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On the Anatomy of Distichopora—with a monograph of the genus.

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[Read before the Royal Society of N.S.W., 6 August, 1879.]

THE family of the *Stylasteridae* has attracted so much attention lately in connection with the deep-sea dredgings, and the important researches of Mr. Moseley, naturalist to the "Challenger," that I need offer no apology for these brief researches on one of the least known of the family—the genus *Distichopora*. As far back as 1859 I sent specimens of this singular coral to naturalists in England, who could give me no information concerning them. The species sent home was described by Dr. Gray,* but beyond giving it a name and a brief description nothing was done. It was quite obvious that it must differ from every other kind of coral, but its peculiarities remained without explanation, and its relations or affinities unknown. From its appearance one would imagine that it was on the boundary-line between Polyzoa and Anthozoa, and indeed this was the origin of my interest in the solution of its anomalies. At that time I was becoming acquainted with the vast quantities of fossil polyzoa and corals in the tertiary formations of South Australia, all new to science, and belonging not only to new genera but families. The first step in their elucidation was to find out their connection with the living fauna. But I soon found that the living fauna was almost as unknown as the fossil. This led me to send many specimens to Europe, seldom, however, with any satisfactory result. I then saw that the work must be done, as far as it could be done, by Colonial naturalists.

One of my earliest puzzles was *Distichopora*. As early as 1858 I made some of the drawings which illustrate this paper, and I arrived at some of the conclusions which I embody here. As soon as I had seen the results of Agassiz's studies on the genus *Millepora* I came to the conclusion that *Distichopora* was one of those forms which, like the *Millepores*, belong more to the medusæ than corals. Relying upon the remark of Milne-Edwards, that the line of demarcation between these sub-kingdoms was the dermal organs of reproduction in the one case and the visceral organs in the other, I had already arrived at the supposition that the "*ampullæ*" were

* *Proc. Zool. Soc.*, 1860, p. 244.

the exodermal reproductive organs of *Distichopora*. I never had until lately an opportunity of studying the animals alive, and in the meantime Mr. Moseley had ably and satisfactorily decided the whole question in those brilliant researches which I shall refer to further on. After all that he has done, I consider the observations I have to offer here as a very trifling contribution to the stock of knowledge on the subject. Though they are original, there are few that will be new. During the long period over which my observations have extended, I have been enabled to work out the literature of the subject as I think pretty completely, and this, with the remarks on the new species I here introduce to science, will be all that I propose to add to what Mr. Moseley has given to the world.

The genus *Distichopora* was originally erected by Lamarck* for a coral which had previously found its place among the *Millepores*. It was described by Dr. P. S. Pallas in his summary of Zoophytes (*Elenchus Zoophilorum*) published at the Hague in 1766.† He placed it among his *Millepores*, which were thus defined: *animal vegetans, corallium, solidiusculum, ramosum, poris cylindraceis, in acin perpendicularibus, exserens*. This is the old Linnean definition, and included a very heterogeneous assemblage. The species referred to was mentioned by Rumphius in the *Herbarum Amboynense* (Amsterdam, 1750) as *Lithodendrum saccharaceum rubrum* (vol. vi, p. 243). Pallas supposes that the species he describes was meant, but as his is of a violet colour, which is very constant, Rumphius would have hardly designated his *rubrum*. It is much more likely that another species, *D. coccinea* or *D. rosea*, was designated by Rumphius. Pallas does not appear to have known them. The species he named *Millepora violacea*. The following is his diagnosis: *Musula corallina in rupibus diffusæ, assurgentes, ramulis teretibus, obtusis, subflexuosis, passim ramosis, verrucosisve, sesquipollicaribus. Substantia intus tubulis vasculosa, violaceo-albida, in superficie tenerime scabra et sæpe pulcherrimo florum sambuci‡ colore tincta. Per ramulos extus suturæ vulgo binæ plerumque oppositæ, longitudinales, cellulose seu ex poris concatenate decurrunt. In quibusdam specimenibus observavi passim crebras in superficie bullulas, quales in adusto glutine fere surgunt; quæ confractæ cellulositatem latentem prodiderunt efflorescentiumque polyporum gemmulæ esse videntur. Locus: Mare Indicum unde cum ISIDE ocreacea et GORGONIA SUBEROSA promiscue allatam habeo.*

* *Hist. Nat. d'Anim. s. Vertèbres*, 1st edit., vol. ii, p. 198.

† There were no plates to this edition, which is a small 8vo. Another was published in 1768 by Boddaert, at Utrecht, with plates. I have not seen any copy of it.

‡ The pale yellow of elder flowers is, I suppose, meant, though the simile is rather far-fetched.

Ellis knew the species, for he describes and figures it in his *Nat. Hist. of Zoophytes*, p. 140. *MILLEPORA VIOLACEA. M. in plano ramosa, ramulis ascendentibus, flexuosis, tereti impressis, sutura porosa, marginem ambiente*. He adds: "This coral is of a fine violet blue. It rises from a spread base about three inches high. Besides the line of large pores which surround the margin, there are two rows of small pores on each side of it. The surface when magnified is rough like shagreen, and here and there upon it there are clusters of little warts, like studs or bullulæ, which may probably be its ovaries. When the branches are broken across, there appears in the middle a row of three or four large pores surrounded by small ones. I had formerly a specimen of this coral from W. Webber, Esq., F.R.S., and very lately some complete ones from Mr. Banks and Dr. Solander, that the divers had fished up about the islands of the South Sea." There is no reference to any plate, but on turning to plate 26 we find a very excellent drawing (fig. 3), with a slightly enlarged fragment in fig. 4. In the accompanying letter-press it is stated that no explanation of this plate was found amongst Mr. Ellis's papers. Lamarck, with his usual accuracy, recognized the plate, and gives the following definition:—"Distichopora. Polypary stony, solid, attached, branched, a little compressed. Pores unequal, marginal, disposed on the two opposite edges in longitudinal series, and in the form of sutures. On the surface of the branches there are a number of stelliform warts gathered in places. *Polyparium lapideum, solidum, ramosum, fixum, compressiusculum. Pori inæquales, marginales, longitudinaliter seriati, suturam disticham mentientes. Verruca stellata, ad superficiem ramorum passum acervata. Observations.* I cannot avoid the necessity of separating from the Millepores the *Millepora violacea* of Pallas, and forming with it a distinct genus. This coral presents such singular characters in the form and in the disposition of its pores that although it is the only species known with this peculiarity, it is probable that others will be discovered of the same genus. Its characters equally remove it from millepores, and retepores, and escharas, but its substance is more solid, and it cannot properly be placed amongst any of the genera with stony polypidoms. *Distichopora violacea. D. ramosa; ramulis ascendentibus, flexuosis, tereti compressis. Millep. violacea. Pall. Zooph.*, p. 258. Solander and Ell.,* p. 140. Habitat, Indian Ocean and Austral. My collection."

* The reason why no reference to the plate is found in Ellis's work is this: Ellis was publishing it with the assistance of Drs. Solander and Fothergill, the latter giving pecuniary aid. Ellis died Oct. 15, 1775, when the book was far on towards completion. Dr. Solander was then engaged at the British Museum, and could not do much alone. Dr. Fothergill died in 1780, and he was soon followed to the grave by Solander (in 1782). Urged by Sir Jos. Banks, the book was published in 1786, just as it was, by Mrs. Martha Watt, a surviving daughter of Ellis.

In Blainville's *Manuel d'Actinologie* p. 416, we find the following reference:—"Animal unknown, contained in cellules of two sorts, one stelliform, scattered, extremely superficial, and leaving few traces; the others poriform, deep, unequal, forming three lateral series on each side of the branches of a calcareous polypary, dendroid, fixed, composed of compressed branches, obtuse, rounded, subflexuous, vasculo-tubulous in the interior. *D. violacea*. Lam., *Encyclo. Méthodique*, p. 481, No. 1, a b, Atlas (Atlas to the *Manuel d'Actinologie*, where the figure is a very poor one, though the general idea of the coral is more exact than that of Ellis), pl. 55, fig. 2. *Millepora violacea*. Linn. Gmelin, p. 3,785, No. 12. Red Sea and India.* Obs. This genus has been established by Lamarck for a polypary differing from every known Millepore. In effect all its surface is covered with stelliform cellules, polygonal, extremely superficial, so as to be seen with difficulty, while on each side of the branches are round or oval holes, rather deep, disposed in three longitudinal series, those of the medium line being the largest† as the animals are lodged there. We cannot be sure of this, though it seems probable. What is certain is that the polypary is extremely porous and scarcely solid." Blainville places the coral in the class Polyparia, sub-class Stony Polyparia, family Millepora. His observations are incorrect in two particulars—first in regarding the wart-like clusters as one of the kinds of cells; and secondly, as to the polypary not being solid. Dana also mentions the genus in his *Synopsis of the Report on Zoophytes*, 2nd edit. New Haven, 1859, p. 15.† "Genus *Distichopora*. Lamarck. Ramose, quite small, branched in a plane. Corallum firm, branches often a little compressed, and a cellular furrow on two opposite sides extending over the extremity."

1. *Distichopora violacea*. Lamarck. Violet, with the tips a little yellowish; 2 to 2½ inches high and ramose; branches somewhat compressed, dichotomous, 1 to 1½ line broad. Plate 60, fig. 3, corallum nat. size; 3 a, extremity of a branch magnified. East Indies and Pacific, Paumotu, Archipelago.

* This shows how little the habitats of the older authors can be trusted. I don't know where Blainville obtained his habitat. Ellis says the Pacific.

† Turton, in his translation of Gmelin, says this, but his description is extremely obscure in all but the habitat, thus—"South Sea Islands, about 3 in. high, with two rows of small pores each side the margin, besides the line of larger ones surrounding it. Surface rough, with here and there clusters of little studs." Turton's Linnaeus, vol. iv, p. 636.

‡ It must be borne in mind that the first edition of Dana's *Zoophytes* was the only one which had the atlas of plates, of which, unfortunately through a mistaken economy of the American Government, only 200 copies were printed. The *Report on Zoophytes* which accompanied it was a 4to volume of 750 pages, published in 1846. A second edition of this in 8vo. 172 pages, was published as above.

2. *Distichopora gracilis*. Dana. Reddish; more slender than the *violacea*, ramulous; branchlets one-third as broad, at summit about a third of a line. Plate 60, fig. 4, corallum natural size; fig. 5, a variety(?) natural size; 5a 5b, views enlarged. Paumotu, Archipelago.

Dana makes no further remark. It is rather singular that Milne-Edwards, in his *Hist. Nat. des Corallaires*, in which he refers to almost every coral and every author on corals known, makes no reference to this singular genus, nor to the observations of Pallas, Lamarck, or Ellis, except in the appendix, including it in the sub-class Cnidiæres, or corals imperfectly known, or the affinities of which are doubtful. His observations are as follow:—"Genus *Distichopora*. "Lamarck has established this genus for a very singular polypary, which Pallas had described under the name of *Millepora violacea*, but which is known in only a very imperfect manner. The soft parts of this zoophyte have not yet been observed, and after the study we have made of the interior structure, there still remains much uncertainty as to the place it ought to occupy in a natural system of classification. Most naturalists consider it as belonging to the great division of *Madreporaria*, and in effect it has some points of resemblance with the *Favosites*, but in other respects it is very remote, and appears to me to have more analogy with the *Acyonaria*. It has a dendroid habit, and is composed of almost cylindrical branches, somewhat twisted and nodulous, outspread on a vertical plane, and which presents, on the same plane at each side, a groove occupied by pores with an irregular contour. On making a vertical section, it is seen that these orifices are the termination of as many long tubular cellules, which are disposed in bundles and ranged transversely on two or many planes, as I have represented in the atlas of the great edition of the *Règne Animal de Cuvier* (*Zoophytes*, pl. 85, fig. 46). After being raised in an almost straight line, these cellules curve from both sides, so as to represent a kind of fan. They are nearly cylindrical at first, but open out gradually as they ascend. Towards the summit they become distorted by mutually pressing upon one another, and terminate by orifices, which are generally triangular and disposed in a single line at the extremity of the branches in two vertical lateral ranks. On the two opposite surfaces of the branches comprised within these series of openings the polypary is thickened, and presents a very compact structure which is a little granulose. Finally, on the edge of the lateral groove, where the ends of the cells are disposed, one observes a series of little circular openings, which appear to be nascent cells analogous to the larger tubular cells already mentioned. There are only two species—one recent and the other fossil."* Mons. Edwards then describes the two

* *Hist. Nat. des Corallaires*, vol. iii, 1860, p. 450.

species. He says that the clusters of warts are not perforated, but they are so when old, but the perforation is generally at the side. He adds that his specimen came from the island of Timor. He also describes the fossil species noticed by Defrance in Michelin's *Iconographie Zoophytologique, Description des Polypiers fossiles de France, &c.* (Paris, 1847), p. 168, plate 45, fig. 11. I give a copy of Defrance's—or rather Michelin's—figure, which is evidently a *Distichopora* closely allied to our species in Australia. It is found at Chaumont (130 miles E.S.E. from Paris), in the Eocene Calcaire grossier, and in the same deposits at Vermandois. It is a thick-branched polypiary without warts; but the dots seen in the figure (fig. 16) show that it had them, but they are broken away, and form the areolar scars to be referred to subsequently. Defrance says of the fossil that, without knowing something of the soft parts of the animal, it would be in vain to discuss its analogies.*

Milne-Edwards refers to drawings of the sections of *Distichopora*, which I have not seen),† but I give here a figure (fig. 13) of a section of a new species—*D. livida, nobis*—which shows the fanlike structure to which he refers. It is very singular that the columella or style seems entirely to have escaped him. Had he noticed that, and its constant absence from the secondary pores in this genus, he would hardly have supposed that the latter were nascent calices.

I especially draw attention to the fact that a fossil species is found in the earlier formations,—a fact amongst many others which daily confront us of extinct European Tertiary species having living representatives in the Australian seas. In Polyzoan organisms we have another instance in the genus *Lunulites*. I have not been able to refer to the works of Schweigger (*op. cit.*), but it is not necessary, as he had no new observations to offer.

Dr. J. E. Gray described a new species of *Distichopora* in the *Proc. Zool. Soc.* for 1860, p. 244. His short paper on the subject is as follows:—

“DISTICHOPORA COCCINEA, n.s.—Coral, bright crimson, much branched, compressed; branches rather fan-shaped, expanded, placed on each side of the stem, the sides of the branches rather compressed; the main branches with a sub-central series of small compressed tubercles, like the commencement of new branches. Lateral pores narrow, cells small. The upper surface of the stem with many short furcate branches; hab., Pacific Ocean, near New Caledonia, in deep water. This species differs from the only other

* M. Edwards had also referred to the genus in his portion of the second edit. of Lamouroux, vol. ii, p. 505. See also Lamouroux, *Expos. Mém.*, p. 46, pl. 26; *Encyclop. Zoophyt.*, p. 256; Schweigger, *Beobachtungen u. Natur. Hist. Reisen*, pl. 6, fig. 61; *Handbuch*, p. 431.
 † Except the copy in Mosely's Croonian Lecture.

recent species of the genus known, not alone in the beautiful bright crimson colour, but also in the form of the stem and branches, which in this coral is much more compressed, broader, and with shelving edges, giving it rather a sword-like appearance. The lateral grooves containing the cells are much narrower, the polypiferous cells much smaller. In one specimen, the small oblong, compressed tubercles in the middle of the upper side of the branches are produced into simple forked, or sometimes more subdivided short branches. The apices of the branches which have been broken and reproduced are whitish. The surface of many of the branches, as in *D. violacea*, is more or less crowded with convex circular elevations, or slight tubercles, which appear to be hollow or blister-like, with rather thick parietes.”

In figure 8 I give a sketch of the coral, which I do not think has been figured before. I shall give a more minute diagnosis subsequently. I have seen no type specimen, but I think there can hardly be a mistake about the species. No other known to me has the peculiar lines of small branchlets running up the main stems in almost a linear series and jutting out at right angles from it. These always have pores through the centre, both gastro-pores and dactylo-pores. The species is so very commonly met with that I am inclined to think it is to be found on the New South Wales coasts.

In the *Bulletin of the Museum of Comparative Zoology* (Cambridge, U. States) for 1868, I am informed that Count de Pourtales has given some observations on the genus *Distichopora*. I have not seen the paper in question; but in the *Proc. Zool. Soc.* for 1871, p. 281, Mr. W. Saville-Kent refers to an opinion given by the Count de Pourtales on the genus. He says that the structure of the calices in *Distichopora* is identical with what obtains in *Stylaster* and *Allopora*, with the exception that the calices are confluent. This structure is a tendency for the septa to unite and form with its loculi a ring of pores around the central chamber or columella (see fig. 15). In respect to the calices being confluent, he adds that *Distichopora* bears the same relation to *Stylaster* and *Allopora* that *Lithophyllia* and *Dasyphyllia* do to *Mussa* and *Symphyllia* among the *Astreidae*, the latter having confluent calices, while the former have them always distinct.* Count de Pourtales further states that he considers *Distichopora* to be more closely allied to *Allopora* than to *Stylaster*. In this Mr. Saville-Kent differs from him, as he regards the lateral and serial disposition of the calices as indicating an origin from primary alternate distal rather than from an

* Prof. Verrill makes no distinction between *Mussa* and *Symphyllia*; the differences between them, he states, being dependent on the mode of growth, which may vary in the same species.

irregularly scattered gemmation. Mr. Saville-Kent then describes a new species, which he names *Distichopora rosea*. See *Proc. Zool. Soc.* 1871, loc. cit.

The wart-like clusters so frequently referred to are made one of the features for classifying *Stylasters*. M. Edwards says of that genus that the branches have in various places clusters of vesicular tubercles. *S. gracilis*, *roseus*, *gemmascens* and *granulosus* all have them. Mr. Saville-Kent and others name them "ampullæ."

I am indebted to the Croonian Lecture* of Mr. Moseley, on the structure of the *Stylasteridae*, for the following. Count de Pourtales, in his *Deep Sea Corals* (*Illustrated Catalogue of the Museum of Comparative Zoology at Harvard College*, No. 4, 1871, p. 33), writes as follows:—"Professor Verrill first recognized the close affinity of *Distichopora*, *Errina*, and *Stylaster*. *Bull. Mus. Comp. Zool.*, No. 3, 1864.) In his notes on the *Radiata* (*Trans. Conn. Acad.* vol. I, 1870) he adopted a suggestion of mine to make a distinct family of the *Stylasteridae*, which he places in his sub-order *Oculinacea*, both of us overlooking the fact that Gray had already established it. Pourtales, struck by the porous nature of the canenchyma of the coralla of the *Stylasteridae* and other points in the hard structure which he observed, removed them from amongst the imperforate corals and ranged them next *Eupsammiidae*. He fully recognized many strong points of affinity which rendered the family a natural one, but failed to ascertain the true character of the organism, because he had not an opportunity to examine the soft structures."

Several other species of *Distichopora* were described from the Atlantic and West Indies by Prof. Verrill and Pourtales, as I gather from Moseley (*op. cit.*) thus:—*D. nitida*, Verrill *Bull. Mus. Comp. Zool.*, Cambridge, 1, p. 46. *D. cervina*, Pourtales' *Deep Sea Corals*, p. 39, note, Ill. Cat. Mus. Comp. Zool., Harvard, No. 8, pl. 7, fig. 11, St. Thomas, Danish, West Indies. *D. foliacea*, Pourtales' *Deep Sea Corals*, p. 38, pl. 4, figs. 12, 13, off Florida and Key West, 100 to 262 fathoms. *D. sulcata*, Pourtales' *Deep Sea Corals*, p. 38, pl. 4, fig. 14, pl. 7, fig. 7, off Havana, 270 fathoms, off Cuba. *D. barbadensis*, Pourtales, Ill. Cat. Mus. Comp. Zool., Harvard, No. 8, p. 43, pl. 7, fig. 10.

I have not had an opportunity of verifying any of these references or consulting the essays of Count Pourtales, but I have recently seen some of those of Prof. Verrill.

All the preceding observations referred to the calcareous part of the coral. The soft parts of any of the *Stylasteridae* were not even known to any observer except Sars†, who was enabled to see just

* See *Philosoph. Trans.*, Pt. ii, p. 425.

† *Bidrag til Kundskaben om Dyrelivet paa vore Havbanker*, Forh. i Videnskabs. Selskabet i Christiania, 1872, p. 115. Fide Moseley, loc. cit.

enough to make him suspect the affinity of the *Stylasteridae* to the *Hydroids*. Ever since the observations of Agassiz on *Millepora* corals, by which they were identified with *Hydroids*, there has been a growing conviction that the *Stylasteridae* were related to them. To follow the description of Mr. Moseley, in his charming Notes of a Naturalist on the "Challenger" (p. 526) the hard parts of the coral or calcareous skeleton of *Millepora* is finely porous throughout, and within this porous mass at its surface are excavated cylindrical holes or pores of two sizes. The porous mass supports the living tissue, which is a canal system or meshwork for circulation through the smallest part of the coral. Two kinds of polyps inhabit the two-sized pores. The larger are short, stout, cylindrical polyps, with four tentacles, a mouth, and a stomach. They are called *Gastrozooids*, and the pores they inhabit *Gastropores*. The smaller pores are occupied by a polyp with numerous tentacles, but devoid of mouth or stomach. They are called *Dactylozooids*, and the pores *Dactylopores*. All the polyps of the Colony are at their bases connected with canal system of circulation. Their mode of reproduction is not known. It is thought that they produce free-swimming Medusæ. It has been left to Mr. Moseley to be the discoverer of all the analogies of the *Stylasteridae*, to which the *Milleporidae* gave only an imperfect clue. During the voyage of the "Challenger" many new species and new genera of *Stylasteridae* were dredged up, and though they were from great depths yet the tissues were living in some cases, and admitted of a complete examination. All the structures found a ready explanation. The two kinds of pores, the canal system, the ampullæ, and the serial pores all are found to be modifications of the one type, as following summary of the observations of Mr. Moseley will show.

In the *Stylasteridae* there is a canal system or network of circulation. Gastrozooids and dactylozooids are present, consequently the two kinds of pores. In the gastropores there is usually a style or columella, and none in the dactylopores, but there are genera where the style is found in both, and others where it is found in neither. For the process of reproduction each colony or coral is of a separate sex, male or female. In the female stocks ova are developed in special chambers, which are the warts or ampullæ. The ova do not leave the ampullæ until they are developed into a cylindrical larva or planula, when it swims off and develops itself, when attached, into a new stock. The male organs are in ampullæ also, and contain spermatozooids. In some genera the pores are irregularly scattered, in others the dactylopores are grouped round the gastropores either irregularly (*Sporadopora*), regularly but few (*Allopore*), regular and numerous (*Allopore*, *Astylus*), few and in a linear series (*Distichopora*).

With regard to the reproduction, the influence or contact between the ova and spermatozooids has not been made out; indeed the whole question of reproduction in these, as well as *Anthozoa*, is obscure and unsatisfactory. The gonophore sacs within the ampullæ are called gonangia. The ova must be in some way impregnated within the gonangia, says Mr. Moseley, but this was not seen, nor has it been proved. In almost all *Hydroids* the sexes are on distinct stocks, and the tendency is always towards an alternate gemmation.

Like all other *Hydroids*, the surface layer develops *nematocysts* or receptacles for those coiled tubular threads which can be darted out when needed for purposes of offence or defence. In *Actinia* these are venomous in character. No triple-spined *nematocysts* such as those occurring in *Millepora* and in most *Hydroids* were detected as existing in any of the *Stylasteridae*.

Mr. Moseley was enabled to examine the soft parts of *Distichophora violacea*. The dactylozooids were found to be stoutly formed, and attached to the bottom of the pore by a long muscular slip. The gastrozooids were short and cylindrical, with four small clavate tentacles. The gonophores were similar in structure to other *Stylasteridae*; both male and female specimens were examined, the latter distinguished by the prominence of the ampullæ. In the males the ampullæ were invisible, from the surface being sunk in the tissue.

Since these discoveries of Moseley have placed the *Stylasteridae* in a definite position, it remains to state what that position is, and thus come to the true zoological character of *Distichophora*. In this I follow first the general outline proposed by Ray Lankester.

Animalia. Grade 2. Enterozoa—Animals consisting of many plastids primarily arranged in two layers, surrounding a food-receiving cavity, the enteron. Grade 1. *Cœlentera*. Enterozoa, in which the enteron remains as a continuous cavity either simple or much ramified inextensive with the body wall. * Phylum 1. *Porifera*. Phylum 2. *Nematophora*. The latter are arranged in six classes, thus—1, HYDRO-MEDUSÆ. 2, PODACTINARIA. 3, DISCO-MEDUSÆ. 4, HYDROCORALLINÆ. 5, ANTHOZOA. 6, CTENOPHORA.

The Hydrocorallinæ contain two orders, viz.—1, *Petrosa* (Stylaster, *Millepora*). 2, *Graptolitidae* (Graptolites).

The synopsis of the genera is thus formed by Mr. Moseley.

HYDRO-CORALLINÆ (Sub-order).

Hydroids forming a corallum with two kinds of zooids, viz.—Gastrozooids and Dactylozooids.

Dactylozooids with numerous tentacles. Ampullæ absent.
Fam. *Milleporidae*.

* Phylum is a term proposed by Hæckel instead of sub-kingdom.

Fam. STYLASTERIDÆ. Gray.

A. Pores sporadic or not in cyclo-systems. Gastrozooids with styles. Dactylozooids without them.

AA. Dactylozooids of one kind only.

Genus SPORADOPORA. Moseley, 1878.

Pores of both kinds simple. Gastrozooids with four tentacles.
Polypora. Moseley, 1876.

Genus PLIOBOTHURUS. Pourtales, 1871.

Dactylozooids at the tips of tubular projections. Gastrozooids without tentacles.

Genus ERRINA. Gray, 1835.

Gastrozooids sometimes covered with a projecting scale. Dactylozooids within nariform projections.

Genus DISTICHOPORA. Lamarck, 1816.

Pores simple in a triple linear row at the lateral edges.
AAA. Dactylozooids of two sizes.

Genus LABIOPORA. Moseley, 1878.

Larger dactylozooids within nariform projections arranged in regular rows. Smaller dactylozooids at the sides of these.

Genus SPINIPORA. Moseley, 1878.

Larger dactylozooids within long spine-like projections. Smaller dactylozooids in simple cavities at their bases. Gastrozooids with six tentacles.

B. Pores occurring in regular cyclo-systems only. Styles present in both kinds of pores or absent.

BB. Both kinds of pores with styles. Gastrozooids with tentacles.

Genus ALLOPORA. Eherenberg, 1834.

Cyclo-systems budding from one another somewhat irregularly. Gastrozooids with twelve tentacles.

Genus STYLASTER. Gray, 1831.

Corallum increasing by regular alternate gemmation of the cyclo-systems from one another. Gastrozooids with eight tentacles.

BBB. Styles absent, gastrozooids without tentacles. Gastrozooids with two chambers.

Genus *CRYPTOTHELIA*. Milne-Edwards, 1849.

Summits of the cyclo-system covered by a lid. *Cryptothelia* E & H.

Genus *ASTYLUS*. Moseley, 1878.

Cyclo-systems without a lid.

In the definition which Mr. Moseley gives of *Distichopora* I think it necessary to make certain little additions or slight corrections after giving his words.

Distichopora. Lamarck. Corallum branching, flabelliform, with branches usually flattened in the plane of the flabellum, composed of very compact cœnenchyma. Pores confined to narrow lines or rows running along the exact edges of the sides of the branches, generally absent on their faces except as occasional abnormalities or rudimentary branchlets budding in a direction out of the plane of the flabellum. The lines of pores composed of three rows, a central row of larger gastropores with circular or oval mouths, and a row on each side of this of smaller dactylopores, sometimes very minute, often slit-like in aperture, the length of the slit being directed at right angles to the line of the row. Pores very deep, prolonged in curved lines side by side on the plane of the flabellum inwards and downwards towards the bases of the branches, forming thus throughout the flabellum a thin continuous tract of fragile tubular tissue, in which the successively developed curved pore tubes stand out fan-wise, separating from one another, the compact masses of cœnenchyma forming the opposite sides of the branches. The branches may therefore be readily split into two halves along the tubular track. Older gastropores with immensely long filiform styles. Styles much shorter in the younger cells. None in dactylopores. Ampule sometimes on one, sometimes on both faces of the flabellum, prominent and often forming confluent masses.

The remarks I wish to add are that in all the species known to me, viz., *D. rosea*, *D. coccinea*, *D. violacea*, *D. livida*, the gastropores are very irregular in shape, and vary extremely in size, being (in *D. violacea*) often quadrate or angular. They at times are studded with trabeculae on the inside, see fig. 2, 3, and 10. The dactylopores are generally on a raised line and surrounded by a well defined wall and a row of smaller pores. See fig. 3 of a section. The pores round the dactylopores are very small and shallow. The styles vary much in shape. In *D. rosea* they are fine and feathery; in *D. violacea*, swollen towards the summit and covered with short spines, something like the thorns on a rose-bush; in *D. livida* it is very long and covered with irregular spinous processes (fig. 10).

I now give a list of the species, with a definition of those common in our seas.

D. nitida. Verrill.

D. cervina. Pourtales.

D. foliacea. Pourt.

D. sulcata. Pourt.

D. barbadensis. Pourt.

D. irregularis. Moseley. Sp. ind. postscript to Croonian Lecture, p. 502.

Distichopora violacea. Pallas. Corallum in tufts about (at most) two inches high and stained a pale bluish violet, nearly white at the tips, branching in a double antler-like manner. Branches almost cylindrical, but a little wider than thick, bifurcating two and three times. At each side the lateral furrow is broad, deep, and undulating. Margins of furrow very prominent—irregularly and finely dentate, sometimes extending in lobes on to the face of the branches. Surface finely granular—the granules larger than any other species here named; here and there studded with prominent, rounded, or roughly stellate excrescences. Gastropores contiguous, deep, sometimes alternating in size. Columella very long, thick at the summit, not visible from above. Dactylopores oblong, situated in the indentations of the raised margins.

Timor. *Aneitum*, N. Hebrides. J. Brazier; New Guinea; N. E. Australia, within the tropics.

Fig. 1. Coral nat. size. Fig. 2. Lateral groove much enlarged. *a*, gastropores. *b*, dactylopores on raised margin. Fig. 3, section of branch at margin a little more enlarged to show distinct wall round primary and secondary pores. *a* and *b* as before. Fig. 4, ampullae much enlarged.

D. gracilis. Dana. *Descrip. of Zoophytes*, op. cit., p. 151, pl. 60 fig. 4. Reddish, more slender than *D. violacea*, ramulous, branchlets one-third as broad, at summit about a third of a line. Paumotu Archipelago.

It is very difficult to recognize the species from this very imperfect diagnosis, so I have given the figures. Fig. 5. Coral nat. size. Fig. 6. Lateral groove enlarged. Fig. 7. Portion of branch enlarged. All from Dana's figures.

D. rosea. Saville-Kent. *Proceed. Zool. Soc.* 1871, p. 281. Corallum arborescent, branches nearly cylindrical. Calices occupying deep and occasionally interrupted lateral furrows, margins of the furrows very prominent. Columella attenuate, stylate, echinate very deeply immersed, made visible by the fracture of the corallum. Height of corallum, one or two inches; diameter of calicinal furrows, one-twentieth of an inch; of the branches, quarter of an inch. Colour of the cœnenchyma, bright rose pink. Habitat, east coast of Australia. Brit. Museum.

The specific characters here noted are the raised margin to the lateral furrow and the colour. If I am right in my identification of the species, I may add that the surface is much more hispid than any other species, the pores smaller—the dactylopores especially. The ampullae do not project much, and though lighter in colour are not conspicuous, and the branches often coalesce. It is not known outside the tropics.

D. coccinea. Gray. See *Proceed. Zool. Soc.* 1860, p. 244, *ut supra*. Corallum, five to six inches high, flabellate, spreading nearly on the same plane, a deep blood red, the distal ends often lighter in colour and fading into pale yellow. Branches broad and flat, very much compressed, never cylindrical, very finely hispid, studded all over with little wart-like branchlets, seldom more than two millim. high, but having primary and secondary pores. Lateral grooves, small, margins rounded, scarcely projecting. Gastropores distant, irregular, dactylopores minute. Style very minute, and fine ampullae, cells paler in colour, not much raised but vesicular, numerous. Branches often coalescing, the distal ends very thin, flat, and often falcate.

N. East coast of Australia and Pacific. Though I have never found it on the N. S. Wales coast, I am inclined to think that it occurs there, as fragments are seen in almost every private collection of shells. Fig. 8. Corallum nat. size.

D. livida, nobis. See *Proc. Lin. Soc., N. S. Wales*, May, 1879. Corallum in stout solid tufts, three or four inches high, flabellate or twisted and gnarled, not always spreading in the same plane, very solid and compact, livid, the tip often yellow or white, the lateral furrows and the tips of the smaller branches orange or red. Branches almost cylindrical, stout, rugose, very finely vermiculate, many projecting branchlets, the central stem often disproportionately thicker than the branches and smooth. Lateral furrows conspicuous from their orange colour. Gastropores large, irregular. Dactylopores very small, situated on the margin, which is not much raised but broad. Style very long and spinous. Ampullae in slightly swollen pale livid masses, in which the cells are not easily distinguished. When broken they leave deep areolar pits. Solomon Islands; New Hebrides; New Guinea.

Fig. 9. Corallum, nat. size.

Fig. 10. Gastropore with columella, much enlarged.

Fig. 11. Style (part of), highly magnified.

Fig. 12. Section near base.

Fig. 13. Enlarged longitudinal section of terminal branch, showing fan-like disposition of cells, styles removed, magnified.

Fig. 14. Transverse section of terminal branch, showing canal system between coenenchyma cells, much enlarged.

Fig. 15. *a*, calices of *Allopora*, enlarged; *b*, single calice, highly magnified.

Fig. 16. *a* and *b*, *D. antiqua*. Defrance. Fossil species from European Eocene.

The following is a synopsis of the Pacific species:—

A. Branches nearly cylindrical.

a. Marginal furrows much raised.

Colour, pale violet. *D. violacea*.

Colour, rose pink. *D. rosea*.

b. Margins slightly raised.

Colour, livid with orange furrows. *D. livida*.

B. Branches compressed.

a. Large, with lateral branchlets.

Colour, blood red. *D. coccinea*.

b. Small, thin, smooth.

Colour, rose. *D. gracilis*.

[Two plates.]



Fig 1



Fig 5

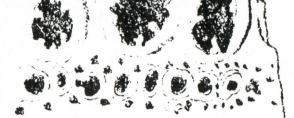


Fig 3

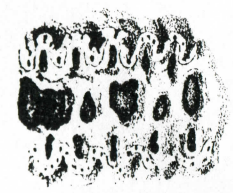


Fig 2



Fig 4

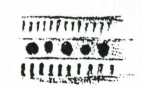


Fig 6

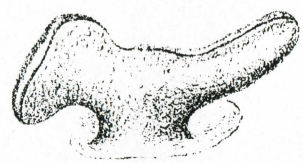


Fig 7



Fig 11



Fig 9



Fig 10



Fig 16

Fig 12

Fig 13

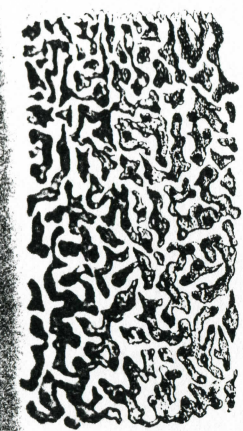


Fig 14

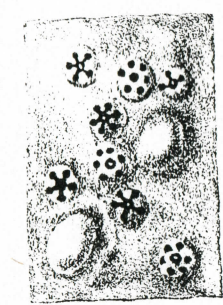
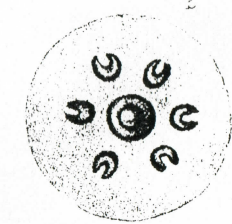


Fig 15

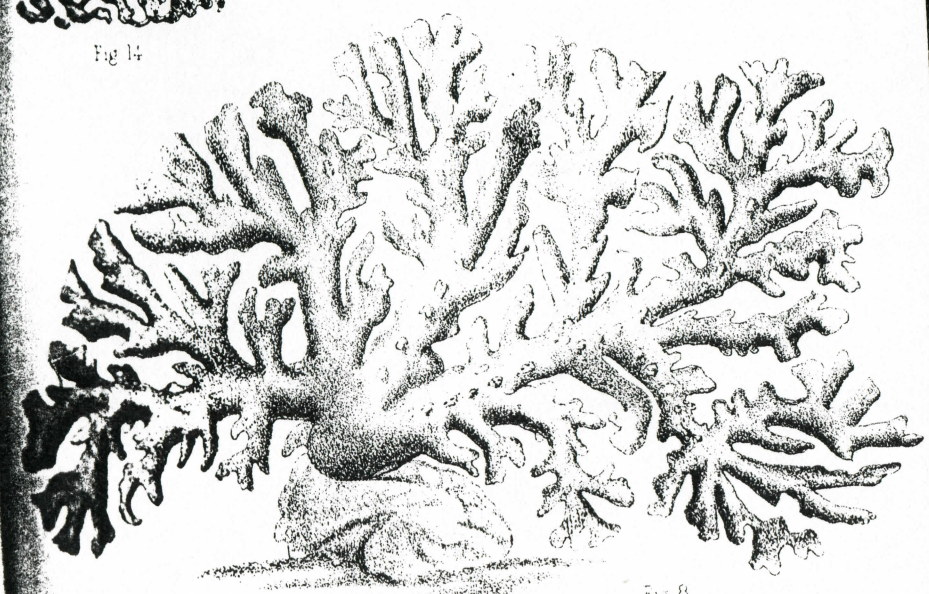


Fig 8