description. The penis rod is long and slender, the glans short and closely covered with minute hooks about 0·04 millim. in length.

The length of the "cartilaginous" rod is 16 millims., that of the spinulose glans 1·8 millims. The dart sac with its ampulla is of the usual form, the ampulla long and rather narrow and sharply curved at its anterior end, where it overlies the œsophagus. The length of the ampulla is 10 millims., the distance from the ampulla to the papilla of the dart sac 8 millims. The dart (Plate VI., fig. 13) is straight, regularly tapered; length 2·8 millims. Its free extremity shows a slight curve and has a solid lateral lip.

The radula (Plate VI., figs. 19 to 22) is of a pale yellow colour very slightly chitinised. It is made up of 60 rows of 83–1–83 teeth of the usual form. The central tooth is slightly broader than long; the lateral teeth, except those close to the middle line, are produced downwards into a broad adze-shaped hook and upwards into an irregular thin tongue, which takes part in their attachment to the radula ribbon.

The contents of the stomach consisted of quartz sand grains and a quantity of white flocculent matter, amongst which a few Foraminifera were noticed.

Onchidium verruculatum is very widely distributed in the Indian and Pacific Oceans, occurring from the East Coast of Africa and the Red Sea to Japan and Australia.

FAMILY: MARSENIADÆ.

Marsenia perspicua (LINN.)—Plate VI., figs. 23 to 26.

There are eleven specimens of *Marsenia* in the collection, most of them from Cheval Paar and its neighbourhood and the remainder from South-east Modragam, Gulf of Manaar, and Galle. Externally they are not to be distinguished from the common *M. perspicua* of European waters, with which species also the radula (Plate VI., figs. 24 to 26) and shell are in close agreement. The largest specimen, one of those from South-east Modragam, is a female, and measures 2·5 centims. by 2·2 centims., the shell (Plate VI., fig. 23) measuring 1·6 centims by 1·2 centims. These measurements are somewhat in excess of those usually attained by European specimens, but the difference in size and locality does not seem to warrant the use of a separate specific name.

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EXPLANATION OF PLATES.

The figures, with the exception of Plate II., figs. 2, 3, 13, 14, 17, 20, and 21; Plate III., figs. 4, 11, 16, 17, and 20; Plate V., figs. 4, 5, 11, 18, 24, and 25; Plate VI., figs. 6, 8, 11, 12 and 14, were all drawn with the aid of a camera lucida.

PLATE I.

Fig. 1. *Hervia ceylonica*, n. sp., side view of animal. × 9.
„ 2. „ „ 3 teeth from radula, dorso-lateral view. × 470.
„ 3. „ „ tooth from radula, seen from above. × 470.
„ 4. „ „ jaw plate. × 83.
„ 5. „ „ cutting edge of jaw plate. × 340.
„ 6. *Galvina producta*, n. sp., median tooth with one of side plates. × 700.
„ 7. „ „ 4 teeth from radula, with side plates, lateral view. × 350.
„ 8. „ „ view of under-side of head.
„ 9. „ „ jaw plate, restoration from crushed specimen. × 55.
„ 10. *Linguella cinerea*, n. sp., median and 2 lateral teeth from radula. × 340.
„ 11. „ „ jaw plate. × 16.
„ 12. „ „ lateral tooth from radula, 39th from median. × 340.
„ 13. „ „ 2 outermost teeth from radula. *a* = outermost. × 340.
„ 14. *Pleurophyllidia formosa*, KEL., jaw plate. × 8·3.
„ 15. „ „ outer tooth from radula. × 285.
„ 16. „ „ median and 2 lateral teeth from radula. × 285.
„ 17. *Discodoris labifera*, ABR., 4 outermost teeth from radula. × 330.
„ 18. „ „ innermost teeth, *a* = rachis of radula. × 330.

PLATE II.

Fig. 1. *Pleurophyllidia formosa*, KEL., lateral teeth from radula, 8th to 13th from middle. × 136.
„ 2. *Platydoris inframaculata* (ABR.), under-side, anterior.
„ 3. „ „ branchiæ and collar.
„ 4. „ „ teeth from radula, middle of lateral row. × 132.
„ 5. „ „ armature of penis. × 29.
„ 6. „ „ discs from vagina. × 29.
„ 7. „ „ upper part of penis.
„ 8. *Platydoris speciosa* (ABR.), lateral teeth from radula, 70th to 74th from middle. × 132.
„ 9. „ „ worn teeth from lateral row of radula. × 110.
„ 10. „ „ lateral tooth, side view. × 110.
„ 11. „ „ lower portion of penis, showing armature. × 35.
„ 12. „ „ upper portion of penis, with glans. × 35.
„ 13. *Platydoris herdmani*, n. sp., view of under-side, anterior. × 2.
„ 14. „ „ dorsal view. × 1·5.
„ 15. „ „ outermost teeth of radula, 15th and 16th rows. × 370.
„ 16. „ „ penis, upper portion. × 25.
„ 17. „ „ „ and vagina.
„ 18. *Thordisa* (?) *caudata*, n. sp., innermost teeth of radula. *a* = rachis. × 305.
„ 19. „ „ 5 outermost teeth of radula. × 305.

Fig. 20. *Platydoris spinulosa*, n. sp., dorsal view of bulbus pharyngeus.
„ 21. „ „ stomach, dorsal view.
„ 22. „ „ vagina, after treatment with caustic potash. × 15.
„ 23. „ „ opposite plates from vagina. × 60.

PLATE III.

Fig. 1. *Platydoris spinulosa*, n. sp., lateral teeth from radula, 36th and 37th from middle. × 300.
„ 2. „ „ innermost 4 teeth. *a* = innermost. × 300.
„ 3. „ „ outermost 8 teeth. × 300.
„ 4. *Halgerda punctata*, n. sp., lateral view of animal. × 2.
„ 5. „ „ outermost 4 teeth from radula. × 300.
„ 6. „ „ arrangement of branchiæ.
„ 7. „ „ innermost teeth of radula. *a* = rachis. × 300.
„ 8. *Platydoris inframaculata* (Abr.), innermost teeth of radula. *a* = rachis. × 100.
„ 9. „ „ 3 outermost teeth. × 300.
„ 10. *Platydoris speciosa* (Abr.), 4 outermost teeth. × 300.
„ 11. *Chromodoris tenuilinearis*, n. sp., animal, dorsal view.
„ 12. „ „ median teeth from radula. *a* = rachis. × 480.
„ 13. „ „ 3 outermost teeth from radula. *a* = outermost. × 480.
„ 14. „ „ 3 teeth from middle of lateral row. × 480.
„ 15. „ „ elements of jaw plate. *a* = side view of one. × 480.
„ 16. *Phyllidia nobilis*, Bgh. (?), animal, dorsal view. × 2.
„ 17. „ „ head and front of foot.
„ 18. *Ægires villosus*, n. sp., animal, lateral view from right. × 7.
„ 19. „ „ tubercles surrounding branchial pore, from left side.
„ 20. „ „ rhinophore sheath.
„ 21. „ „ buccal collar. × 31.
„ 22. „ „ lateral teeth from radula. × 310.
„ 23. *Kalinga ornata*, A. and H., median teeth. *a* = rachis. × 310.
„ 24. „ „ lateral teeth. *a* = innermost. × 310.

PLATE IV.

Fig. 1. *Philine aperta*, Linn., shell. × 2.
„ 2. *Aplysia cornigera*, Sow., teeth from radula, median and 2 lateral. × 127.
„ 3. „ „ 5th and 6th teeth from centre of radula. × 127.
„ 4. „ „ shell. × 2.
„ 5. „ „ teeth from radula, 12th from centre to margin. × 127.
„ 6. „ „ section of hyaline gland. × 52.
„ 7. „ „ gill. × 2.
„ 8. *Aplysia intermedia*, n. sp., median tooth from radula. × 340.
„ 9. *Aplysia elongata*, Pse., median tooth from radula. × 340.
„ 10. „ „ lateral view of head.
„ 11. „ „ shell, ventral. × 7.
„ 12. „ „ shell, lateral. × 7.
„ 13. *Phyllaplysia albomaculata*, n. sp., teeth from radula, median to 6th lateral. × 310.
„ 14. „ „ 6 outermost teeth from radula. × 310.
„ 15. „ „ shell, ventral. × 7·5.
„ 16. „ „ apex of shell showing spire.

Fig. 17. *Phyllaplysia pellucida*, n. sp., 19th to 22nd lateral teeth from radula. × 320.
„ 18. „ „ rods from jaw plates. × 310.
„ 19. „ „ median and 2 lateral teeth from radula. × 320.
„ 20. „ „ 9th to 12th lateral teeth from radula. × 320.
„ 21. „ „ 7 outermost teeth from radula. × 310.
„ 22. *Aplysiella mollis*, n. sp., lateral teeth from radula, 6th and 7th from margin. × 310.
„ 23. „ „ rods from jaw plates.
„ 24. „ „ 3rd to 5th teeth from centre of radula. × 310.
„ 25. „ „ 32nd to 35th teeth from centre to radula. × 310.
„ 26. „ „ median and 1st lateral teeth from radula. × 310.

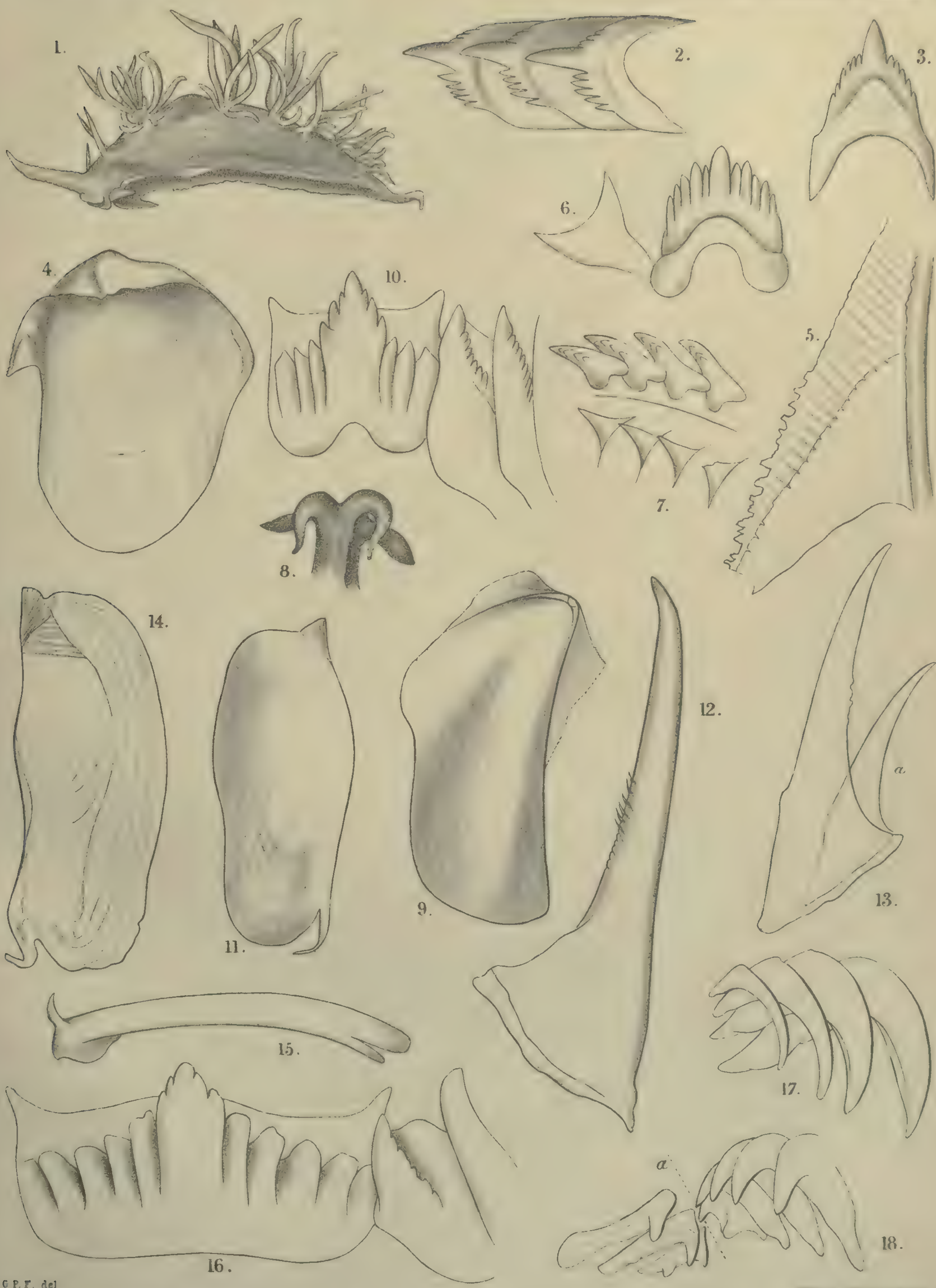
PLATE V.

Fig. 1. *Phyllaplysia pellucida*, n. sp., shell, dorsal view. × 7.
„ 2. *Aplysiella mollis*, n. sp., shell, ventral view. × 7·5.
„ 3. „ „ calcareous layer of shell, dorsal view. × 7·5.
„ 4. *Dolabrifera maillardi*, Desh., animal, dorsal view. × 2.
„ 5. „ „ „ seen from right side. × 2.
„ 6. „ „ teeth from radula, middle of lateral row. × 315.
„ 7. „ „ lateral tooth from radula, 19th from centre. × 315.
„ 8. „ „ apex of shell showing spire.
„ 9. „ „ shell, ventral view. × 15.
„ 10. „ „ median and 1st lateral teeth from radula. × 315.
„ 11. *Dolabrifera marginata*, n. sp., animal, dorsal view. × 2.
„ 12. „ „ median and 1st to 3rd lateral teeth from radula. × 310.
„ 13. „ „ lateral tooth from radula, 3rd from margin. × 310.
„ 14. „ „ 22nd and 23rd lateral teeth from radula. × 310.
„ 15. „ „ shell. × 15.
„ 16. *Dolabella scapula*, Mart., lateral teeth from radula. × 74.
„ 17. „ „ median and 1st to 3rd lateral teeth from radula. × 74.
„ 18. *Notarchus ceylonicus*, n. sp., animal, dorsal view. × 2.
„ 19. „ „ rods from jaw plates. × 130.
„ 20. „ „ 9th and 10th lateral teeth from radula. × 114.
„ 21. „ „ median and 1st and 2nd lateral teeth from radula. × 114.
„ 22. „ „ 24th and 25th lateral teeth from radula. × 114.
„ 23. „ „ outermost 3 teeth from radula. × 310.
„ 24. *Pleurobranchæa brocki*, Bgh., animal, dorsal view. × 2.
„ 25. „ „ „ from left side. × 2.
„ 26. „ „ 5 innermost teeth from radula. a = innermost. × 116
„ 27. „ „ rods from margin of jaw plate. × 320.
„ 28. „ „ 12th and 13th lateral teeth from radula. × 116.

PLATE VI.

Fig. 1. *Pleurobranchus hornelli*, n. sp., shell, membranous margin not shown. × 13.
„ 2. „ „ 9 outermost teeth from radula. × 320.
„ 3. „ „ 7 innermost teeth from radula. × 320.
„ 4. „ „ portion of jaw plate. × 300.
„ 5. „ „ section of mantle.

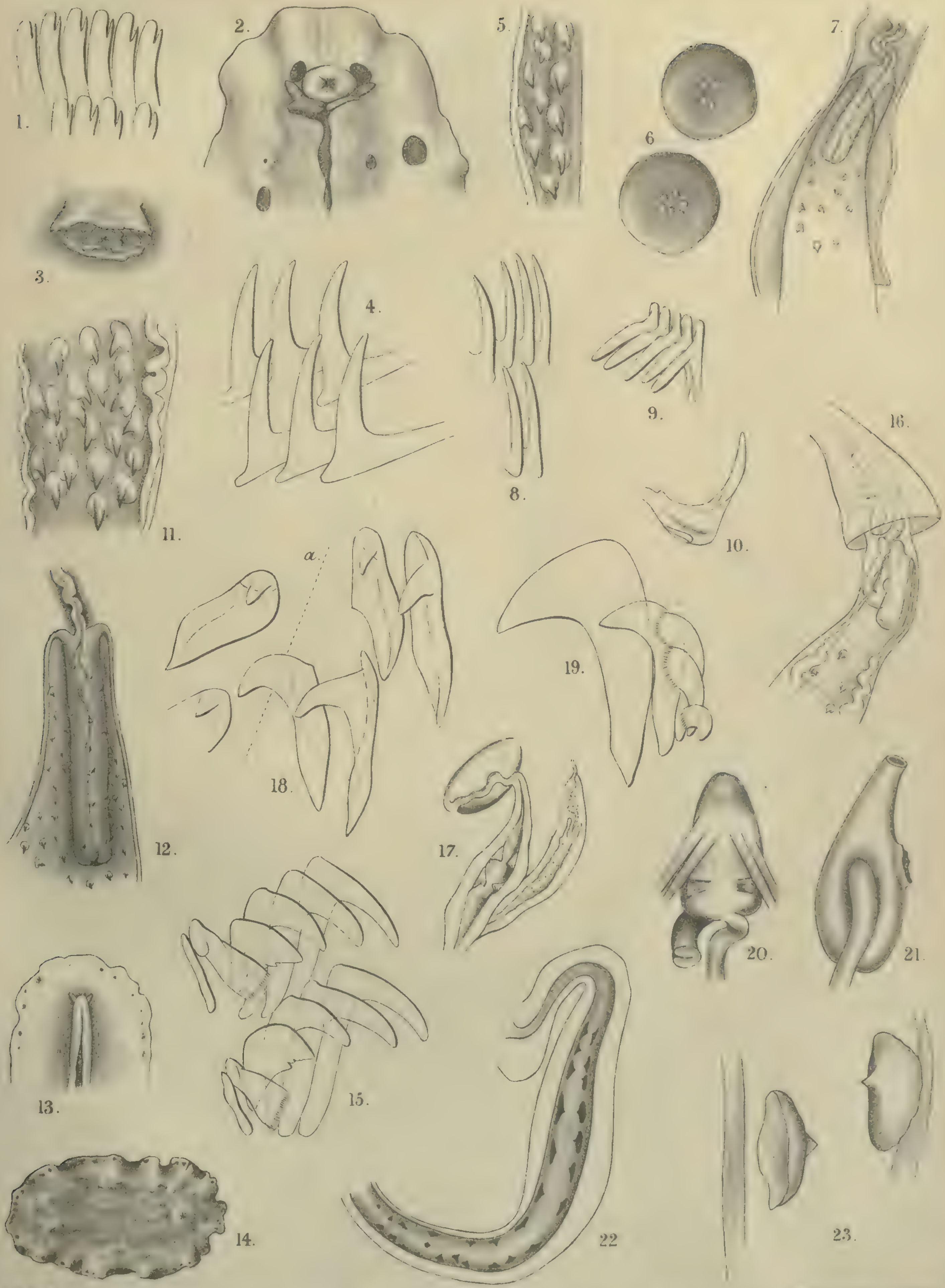
Fig. 6. *Phyllaplysia albomaculata*, n. sp., dorsal view. × 2.
„ 7. *Pleurobranchus* (*Berthella*) *citrinus* (R. and L.), shell. × 7·5.
„ 8. „ „ „ sculpture of shell.
„ 9. „ „ „ lateral teeth from radula. × 320.
„ 10. „ „ „ portion of jaw plate. × 320.
„ 11. *Aplysiella mollis*, n. sp., dorsal view. × 1·5.
„ 12. *Phyllaplysia pellucida*, n. sp., dorsal view. × 2.
„ 13. *Onchidium verruculatum*, Cuv., dart. × 31.
„ 14. „ „ papilla of dart sac.
„ 15. „ „ apex of dart. × 78.
„ 16. „ „ another view of same. × 78.
„ 17. „ „ male gonads. *a*, ampulla of dart sac; *b*, dart sac; *c*, rod of penis; *d*, vas deferens; *e*, retractor penis; *f*, adductors. × 28.
„ 18. „ „ hooks from glans of penis. × 116.
„ 19. „ „ teeth from radula, 53rd and 54th from centre. × 300.
„ 20. „ „ side view of tooth from near margin of radula. × 300.
„ 21. „ „ 5 outermost teeth from radula. × 310.
„ 22. „ „ median and 2 lateral teeth from radula. × 300.
„ 23. *Marsenia perspicua*, Linn., shell. × 2.
„ 24. „ „ 2 rows of teeth from radula.
„ 25. „ „ apex of lateral tooth.
„ 26. „ „ 2 median teeth.



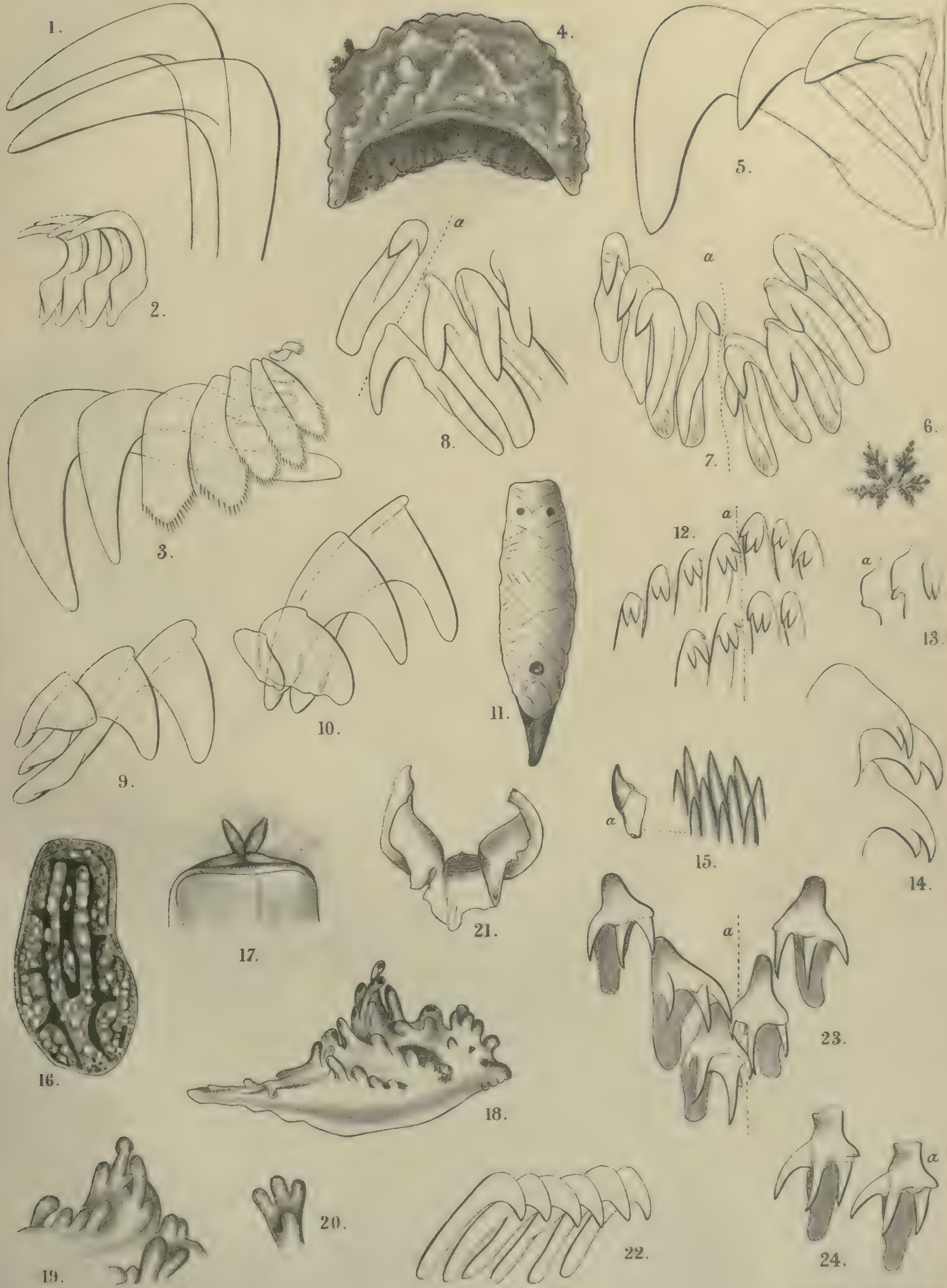
G. P. F. del.

M'Farlane & Erskine Lith. Edin.

1-5. Hervia Ceylonica n. sp. 6-9. Galvina producta, n. sp. 10-13. Linguella cinerea, n. sp.
14-16. Pleurophyllidia formosa, Kel. 17, 18. Discodoris labifera, (Abr.)



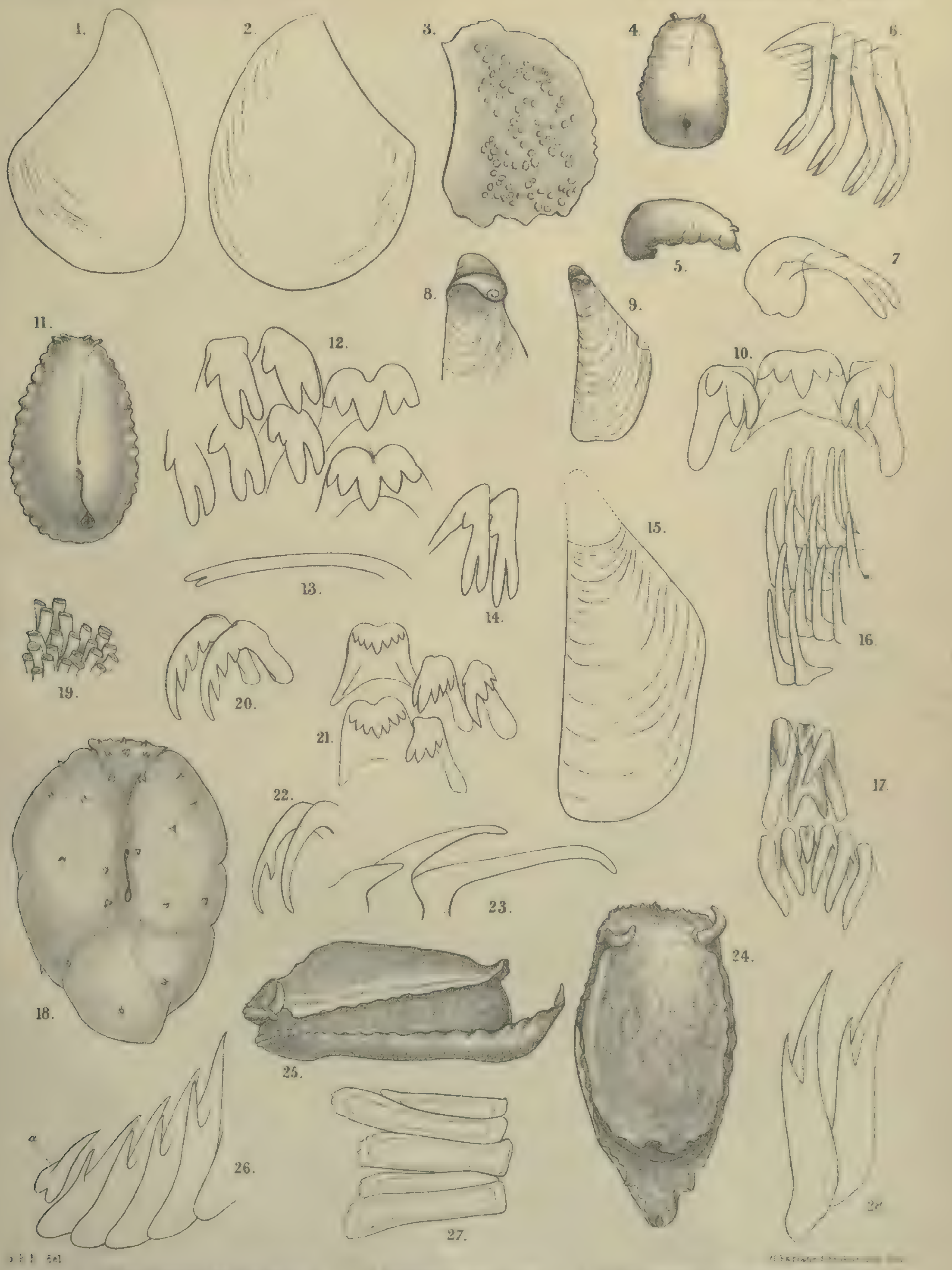
1. Pleurophyllidia formosa Kel. 2-7. Platydoris inframaculata Abr. 8-12. Platydoris speciosa (Abr.)
13-17. Platydoris herdmani n. sp. 18, 19. Thordisa caudata n. sp. 20-23. Platydoris spinulosa, n. sp.



G. P. F. del. McFarlane & Erskine Lith. Edin.

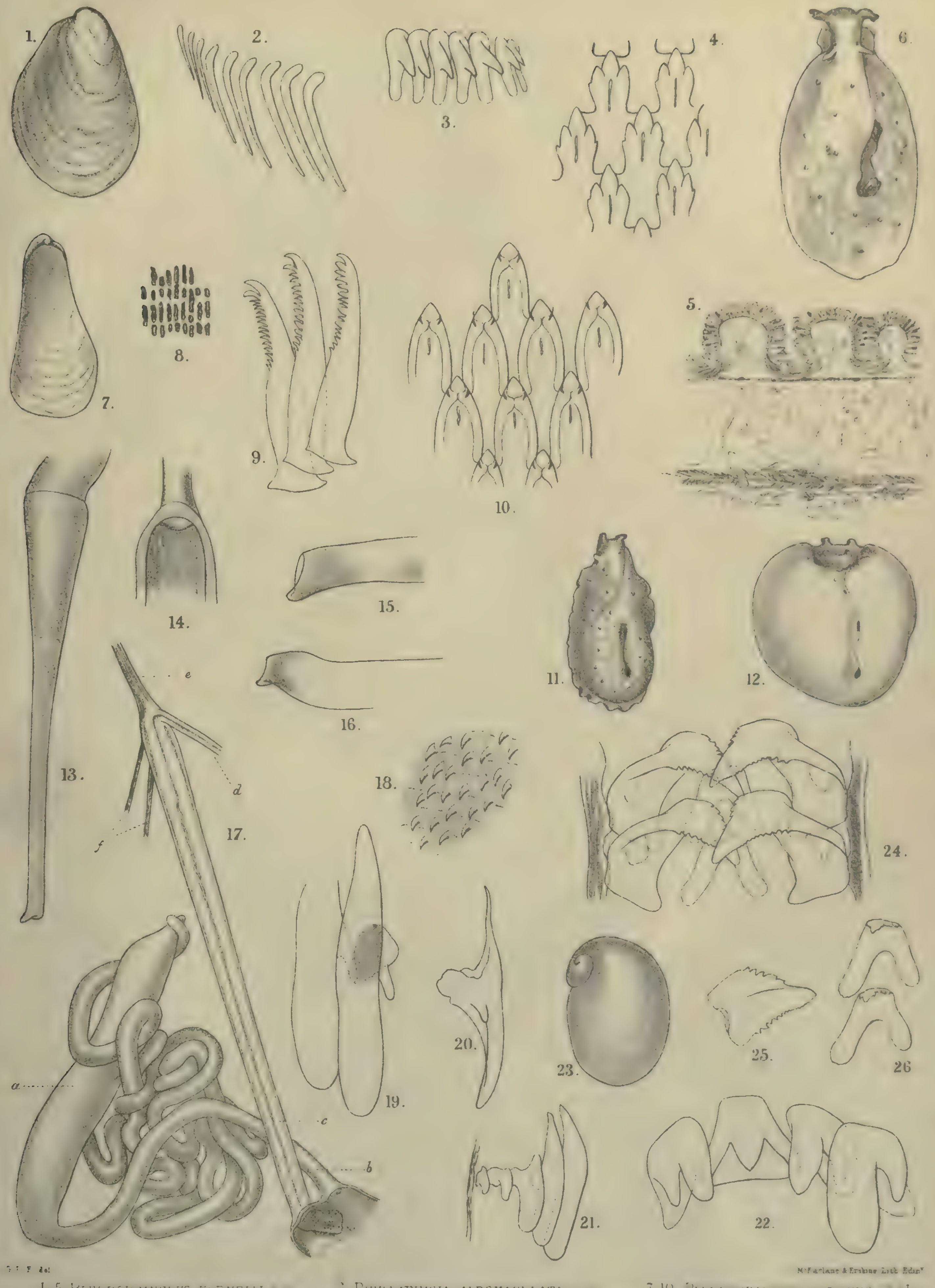
1-3 Platydoris spinulosa n. sp. 4-7 Halgerda punctata n. sp. 8, 9, Platydoris inframaculata, Abr.
10, Platydoris speciosa (Abr. 11-15. Chromodoris tenuilinearis, n. sp. 16-17, Phyllidia nobilis, Bgh

1, Philine aperta Linn. 2-7 Aplysia cornigera Sow. 8, Aplysia intermedia, n. sp.
9-12 Aplysia elongata, Pse. 13-16 Phyllaplysia albopunctata, n. sp. 17-21, Phyllaplysia, pellucida, n. sp.
22-26 Aplysiella mollis, n. sp.



del.

1. Phyllaplysia pellucida n. sp. 2, 3. Aplysiella mollis n. sp. 4–10. Dolabrifera ma... n. sp.
11–15. Dolabrifera marginata n. sp. 16, 17. Dolabrella scapula Mar. 18–23. Notarchus Ceylonicus n. sp.
24–28. Pleurobranchaea Brockii Berg.



M

1-5. PLEUROBRANCHUS HORNELLI n. sp. 6. PHYLLAPLYSIA ALBOMACULATA n. sp. 7-10. [illegible]
11. APLYSIELLA MOLLIS n. sp. 12. PHYLLAPLYSIA PELLUCIDA, n. sp. 13-22. ONCHIDIUM VERRUCULATUM Cuv.
23-26. MARSENIA PERSPICUA. (Linn.)

REPORT

ON THE

OSTRACODA

COLLECTED BY

PROFESSOR HERDMAN, AT CEYLON, IN 1902.

BY

ANDREW SCOTT, A.L.S.,
RESIDENT FISHERIES ASSISTANT IN THE MARINE LABORATORY AT PIEL, BARROW-IN-FURNESS.

[WITH TWO PLATES.]

THE OSTRACODA forming the subject of this report were, with a few exceptions, found amongst the sand and *débris* washed out of the vessels containing other groups of the Ceylon collection. Pelagic species were occasionally taken in the tow-nettings made during the examination of the pearl banks, and also in the series of plankton collections taken during the outward and homeward journeys. Samples of mud and sand from various pearl banks were also examined, but these yielded no members of this group. Some of the material had been preserved in formol, which had apparently a bad effect on the delicate shells of these creatures. In some cases the lime salts had been partly or entirely dissolved out, making the identification a work of much difficulty.

The Ostracoda are represented by 77 species belonging to 22 genera. Thirty-five of the above number appear to be undescribed, and are now added to the Ceylon Fauna, and figured in the plates.

A considerable amount of work has already been done and a good deal of information published relating to the Ostracoda of Ceylon. Professor BRADY has one paper in 'The Journal of the Linnean Society' (vol. xix., No. 114, 1886) which deals entirely with Ceylonese Entomostraca. It contains descriptions of new and other marine species dredged in 2 fathoms off Kalpentyn, in the Gulf of Manaar. Descriptions of other species are given by Professor BRADY in reports published in the 'Transactions of the Zoological Society.' The valuable work on the Ostracoda collected by the "Challenger" is indispensable in dealing with tropical forms. 'The Monographs on the North Atlantic and North-Western European Ostracoda,' by Professor BRADY and Dr. NORMAN, are also of much service. The splendid work of Dr. G. W. MÜLLER, published by the Naples Zoological Station, is a mine of information, as the anatomical details of the animals are fully illustrated, and the positions of many hitherto incompletely described species are thus firmly established. Finally, every paper dealing with marine Ostracoda from foreign localities requires to be consulted, and this has been done as far as possible in the present case; but it is not considered necessary to give references under the species, or to add a list of the literature, as the authors named and the papers made use of are well known to all workers at the group.

I am much indebted to Professor BRADY, F.R.S., for looking over the identifications made and for assistance given with some doubtful species. My father, Dr. T. SCOTT, has also helped me greatly with the work of classifying the undescribed forms. Owing to the absence of the appendages, the exact positions of one or two of the new species, which happened to be only empty shells, are at present uncertain.

It is almost impossible to find good descriptive names in certain genera of Ostracoda which are not pre-occupied, and geographical terms are apt to prove misleading. So I have named the new species of *Cythere* and *Cytherella* in honour of some of the officials and naturalists connected with Ceylon and its pearl fisheries who were mentioned in Professor HERDMAN's Introduction to these Reports.

SECTION I.: MYODOCOPA.

FAMILY: ASTEROPIDÆ.

Asterope oculata, BRADY.

In washings from young pearl oysters collected from Cheval Paar, February and March, 1902, and from Muttuvaratu Paar, November 19th, 1902; also in general washings from invertebrates from Gulf of Manaar. Ten females and four males were found altogether. Professor BRADY records it from the surface at Trincomalee, and from Cruz Bay.

Asterope quadrata, BRADY.

Three females were present in the washings from invertebrates dredged on the pearl banks. This species was described from specimens collected at Lyttelton Harbour, New Zealand.

Asterope arthuri, STEBBING.

Specimens of this fine species were taken by the tow-net in 6 to 10 fathoms at Karativo Paar on March 10th, 1902, and at 9 fathoms at 9 P.M. on Vankali Paar, March 13th, 1902. On the latter date there was much phosphorescence in the water. STEBBING describes it in Dr. ARTHUR WILLEY'S "Results," Crustacea, Part v.

Cyclasterope similis, BRADY.

Two females in general washings from dredged invertebrates from Gulf of Manaar. Java Sound is the only previous locality given for the species.

FAMILY: CYPRIDINIDÆ.

Cypridina faveolata, BRADY.

One specimen, from the pearl banks in the Gulf of Manaar. It has hitherto been recorded only from the China Sea, where a single example was found.

Pyrocypris chierchiæ, MÜLLER.

This species appeared to be generally distributed throughout the area investigated and has been found in the following places:—Muttuvaratu, West Cheval, South-south-west of Silavaturi, off Kalpentyn Island, at Galle, in washings from young pearl oysters, and from the general washings from dredged invertebrates from the Gulf of Manaar.

According to Professor BRADY, this and other species of *Pyrocypris* occur in immense numbers in tropical seas, and seem to contribute a very large share to the phosphorescence of these regions. MÜLLER states that as many as twenty thousand of the above species have been taken in a single haul, and attributes their light-producing power to the labial papillæ which so far appear to be peculiar to the genus.

Codonocera cruenta, BRADY.—Plate II., figs. 43 to 45.

A single specimen of this peculiar ostracod was taken in the collection made by Professor HERDMAN on the homeward journey when west of Minikoi, in the Indian Ocean. In Professor BRADY'S description of the animal it is stated that the post-abdominal laminæ have only three ungues. In the present specimen there are distinctly four, the fourth, however, being very small (Plate II., fig. 43). The specimen was a male. The peculiar filaments on the antennules ending in bell-shaped disks (fig. 44) and the muscular hand of the antenna (fig. 45) are noteworthy characters; size, 1·73 millims.

Professor BRADY'S single specimen was taken at Pulo Penang.

FAMILY: SARSIELLIDÆ.

Sarsiella ornithoides, BRADY.

One specimen of this distinct form was found in the collection made at Karativo Paar on March 10th, 1902.

The only other locality for the species is Trincomalee.

Sarsiella carinata, n. sp.—Plate I., figs. 1 and 2; Plate II., figs. 40 and 41.

Shell membranous, thin and flexible, seen from the side subrhomboidal, height equal to about two-thirds of the length. Anterior extremity truncate, and provided with a prominent protuberance at the beginning of the dorsal curve; posterior narrower, deeply excavated, bounded above and below by prominent projections; dorsal margin boldly arched, highest behind the middle, whence it slopes rapidly towards the large projection; ventral margin nearly flat, except at the posterior end, where it is deeply sinuated; seen from above elongated, widest in the middle, width considerably less than half the length; anterior extremity narrow, emarginate; posterior wide, terminating in one median and two lateral protuberances. The dorsal and ventral margins are in the form of a continuous ridge with radiating lines, two longitudinal ribs of a similar structure run parallel to, but at a considerable distance within the margins, both terminating posteriorly in protuberances; ventral margin adorned with four protuberances of various sizes; in addition to these, there are two between the ventral margin and the lower ridge and one on the surface of the lower posterior projection. Surface of the shell marked with numerous circular depressions, which have four or five short setæ round the outside; dorsal and ventral margins ciliated; size, 1·1 millims.

Three specimens, all males, were found in washings from deep-water dredgings off Galle. The antennules have the characteristic dense brush of long fine hairs; postabdomen with five marginal ungues, increasing in length from the first to the last, which is about five times as long as the first; margins spinulose.

Sarsiella gracilis, n. sp.—Plate I., figs. 3 and 4; Plate II., fig. 37.

Shell membranous, thin and flexible; seen from the side subcircular, height equal to fully two-thirds of the length; anterior extremity broadly rounded, crenate, with a distinct notch near the middle; posterior truncate, with a wide triangular process above and below; dorsal and ventral margins rounded, the former sloping rapidly at its posterior end; seen from above, oblong subovate, widest near the posterior end, width slightly less than one-third of the length; anterior extremity obtusely rounded, posterior truncated, with a median process; surface of the shell slightly ciliated, covered with small impressed puncta; anterior and ventral margins ciliated; size, 1·34 millims.

Two specimens were found in a dredging from 100 fathoms, off Galle, and one in the general washings from invertebrates from Gulf of Manaar. All were mature females with ova. The postabdomen has three stout ungues with spinulose margins, and three short plumose setæ.

Sarsiella similis, n. sp.—Plate I., figs. 5 and 6; Plate II., fig. 38.

Shell thin and flexible, subcircular, height fully two-thirds of the length; seen from the side anterior extremity rounded, crenate, with a slight notch in the centre, posterior truncate, with distinct projections above and below; dorsal and ventral margins boldly convex; seen from above subovate, fully twice as long as broad, anterior extremity narrow, posterior widely truncate, with a small median process; for the greater part the sides are nearly parallel, converging rapidly towards the anterior end; surface of the shell slightly ciliated, covered with small impressed puncta, the valves have four or five longitudinal ribs at the posterior and a number of radiating lines at the anterior extremity; anterior and ventral margins ciliated; size, 0·93 millim.

A number of ova-bearing females were found in washings from Muttuvaratu Paar and in the general washings from Gulf of Manaar. The species resembles the last in general shape, but is distinguished by the longitudinal ribs. The postabdomen (Plate II., fig. 38) is much narrower, and the ungues more spinulose.

Sarsiella crispata, n. sp.—Plate I., figs. 7 and 8; Plate II., fig. 39.

Shell thin and flexible; seen from the side subcircular, broadly rounded in front, slightly narrowed and produced into a wide ciliated beak posteriorly; seen from above broadly ovate, widest just behind the middle, twice as long as broad; anterior extremity narrow, posterior truncate, with one median and two lateral projections; surface covered with large impressed puncta, valves with a number of conspicuous ridges, the two near the posterior end of the dorsal margin forming distinct projections, anterior and ventral margins crenate and ciliated, with a corrugated line a little within; size, 0·8 millim.

About a dozen mature females were obtained in the same material as the previous species. Postabdomen (fig. 39) with four stout spinulose ungues of different lengths.

Sarsiella tumida, n. sp.—Plate I., figs. 9 and 10; Plate II., fig. 42.

Shell membranous, thin and flexible. Seen from the side subcircular, slightly longer than wide; anterior extremity broadly rounded, with a small beak in the centre; posterior truncate and produced into a wide beak at the lower angle; dorsal and ventral margins boldly convex, the dorsal forming a distinct hump in the centre; seen from above broadly ovate, widest slightly in front of the middle, width equal to less than two-thirds of the length, narrow in front, rectangularly truncate behind, with a distinct median projection; surface of the shell devoid of sculpture, but having a large fold near the posterior end of the dorsal margin; anterior and ventral margins ciliated; size, 1·26 millims.

Two mature females of this species were found in the general washings from dredged invertebrates. The postabdomen is narrow and furnished with five spinulose ungues, the longest being about five and a half times the length of the shortest.

Future investigation may show this form to be the female of *Sarsiella carinata*, as the comparative lengths of the ungues on the postabdomen of both species are nearly alike, but in the meantime it is thought best to keep them separate.

Family: HALOCYPRIDÆ.

Conchœcia magna, Claus.

Two specimens belonging to this species were taken in the tow-netting collected in the Suez Canal, between Port Saïd and Suez, on the outward journey.

Conchœcia clausii, G. O. Sars (?).

Two specimens apparently belonging to this species occurred in the above collection, but their very poor condition makes their identity uncertain.

Conchœcetta acuminata, Claus.

One specimen in the above collection, one from near Perim Island in the Red Sea, and a third from the middle of the Indian Ocean.

Halocypris concha, Claus.

This species occurred in a number of the collections taken between the Mediterranean and Ceylon on both journeys, and also on the pearl banks in the Gulf of Manaar.

Section II.: PODOCOPA.

Family: CYPRIDÆ.

Macrocypris decora (Brady).

In general washings from invertebrata and in washings from sponges dredged in the Gulf of Manaar.

Macrocypris orientalis, Brady.

In general washings from invertebrata from the Gulf of Manaar.

Macrocypris similis, Brady.

Also in general washings from invertebrata from the Gulf of Manaar.

Macrocypris maculata (Brady).

In the general washings from the Gulf of Manaar and in washings from Cheval pearl oysters.

Pontocypris robusta, n. sp.—Plate I., figs. 17 and 18.

Shell seen from the side subtriangular, the height being equal to slightly more than half the length, anterior extremity moderately broad and obliquely rounded, posterior attenuated and almost acuminate; dorsal margin boldly arched, highest in the middle, sloping with a steep curve backwards, and more gently towards the front; ventral margin deeply sinuated well in front of the middle. Seen from above the outline is ovate, acuminate in front and rounded behind, greatest width in the middle and equal to fully two-fifths of the length; shell white, polished, with minute setæ and impressed puncta; the valves are marked with five lucid spots arranged in a semicircular manner; size, 0·82 millim.

A few specimens from the general washings from Gulf of Manaar; from Cheval pearl oyster washings; and from Gulf of Manaar sponges.

At first it was thought this might be a form of *Pontocypris trigonella*, G. O. Sars, but a comparison with the figures given in the '"Challenger" Report,' in the report 'On the Entomostraca from the Gulf of Guinea,' by my father, and in the 'Monograph on the North Atlantic and North-western European Ostracoda,' by Brady and Norman, shows that it is distinct.

Pontocypris elegans, n. sp.—Plate I., figs. 19 and 20.

Shell seen from the side oblong, compressed, subreniform, the height being equal to rather less than one-third of the length; anterior extremity obliquely rounded, posterior produced and subacute at the ventral angle; dorsal margin moderately arched, greatest height slightly in front of the middle, and sloping gently towards each extremity; ventral margin deeply sinuated in the middle; seen from above compressed, ovate, widest in the middle, width about one-fourth of the length, acuminate in front and slightly rounded behind; shell white, polished, with a few minute impressed puncta; the valves are marked with a circular patch of lucid spots and three smaller detached ones; size, 0·6 millim.

A few specimens were found in the same washings as the previous species.

Pontocypris rostrata, n. sp.—Plate I., figs. 21 and 22.

Shell seen from the side subtriangular, greatest height nearly equal to half the length; anterior extremity broadly rounded, almost truncate, posterior produced, subacute in the centre; dorsal margin boldly arched, highest slightly in front of the middle, sloping very gently towards the front, but rapidly to the posterior; ventral margin sinuated in front of the middle, becoming convex near the posterior end where it turns up to join the extremity; seen from above ovate, greatest width in the middle and about equal to one-third of the length, acuminate in front and behind, sides distinctly compressed in front, forming a beak-like process; shell white and polished, valves unequal, the right being slightly smaller than the left; size, 0·64 millim.

In washings from sponges dredged in the Gulf of Manaar.

Pontocypris tumida, n. sp.—Plate I., figs. 30 and 31.

Shell seen from the side subovate, the height being rather more than half the length; anterior extremity rounded, somewhat depressed, posterior subacute; dorsal margin boldly arched, highest in the middle, ventral slightly sinuated in front of the middle; seen from above ovate, widest behind the middle, length equal to two and a half times the width, right valve smaller than the left; shell white, smooth, and polished; size, 0·97 millim.

In general washings and in washings from Gulf of Manaar sponges.

Erythrocypris herdmani, n. sp.—Plate I., figs. 15 and 16.

Shell seen from the side subtriangular, the height being about equal to half of the length; anterior extremity broadly rounded, posterior attenuated and subacuminate; dorsal margin strongly arched, almost angular at its highest point, forming a distinct hump, greatest height considerably in front of the middle, and sloping with a steep curve to both extremities, ventral margin slightly sinuated; seen from above ovate, width fully two-fifths of the length, greatest width about one-third from the anterior extremity, extremities obtusely pointed, rather more acute in front than behind; valves yellowish, smooth, and shining, covered with numerous short rigid hairs, the left valve has a distinct tooth at its posterior end; size, 0·85 millim.

Specimens were found in general washings from Gulf of Manaar, in washings from Cheval pearl oysters, and Manaar sponges, and on Karativo Paar. This species, which is easily distinguished from any of those already described, is named in compliment to Professor HERDMAN, whose labours on the Ceylon pearl banks have added an extensive chapter to our knowledge of the tropical marine fauna.

Bairdia villosa, BRADY.

In general washings from invertebrates from the Gulf of Manaar.

Bairdia attenuata, BRADY.

In general washings from invertebrates from the Gulf of Manaar.

Bairdia woodwardiana, BRADY.

In general washings from invertebrates from the Gulf of Manaar.

Bairdia amygdaloides, BRADY.

In general washings from invertebrates from the Gulf of Manaar.

Bairdia faveolata, BRADY.

In the general washings and in washings from Cheval pearl oysters.

Bairdia hirsuta, BRADY.

In general washings, in washings from Cheval pearl oysters, and from Karativo Paar.

All these species of *Bairdia* are new to the fauna of Ceylon.

Bairdia inornata, n. sp.—Plate I., figs. 11 and 12.

Shell seen from the side subreniform, height equal to more than half the length;

anterior extremity obliquely rounded, posterior produced in the middle into an obtusely angular beak; dorsal margin boldly arched, highest in the middle and sloping steeply towards the extremities, slightly sinuated at the anterior and posterior ends, ventral margin deeply sinuated in the middle; seen from above compressed, ovate, widest in front of the middle and nearly three times longer than wide, extremities obtuse, subtruncate; colour almost black, with one or two lighter bands; surface of the valves covered with closely set, short, stiff setæ; posterior end of the ventral margin finely serrate; right valve smaller than the left; size, 0·74 millim.

A few specimens in general washings from invertebrates from Gulf of Manaar.

Bairdia robusta, n. sp.—Plate I., figs. 13 and 14.

Shell seen from the side subtriangular, height equal to fully two-thirds of the length; anterior extremity obliquely rounded, posterior produced in the middle into an obtusely angular beak; dorsal margin greatly arched, highest slightly in front of the middle, ventral nearly straight; seen from above broadly ovate, length fully one and a half times the width, extremities subacute, posterior more so than the anterior; shell white, polished, closely beset with black setæ; anterior and posterior extremities with a dense fringe of setæ; size, 0·87 millim.

In general washings from invertebrates from Gulf of Manaar. This species resembles *Bairdia villosa*, BRADY, but is much more tumid and obtuse.

Anchistrocheles bradyi, n. sp.—Plate I., figs. 34 and 35.

Shell seen from the side reniform, height slightly less than half the length; anterior extremity wide, obliquely subtruncate, posterior broadly rounded, slightly produced in the middle; dorsal margin gently and evenly curved, highest behind the middle, ventral sinuated in front of the middle; seen from above the outline is elongated, with parallel sides, nearly four times longer than wide; both extremities acute, anterior more so than the posterior; shell smooth, thin and fragile; size, 0·9 millim.

In dredged material from 6 fathoms to 10 fathoms, Karativo Paar.

The species resembles *Anchistrocheles fumata*, BRADY, in general appearance, but is easily recognised by the more acute extremities, as seen from the dorsal aspect. I have great pleasure in naming it after Professor BRADY, to whom we remain indebted for much help both in this group and in the Copepoda.

Pseudocythere minuta, n. sp.—Plate I., figs. 28 and 29.

Shell seen from the side oblong, subquadrate, slightly higher in front than behind, height slightly less than half the length; anterior extremity rounded, with one or two tooth-like projections near the middle; posterior oblique, subtruncate, much compressed, produced at the upper angle into a broad, blunt beak, lower angle also produced, but the beak is much smaller; dorsal margin almost flat, highest near the anterior end, sloping very slightly towards the posterior, ventral margin slightly sinuated in front of the middle; seen from above ovate, widest in the middle, tapering to the extremities, both of which are acuminate, the posterior much attenuated; width equal to less than half the length; shell marked with numerous puncta arranged in fairly regular, slightly curved, longitudinal rows. Size, 0·35 millim.

A single specimen in general washings from dredged invertebrates from Gulf of Manaar.

Paradoxostoma cingalense, BRADY.

One or two specimens in general washings from dredged invertebrates from Gulf of Manaar. Off Kalpentyn is the only previous locality given for the species.

Paradoxostoma attenuatum, n. sp.—Plate I., figs. 32 and 33.

Seen from the side pear-shaped, about two and a half times longer than broad; anterior extremity very narrow, rounded, posterior broad and truncate, sloping inwards, forming a distinct tooth at the junction with the lower margin; dorsal margin boldly arched, highest considerably behind the middle, ventral margin sloping outwards from the anterior extremity; very slightly sinuated, convex at the widest part; seen from above much compressed, with acute extremities, greatest width in the middle, length four and a half times the width; shell amber coloured, smooth and transparent; size, 0·6 millim.

In washings from Gulf of Manaar sponges.

Paradoxostoma stebbingi, n. sp.—Plate II., figs. 1 and 2.

Shell seen from the side pear-shaped, two and a half times longer than broad; anterior extremity narrow, obliquely rounded, posterior subacute in the centre; dorsal margin boldly and evenly arched, highest slightly behind the middle; ventral margin sinuated near the anterior extremity; seen from above compressed, ovate, widest in the middle, and nearly four times longer than broad, extremities acute; shell smooth, white and semi-transparent; size, 0·6 millim.

In general washings from dredged invertebrates.

I name this species after the Rev. T. R. R. STEBBING.

Xestolebris margaritea, BRADY.

In the general washings, in washings from Cheval pearl oysters and Gulf of Manaar sponges, and in a dredging from Karativo Paar.

Xestolebris tumefacta, BRADY.

In the general washings from Gulf of Manaar.

Xestolebris aurantia, BAIRD.

Also in the general washings. The specimens were first identified as *Xestolebris* *margaritea*, but Professor BRADY says he cannot distinguish them from our native *Xestolebris aurantia.*

Xestolebris variegata, BRADY.

In the general washings, and in washings from Cheval pearl oysters.

Xestolebris faveolata, BRADY.

In a dredging from Karativo Paar, 6 to 10 fathoms.

Xestolebris squamigera, n. sp.—Plate I., figs. 23 to 25; Plate II., figs. 28 and 29.

Shell seen from the side somewhat siliquose, two and a half times longer than broad. Anterior extremity very narrow, rounded, posterior subacute; dorsal margin boldly arched, highest a little behind the middle, sloping rapidly and evenly to the anterior end; posteriorly the slope is more abrupt and almost truncate; ventral margin nearly straight, slightly sinuated in front of the middle; seen from above the outline is broadly ovate; width about three-fifths of the length, and widest behind the middle; anterior extremity subacute, distinctly sinuated, and expanding rapidly; posterior extremity broadly rounded; seen from the posterior end the valves are deeply concave; valves slightly unequal; shell smooth, white and polished, with numerous whitish spots scattered over the surface; size, 0·52 millim.

In the general washings and in washings from Gulf of Manaar sponges. The drawings on Plate I. represent an ova-bearing female; the antennule and antenna are shown on Plate II., figs. 48 and 49.

Xestolebris irrasa, n. sp.—Plate II., figs. 5, 6 and 46, 47.

Shell seen from the side ovate, height fully two-thirds of the length; anterior extremity narrow, posterior broad, both well rounded; dorsal margin boldly arched, highest in the middle, ventral very slightly convex, with slight sinuations at the extremities; seen from above ovate, widest behind the middle, width fully two-thirds of the length, extremities obtusely pointed in front, wider and more rounded behind; surface of the shell marked with numerous concentric spinulose ridges, and clothed with short stiff setæ; colour yellowish; size, 0·53 millim.

In the general washings and in washings from Gulf of Manaar sponges. The figures represent a female shell, the antennule and antenna being shown by figs. 46 and 47.

Xestolebris tumida, n. sp.—Plate II., figs. 3 and 4.

Shell seen from the side broadly pear-shaped, scarcely one and a half times longer than broad, extremities well rounded, anterior much narrower than the posterior; dorsal margin greatly arched, highest behind the middle; ventral slightly sinuated in front and convex behind; seen from above broadly ovate, rather longer than broad, compressed and pointed in front, broadly rounded behind; greatest width behind the middle; shell smooth, white, with numerous whiter spots on its surface; size, 0·6 millim.

In general washings from the Gulf of Manaar.

The species resembles *Xestolebris variegata*, but is much more tumid.

Paracytheridea perplexa, n. sp.—Plate I., figs. 26 and 27.

Shell seen from the side subrhomboidal, two and a half times longer than broad; anterior extremity obliquely rounded, with three median teeth; posterior produced into a median triangular beak; dorsal margin highest in front, sloping downwards towards the posterior in an irregularly sinuous line; ventral margin slightly convex in front, rising with a gentle slope posteriorly, deeply notched at the hinder end, and then suddenly produced into a curved triangular tooth-like process; seen from above the outline is much like that of a Trilobite, very wide and rounded in front; narrowing slightly posteriorly, then rapidly converging to form a wide triangular end; greatest width much in front of the middle, and equal to three-fourths of the length; surface of the shell marked with large puncta, and in side view with obliquely transverse ridges; size, 0·65 millim.

A few specimens in the general washings from dredged invertebrates from Gulf of Manaar.

The species resembles *Paracytheridea depressa*, G. W. Müller, but differs in the termination of the lateral margins as seen from above. In *P. depressa* the margins end in a distinct tooth projecting at nearly right angles to the sides.

Cytherura concinna, n. sp.—Plate II., figs. 7 and 8.

Shell seen from the side subrhomboidal, with a well-marked dorsal ridge, height equal to half the length; anterior extremity obliquely rounded, posterior broadly beaked above the middle; dorsal margin rugged, broken by a few small blunt projections, sloping gently upwards towards the posterior, ventral convex in the middle; seen from above broadly triangular, greatest width much behind the middle and equal to two-thirds of the length; anterior extremity rounded and produced into a blunt median beak; posterior very wide, subtruncate, and produced into a large median process, its margin forming a distinct flexuous ridge coursing between the outer and inner margins of each valve; surface of the shell marked with numerous puncta, and with a distinct depression in the centre of each valve; size, 0·53 millim.

One or two specimens in general washings from dredged invertebrates from Gulf of Manaar.

Loxoconcha anomala, Brady.

In general washings, in washings from Cheval pearl oysters, and in a dredging from Karativo Paar.

Loxoconcha alata, Brady.

From the same material as the previous species.

Loxoconcha papillosa, Brady.

In general washings from Gulf of Manaar.

Loxoconcha sculpta, Brady.

In washings from Gulf of Manaar sponges.

Loxoconcha australis, Brady.

In the general washings and in washings from Gulf of Manaar sponges.

Cythere bimammillata, Brady.

In washings from Gulf of Manaar sponges.

Cythere darwini, Brady.

In the general washings, in washings from Gulf of Manaar sponges, and in a dredging from Karativo Paar.

Cythere inconspicua, Brady.

In washings from Cheval pearl oysters.

Cythere ovalis, Brady.

In the general washings, in washings from Cheval pearl oysters, and in a dredging from Karativo Paar.

Cythere polytrema, Brady.

In general washings from Gulf of Manaar.

Cythere rectangularis, Brady.

In general washings from Gulf of Manaar.

Cythere ruperti, Brady.

In the general washings and in washings from Gulf of Manaar sponges.

Cythere stimpsoni, Brady.

In a dredging from Karativo Paar.

Cythere subcuneata, Brady.

In general washings from Gulf of Manaar.

Cythere knoxi, n. sp.—Plate II., figs. 9 and 10.

Shell seen from the side elongated, subsigmoid, height equal to half the length, extremities toothed; anterior extremity broad and obliquely rounded, posterior narrower, rounded off below, and obscurely angulated above; dorsal margin sinuated in the centre, highest in front and sloping towards the posterior, ventral sinuated in the middle; seen from above pear-shaped, greatest width near the posterior end, and equal to more than half the length, the outline between the widest point and the anterior end shows two distinct constrictions; shell surface marked with coarse impressed puncta; each valve seen from the side shows two distinct grooves; size, 0·56 millim.

In the general washings and in washings from Cheval pearl oysters.

Named after Captain ROBERT KNOX, 20 years a captive in Ceylon in the seventeenth century.

Cythere chalmersi, n. sp.—Plate II., figs. 11 and 12.

Shell seen from the side subsigmoid, height equal to half the length, extremities corrugated but not toothed; anterior extremity very obliquely rounded, posterior narrower, and broadly rounded; dorsal margin highest at the anterior end, nearly flat, with a gentle slope towards the posterior; ventral sinuated in the middle; seen from above pear-shaped, outline irregular, and marked by three constrictions, widest near the posterior end, greatest width equal to about half the length; anterior and posterior ends with strong thickened lips, the posterior forming a distinct protuberance; surface of the shell marked with moderately coarse impressed puncta, and near the extremities with a row of circular depressions; seen from the side, the valves show three distinct grooves; size, 0·7 millim.

In the general washings and in washings from Gulf of Manaar sponges.

Named after Dr. A. J. CHALMERS, Professor in the Medical College, Colombo.

Cythere imthurni, n. sp.—Plate II., figs. 13 and 14.

Shell seen from the side oblong, subquadrangular, height slightly less than half the length; extremities smooth, anterior extremely broad and obliquely rounded, with an internal row of subcircular markings; posterior narrower, rounded above and truncate below; dorsal margin highest at the anterior end, nearly flat, with a gentle slope towards the posterior, ventral deeply sinuated near the middle; seen from above rather wedge shaped, with nearly parallel sides, deeply constricted near the posterior end, length about two and a half times the width; anterior margin acuminate with projecting thickened lips, posterior almost truncated, projecting slightly in the centre; surface of the shell marked with large irregular impressed puncta, and, when viewed from the side, with a deep hollow near the posterior; size, 0·5 millim.

In the general washings, in washings from Cheval pearl oysters, and from Gulf of Manaar sponges.

Named after the Honourable E. F. IM THURN, Lieutenant-Governor of Ceylon during the pearl oyster investigation in 1902.

Cythere thompsoni, n. sp.—Plate II., figs. 15 and 16.

Shell seen from the side oblong, subquadrangular, height rather more than half the length; anterior extremity wide and obliquely rounded, with about a dozen short thick teeth, posterior slightly narrower, almost truncate, with five or six short stout teeth; dorsal margin deeply sinuated in the middle, highest at the anterior end, ventral margin slightly sinuated near the anterior end; seen from above broadly ovate, with irregular outline, width rather more than half the length, widest near the posterior end; anterior extremity obtuse, with two mucronate processes, posterior wide, truncated, with broad, tooth-like median projections; surface of the shell marked with large regular ridges and deep depressions, which become very conspicuous in dead shells; size, 0·73 millim.

In the general washings and in washings from Gulf of Manaar sponges.

This well-marked species is named in memory of my friend and fellow-worker, the late Mr. Isaac C. Thompson, F.L.S., who was jointly responsible with me in the preparation of the "Report on the Copepoda," published in the first volume of this work.

Cythere donnani, n. sp.—Plate II., figs. 17 and 18.

Shell seen from the side subsigmoid, height equal to half the length; anterior extremity wide and very obliquely rounded, with about fourteen small teeth on the lower margin, posterior narrow, slightly produced in the centre, with four small teeth below the middle; dorsal margin sinuated in the middle, highest at the anterior and rounded off towards the posterior, ventral sinuated, convex in front and behind; seen from above broadly ovate, width slightly less than half the length, with rounded extremities, slightly produced into thickened lips, widest near the posterior, and slightly sinuated in the middle; surface of the shell marked with a number of fairly regular longitudinal ridges and rows of impressed puncta; size, 0·98 millim.

In washings from Cheval pearl oysters, and from Gulf of Manaar sponges.

Named after Captain Donnan, Inspector of the Pearl Banks in 1902.

Cythere willeyi, n. sp.—Plate II., figs. 19 and 20.

Shell seen from the side oblong, subquadrangular, height equal to rather more than half the length; anterior extremity wide and very obliquely rounded, with about seventeen short stout teeth, posterior much narrower, bluntly rounded, with four short teeth on the lower margin; dorsal margin very slightly sinuated in the middle, highest in front, and rounding off posteriorly, ventral sinuated slightly in front of the middle; seen from above broadly ovate, with irregular outline, width rather more than half the length, widest in front of the middle; anterior extremity obtuse, with two mucronate processes, posterior widely triangular; surface of the shell marked with large irregular puncta, and a distinct dorsal ridge; size, 0·8 millim.

In general washings from Gulf of Manaar.

Named after Dr. Arthur Willey, Director of the Museum at Colombo.

Cythere hornelli, n. sp.—Plate II., figs. 21 and 22.

Shell seen from the side siliquose, height rather less than half the length; anterior extremities narrowed and rounded, smooth; dorsal margin boldly arched, highest in the centre, ventral sinuated in the middle; seen from above wedge-shaped, width less than half the length, widest near the posterior; anterior extremity produced, with two mucronate processes, posterior margins truncate, and produced into a broad triangular projection; surface of the shell marked with a number of curved ridges and rows of impressed puncta; size, 0·53 millim.

In general washings from invertebrata from Gulf of Manaar. Named after Mr. James Hornell, now Inspector of the Pearl Banks.

Cythere halyi, n. sp.—Plate II., figs. 23 and 24.

Shell seen from the side oblong, quadrangular, height slightly less than half the length, widest in the middle; anterior extremity broadly rounded, with one tooth below the centre; posterior produced into a wide triangular beak; dorsal margin flat, with a corrugated margin, highest at the extremities, ventral slightly convex and irregular; seen from above narrowly ovate, with produced and thickened extremities, widest behind the middle, width considerably less than half the length; surface of the shell marked with numerous impressed puncta and studded with bluntly pointed spines; size, 0·55 millim.

In general washings from invertebrata from Gulf ot Manaar. Named after Mr. Haly, a former Director of the Colombo Museum.

Cythere kelaarti, n. sp.—Plate II., figs. 25 and 26.

Shell seen from the side oblong, subquadrangular, height scarcely equal to half the length; anterior extremity broadly and obliquely rounded, with about 21 short, stout teeth; posterior narrow and subtruncate, with seven short, thick spines; dorsal margin slightly sinuated, highest in front and sloping gently backwards, ventral nearly straight, much contracted at the posterior; seen from above doubly triangular, widest much behind the middle, where the outline is produced into a blunt tooth; width slightly more than half the length; anterior extremity with two, and the posterior with four, spines; surface of the shell marked with numerous impressed puncta, very rough and studded with short, aculeate spines, one triangular tooth near the posterior; size, 0·65 millim.

In general washings from dredged invertebrates from Gulf of Manaar. Named after Dr. Kelaart, who investigated the pearl banks in 1857.

Cythere willisi, n. sp.—Plate II., figs. 27 and 28.

Shell seen from the side subquadrangular, with compressed margins, height slightly less than two-thirds of the length; anterior extremity broad and very obliquely rounded, with seven short, stout teeth on the lower portion; posterior almost rectangularly truncated, produced below the middle, where it bears two teeth and one or two crenulations; dorsal margin highest in front, sloping with a sinuous curve gently backwards; ventral sinuated in front and convex behind; seen from above ovate, with produced emarginate extremities, sharply constricted in the middle and near the posterior end, width equal to half the length; surface of the shell covered with large irregularly angulated fossæ, marked with a strong marginal ridge and an obliquely transverse one, coursing from the posterior towards the anterior extremity; highest at the posterior end; size, 0·73 millim.

In the general washings, in washings from Gulf of Manaar sponges, and in a dredging from Karativo Paar. Named after Dr. J. C. WILLIS, Director of the celebrated Botanic Gardens at Peradeniya, Ceylon.

Cythere colletti, n. sp.—Plate II., figs. 29 and 30.

Shell seen from above subquadrangular with compressed margins, height equal to slightly less than two-thirds of the length; anterior extremity broad and obliquely rounded, with 10 short, stout teeth on the lower portion; posterior narrowed, truncated, produced near the middle into a quadri-crenulate projection; dorsal margin highest in front, sloping rather steeply to the posterior; ventral slightly sinuated in front, convex behind the middle, rising quickly near the posterior, where there is a strong, stout incurved tooth; seen from above doubly triangular, widest slightly behind the middle, width rather more than half the length, the margins near the posterior end are produced into strong teeth; anterior extremity blunt and produced into the mucronate processes, posterior truncate; surface of the shell marked with curved ridges and rows of impressed puncta; each valve has a strong tooth near the lower margin of the posterior end; size, 0·5 millim.

In washings from Gulf of Manaar sponges.

Named after the late Mr. OLIVER COLLETT, a well-known naturalist in Ceylon.

Cythere holdsworthi, n. sp.—Plate II., figs. 31 and 32.

Shell seen from the side subrhomboidal, height equal to fully two-thirds of the length; anterior extremity broad and obliquely rounded, posterior truncated, with a small projection in the centre; dorsal margin boldly arched, highest in the middle; ventral convex in the middle; seen from above broadly ovate, widest near the middle, width equal to two-thirds of the length; anterior extremity narrowed and bluntly rounded; posterior broadly rounded, almost truncate; surface of the shell marked with concentric rows of impressed puncta; size, 0·5 millim.

In general washings from dredged invertebrata from Gulf of Manaar.

Named after Mr. HOLDSWORTH, the naturalist who investigated the pearl banks in 1868.

Section III.: PLATYCOPA.

Family: CYTHERELLIDÆ.

Cytherella ondaatjei, n. sp.—Plate II., figs. 33 and 34.

Shell seen from the side subquadrangular, height rather less than two-thirds of the length; anterior extremity broadly rounded, posterior obliquely rounded, sloping steeply inwards; dorsal margin slightly arched, highest behind the middle, ventral deeply sinuated in the middle; seen from above elongate narrow, widest behind the middle, width equal to one-third of the length; anterior extremity bluntly rounded, posterior almost truncated, margins much hollowed above the middle; surface of the shell marked with numerous shining spots, and a conspicuous triangular groove; covered with fine spinules, anterior extremity and ventral margin finely spinulate; size, 0·6 millim.

In a dredging from Karativo Paar.

Named after Dr. Ondaatje, a former naturalist and collector in Ceylon.

Cytherella vraspillaii, n. sp.—Plate II., figs. 35 and 36.

Shell seen from the side subelliptical, height less than two-thirds of the length; valves unequal, left valve larger than the right; anterior extremity rounded, posterior rounded and slightly produced in the centre; dorsal margin slightly arched, highest in the centre; ventral flattened, slightly sinuated; seen from above pear shaped, widest behind the middle, width slightly less than two-thirds of the length, obtusely pointed in front, broadly rounded behind, lateral margins boldly convex; surface of the shell smooth and polished; size, 0·55 millim.

In general washings from dredged material from Gulf of Manaar.

This species is named in honour of Mr. V. Vraspillai, the well-known Adigar of Musali, who has rendered able service in connection with the pearl banks for many years.

EXPLANATION OF PLATES.

PLATE I.

Fig. 1. *Sarsiella carinata*, n. sp., from right side.
„ 2. „ „ „ above. × 45.
„ 3. *Sarsiella gracilis*, n. sp., from right side.
„ 4. „ „ „ above. × 36.
„ 5. *Sarsiella similis*, n. sp., from right side.
„ 6. „ „ „ above. × 45.
„ 7. *Sarsiella crispata*, n. sp., from right side.
„ 8. „ „ „ above. × 57.
„ 9. *Sarsiella tumida*, n. sp., from right size.
„ 10. „ „ „ above. × 37.
„ 11. *Bairdia inornata*, n. sp., from right side.
„ 12. „ „ „ above. × 62.
„ 13. *Bairdia robusta*, n. sp., from right side.
„ 14. „ „ „ above. × 44.
„ 15. *Erythrocypris herdmani*, n. sp., from right side.
„ 16. „ „ „ above. × 50·8.
„ 17. *Pontocypris robusta*, n. sp., from right side.
„ 18. „ „ „ above. × 55·5.
„ 19. *Pontocypris elegans*, n. sp., from right side.
„ 20. „ „ „ above. × 74.
„ 21. *Pontocypris rostrata*, n. sp., from right side.
„ 22. „ „ „ above. × 71.
„ 23. *Xestolebris squamigera*, n. sp., from right side.
„ 24. „ „ „ above. × 90.
„ 25. „ „ „ posterior end.
„ 26. *Paracytheridæa perplexa*, n. sp., from above.
„ 27. „ „ „ right side. × 71.
„ 28. *Pseudocythere minuta*, n. sp., from right side.
„ 29. „ „ „ above. × 134.
„ 30. *Pontocypris tumida*, n. sp., from right side.
„ 31. „ „ „ above. × 45.
„ 32. *Paradoxostoma attenuatum*, n. sp., from right side.
„ 33. „ „ „ above. × 74.
„ 34. *Anchistrocheles bradyi*, n. sp., from right side.
„ 35. „ „ „ above. × 45.

PLATE II.

Fig. 1. *Paradoxostoma stebbingi*, n. sp., from right side.
„ 2. „ „ „ above. × 74.
„ 3. *Xestolebris tumida*, n. sp., from right side.
„ 4. „ „ „ above. × 72.
„ 5. *Xestolebris irrasa*, n. sp., from right side.
„ 6. „ „ „ above. × 72.

Fig. 7. *Cytherura concinna*, n. sp., from above.
„ 8. „ „ „ right side. × 72.
„ 9. *Cythere knoxi*, n. sp., from right side.
„ 10. „ „ „ above. × 72.
„ 11. *Cythere chalmersi*, n. sp., from right side.
„ 12. „ „ „ above. × 61.
„ 13. *Cythere imthurni*, n. sp., from right side.
„ 14. „ „ „ above. × 76.
„ 15. *Cythere thompsoni*, n. sp., from right side.
„ 16. „ „ „ above. × 60.
„ 17. *Cythere donnani*, n. sp., from right side.
„ 18. „ „ „ above. × 37·5.
„ 19. *Cythere willeyi*, n. sp., from right side.
„ 20. „ „ „ above. × 46.
„ 21. *Cythere hornelli*, n. sp., from right side.
„ 22. „ „ „ above. × 72.
„ 23. *Cythere halyi*, n. sp., from right side.
„ 24. „ „ „ above. × 60.
„ 25. *Cythere kelaarti*, n. sp., from right side.
„ 26. „ „ „ above. × 60.
„ 27. *Cythere willisi*, n. sp., from right side.
„ 28. „ „ „ above. × 47.
„ 29. *Cythere colletti*, n. sp., from right side.
„ 30. „ „ „ above. × 72.
„ 31. *Cythere holdsworthi*, n. sp., from right side.
„ 32. „ „ „ above. × 70.
„ 33. *Cytherella ondaatjei*, n. sp., from right side.
„ 34. „ „ „ above. × 60.
„ 35. *Cytherella vraspillaii*, n. sp., from right side.
„ 36. „ „ „ above. × 60.
„ 37. *Sarsiella gracilis*, postabdomen. × 70.
„ 38. *Sarsiella similis*, „ × 120.
„ 39. *Sarsiella crispata*, „ × 70.
„ 40. *Sarsiella carinata*, „ × 70.
„ 41. „ „ antennule. × 70.
„ 42. *Sarsiella tumida*, postabdomen. × 70.
„ 43. *Codonocera cruenta*, postabdomen. × 70.
„ 44. „ modified seta of antennule. × 110.
„ 45. „ prehensile branch of antenna. × 70.
„ 46. *Xestolebris irrasa*, antennule. × 260.
„ 47. „ antenna. × 156.
„ 48. *Xestolebris squamigera*, antennule. × 260.
„ 49. „ antenna. × 156.

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