XIV. The Croonian Lecture.—*On the Structure of the Stylasteridæ, a Family of the Hydroid Stony Corals.*

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[Plates 34–44.]

INTRODUCTION.

In the Proceedings of the Royal Society, No. 172, 1876, I published a preliminary note on the present subject, and gave a short account of the results which I had arrived at from a somewhat hurried examination of the material at disposal. After this short account had been written, I devoted my time during the remainder of the homeward voyage of H.M.S. 'Challenger' to the further study of the structure of the Stylasteridæ, and the preparation of drawings illustrating it. I have supplemented this work by additional work in England, and the results are embodied in the present paper. The main part of the specimens of Stylasteridæ, from the study of which the anatomical details were determined, was obtained at a single haul of the trawl-net taken on February 14th, 1876, in lat. 37° 17′ S., long. 53° 52′ W., off the mouth of the Rio de la Plata in a depth of 600 fathoms. The specimens then obtained included six genera of the family of the Stylasteridæ. They were in most excellent preservation, although they had been slowly raised from the bottom, and in all the genera but one the generative organs were in full development. It was the examination of this set of specimens which first convinced me that the Stylasteridæ were Hydroids and not Anthozoans, a fact which I had already been led to suspect from the structure observed in the case of a species of *Astylus* obtained from 500 fathoms off the Meangis Islands, and that of a *Cryptohelia*, a short reference to which was given in a paper "On the Structure and Relations of certain Corals" (Proc. Roy. Soc., No. 64, 1875, p. 64, and Phil. Trans., Vol. 166, Pt. I., 1876, p. 116). I have examined also other specimens of Stylasteridæ obtained by the dredge and trawl of the 'Challenger' in various parts of the world, and a few specimens from those obtained by the United States dredging expeditions, which have been generously placed at my disposal by Mr. Alexander Agassiz and Count de Pourtales of the Museum of Comparative Zoology of Cambridge, Massachusetts.

Literature of the Subject.

The family Stylasteridæ was formed by the late Dr. Gray in his "Outline of an

Arrangement of Stony Corals" (Ann. and Mag. Nat. Hist., vol. xix., 1847, p. 127). The family was made to contain the genus *Stylaster* alone, and was thus characterized:—

"Coral minutely porous, cells deep, cylindrical, with six grooves, each ending in a pore and a central style."

M. EDWARDS and HAIME placed *Stylaster* in a sub-family, Stylasteraceæ, from which however they excluded *Errina* and *Distichopora*, although they included *Axohelia*, which is a Madracis.

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 Stylasteridæ, 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 cœnenchym of the coralla of the Stylasteridæ and other points in the hard structure which he observed, removed the Stylasteridæ from amongst the imperforate corals and ranged them next to the Eupsammidæ. He fully recognized many strong points of affinity which rendered the family a natural one, but failed to ascertain the true character of the organisms because he had not opportunity to examine their soft structures.

The coralla of several species of the family have been known to science from early times. The earliest known species, according to M. EDWARDS and HAIME, seems to have been *Stylaster flabelliformis*, the *Corail blanc* of SEBA (Thesaurus III., p. 204, Pl. 110, fig. 10, 1758), whilst *Stylaster roseus* and *Distichopora violacea* were described under the general genus *Madrepora*, by PALLAS, in 1766.

GRAY gave the name *Stylaster* to the genus in 1831 (Zool. Miscell., p. 36), and described the genus *Errina* in 1835 (Proc. Zool. Soc., 1835, p. 35).

Distichopora was named by LAMARK.

Allopora by EHRENBERG in 1834.

Cryptohelia was described by M. EDWARDS and HAIME in 1849.

POURTALES has added a new genus to the family, viz., *Pliobothrus*, as one of the results of the United States deep sea dredging operations, whilst I here add four further genera, viz., *Sporadopora*, *Astylus*, and *Spinopora*, dredged by H.M.S. 'Challenger,' and *Labiopora*, wrongly described by GRAY as a Bryozoon, under the name *Porella*. The only extant account of the soft parts of any Stylasterid is that by G. O. SARS, of the animals of *Allopora Norwegica*.*

SARS kept a succession of living specimens of the coral in fresh seawater, but never

* G. O. SARS. Bidrag til Kundskaben om Dyrelivet paa vore Havbanker. Forh, i Videnskabs. Selskabet i Christiana, 1872, p. 115.

got the animals to expand themselves so as to raise themselves above the level of the stellate openings. Nevertheless he saw clearly with lenses the tips of the opaque white tentacles in the angles between the so-called incomplete septa, which tips were usually more or less bent inwards towards the centre. He also saw deep down in the bottom of the calicle a similarly opaque white knot-shaped projection. This was all that could be seen in the fresh living animals. Specimens were, however, preserved in spirit and subsequently examined, and the conclusion was come to that the animal was essentially different from the rest of corals, and probably did not belong at all to the Anthozoa, but rather to the Hydrozoa.

By means of lucky breakings through of the stony-hard but nevertheless porous coral, SARS was able to obtain some little view of the general form of the polyps, and their relation to the coral. The true polyp body, he says, lies at the bottom of the central cavity of the calicle. It is very small, almost hemispherical in form, and provided with an apparently protusible beak or proboscis, which is sharply defined and blunt-conical in form, and on which no mouth opening was observable. At the circumference of the head of the polyp proceed out the narrowly cylindrical tentacles which correspond in number to the in-foldings of the calicle. Their lower region is inserted in the interseptal canals, while their upper parts project free from the foldings in between the so-called septa, and usually bend with their bluntly rounded ends towards the centre. No distinct connexion between the different polyp cavities was to be observed. They all seemed completely closed below. But it is to be remarked that the whole upper lining part of the coral is highly porous. Often there were to be found outside real polyp cavities in the inner mass of the coral near the surface; small cavities apparently everywhere closed, wherein were included one or several spherical bodies (eggs ?). Portions of the coral were decalcified in acetic acid. The organic basis remaining preserved to a considerable extent the form of the coral, and was composed of a tolerably regular network of apparently fibrous tissue in which were embedded numerous small elliptical nematocysts. The body of the polyp could be prepared out with considerable ease from this mass in connexion with its several tentacles, which under the microscope showed themselves beset all over with extremely small tightly packed nematocysts.

Although SARS thus suspected the affinity of the Stylasteridæ to the Hydroida, his results were insufficient to demonstrate the fact, since he could obtain no satisfactory information concerning the generative structures of the coral which he studied, and he failed entirely to detect the compound nature of the cyclo-systems of *Allopora,* since he regarded the dactylozooids as the tentacles of the gastrozooid, or body of the polyp, as he terms it. He, however, determined a great deal which was of high value. He was the first to make any observations on the structure of the soft parts of the Stylasteridæ, and is as yet the only naturalist who has watched a Stylasterid in the living condition.

He concludes his account with the following words, which show that he was not

certain as to the true nature of *Allopora,* although he considered there were strong grounds for removing it from amongst the Anthozoa :—

"Af det allerede anførte synes imidlertid med sikkerhed at fremgaa, at vi her have for os en Dyreform der i mange væsentlige Punkter afviger fra Anthozoerne hvortil den maaske slet ikke engang kan henføres."

Methods.

A brief examination of some of the soft structures of certain of the Stylasteridæ was made while they were in the fresh condition, and especially of the various elements of *Sporadopora dichotoma* and of the female gonophores of *Cryptohelia;* but since the trawl-net by which most of the specimens available for examination were obtained came up late in the day, very little unfortunately was able to be done in this way.

Portions of the corals were preserved by means of chromic acid, osmic acid, absolute alcohol, and glycerine, and they were subsequently decalcified and examined in the usual manner by means of sections. In cutting the sections, a method described by MILCHALKOVICS 'Arch. für mikroskopische Anatomie,' ii. Bd. 3[tes] Hft., p. 386, was adopted and found to yield most successful results. The method is especially valuable for cutting fine sections of structures, the parts of which are loosely held together, and where it is desirable to maintain the exact relations in position of parts which in the sections otherwise become entirely disconnected from one another. A strong jelly composed of equal parts of glycerine and gelatine is used as an imbedding substance. It permeates the tissues and takes the place of the hard calcareous supporting structures which have been removed by the acid. The sections are mounted in glycerine, and the imbedding substance which is left in situ in the sections becomes perfectly transparent; in fact, almost invisible in this fluid.

I now proceed to a detailed description of the structure of the several genera of the Stylasteridæ.

Each of the members of the family is composed of hard inert calcareous parts, or "corallum," and soft living structures. In the case of each genus the structure of the hard parts will be first treated of, and then that of the soft parts. The latter consists of cœnosarc, zooids, and gonophores, and will be described under these several headings in each case. A full description of all details will be given in the case of *Sporadopora,* which will be first accounted for, and in the cases of the other genera only those points in which they differ from it will be dwelt upon.

Terms.

In all Stylasteridæ two forms of zooids are present. One form has a mouth and gastric cavity, the other is devoid of these and has a purely tentacular function.

For the former the term "gastrozooid" is here adopted, and for the latter that of "dactylozooid."

The pore in the corallum occupied by the gastrozooid is termed "gastropore," and that of the dactylozooid "dactylopore."

In the more highly differentiated Stylasteridæ the pores are arranged in regular circular systems simulating the calicular systems of the Anthozoans in appearance. These systems are termed "Cyclo-systems."

Structure of the Hard and Soft Parts in the several Genera of the Stylasteridæ.

(1.) Genus *Sporadopora* (H. N. M.).

This genus, hitherto unknown, I described in the Proceedings of the Royal Society, vol. clxxiii., 1876, p. 94, under the name *Polypora*, but as I have been informed by Mr. Etheridge, junr., that the name *Polypora* is already in use, I here change it to *Sporadopora*, which refers to the irregular scattering of the pores over the surface of the corallum. The genus is founded on a single species, *Sporadopora dichotoma*, obtained on one occasion only by the 'Challenger' off the mouth of the Rio de la Plata in 600 fathoms.

Corallum of Sporadopora dichotoma.

The corallum or hard calcareous structure in this Hydroid occurs in the form of stout upright stems, which branch with tolerable regularity dichotomously to form a flabelliform expanse. The stem is usually nearly circular in section towards its base, but becomes compressed above in the plane of the fan, whilst the branches and branchlets forming the fan itself are very much flattened, so as to be more oblong than oval in transverse section. The number of branchings is few in number, only four or five at most. The flattened branches and branchlets coalesce at their adjacent margins. A figure of a well-grown but partly broken example is given on Plate 34, fig. 2, reduced to half the natural dimensions.

Sometimes the stems are somewhat bent and irregular, as are also the flabellate expanses which they support. The height of the largest specimen obtained is about $5\frac{3}{4}$ inches, and the breadth of the fan about 5 inches. The diameter of the stem at its base is about 1 inch; in slenderer specimens $\frac{1}{2}$ inch to $\frac{3}{4}$ inch. In one large broken and dead specimen the stem is 2 inches in diameter. The corallum is dense and heavy, and when macerated out from a living specimen is of a pearly white, and smooth and glistening in appearance (Plate 34, fig. 1). The surface is pierced by deep pores, which are simply circular in outline and of two kinds, large and small, and are scattered irregularly over it. The larger pores or gastropores are less numerous than

the smaller. They are deep, reaching nearly to the centra laxis of the branch or stem on which they are situate, and contain a deep-seated, long, and slender style. The smaller more numerous pores, the dactylopores, are thickly dispersed between the larger ones. They have no style. The pores are usually more abundant on one face of the coral flabellum than on the other; indeed, large areas of what may be called the back of the stem are often devoid of pores altogether.

The appearance of the surface of the corallum as seen by reflected light under a low magnifying power is shown in Plate 35, fig. 2. The surface presents slight irregular undulations. Its texture is somewhat like that of loaf sugar, being composed of closely apposed minute glistening white granules. The margins of the mouths of the dactylopores are often slightly raised above the general surface.

The older pores of the corallum are very deep, and as may be seen in longitudinal sections of the branches or stems (*t.o.*), commence deep down within the stem near its axis, and bend outwards on all sides to the surface of the branch with a nearly uniform curve. The coralla of all Stylasteridæ are traversed in all directions by a system of freely anastomosing and branching canals. In the case of *Sporadopora*, these canals are especially abundant and form comparatively close meshworks, hence the whole corallum is spongy and excessively porous when seen in section (Plate 35, fig. 1). The corallum may, with most truth, be said to be built up of a series of hard partition walls, intervening between and enclosing a highly complex system of tortuous canals and cavities. The meshwork formed by these canals is closer and smaller towards the surface of the corallum, more open and with wider meshes in the deeper regions. In the deeper regions the main canals, as will be seen from the figure, follow more or less the curved directions taken by the walls of the pores on their way towards the surface. There is no main system of canals in the axis of the stem connecting all the zooid cavities. The deep canals become more or less filled up, and the only connexion between distant zooids is by the more superficial living meshworks. In some places irregular cavities of some extent occur amongst the smaller canals, as beneath the ampulla (Plate 35, fig. 1, G). At the very surface, the canal reticulation is very fine indeed.

The pores are cylindrical pits sunk in the spongy mass of the corallum, and their walls are perforated all over by the openings of numerous canals. At their bottoms their cavities pass off into a few large main canals of the meshwork. The styles of the gastropores are very long, and can be traced deep into the axes of the branches of corallum, they having become elongated as the growth of the pores and corallum required it. In their deeper regions, these slender styles show a surface composed of a few dentate ridges (Plate 35, fig. 1, S) only, whilst in their upper and functionally active region they terminate in a long brush-like mass, composed of complicated branchings of fine and delicate calcareous spicules. At the base of this brush-like part of the style, a very thin calcareous partition or "tabula" (Plate 35, fig. 1, T) is sometimes present, stretched across the pore cavity at right angles to its axis. Sometimes

two or three such tabulæ are present in a single gastropore, placed at successively deeper intervals. In some instances, two tabulæ occur close together in a pore, one above the other. These tabulæ are so excessively thin that I considered them at first to be membranous, but I have been unable to dissolve them by the use of very strong alkalis, and I am now convinced that they are calcareous. They do not seem to occur in all the gastropores, and I have not observed them in any instance in the dactylopores. The dactylopores vary much in size, as will be seen from the figures.

Spheroidal cavities occur excavated in the corallum at a very slight depth from the surface. These contain the gonophores in the recent state of the coral, and may be called ampullæ. They are in this genus entirely buried beneath the surface, whereas in most genera of Stylasteridæ they project above it often to a very conspicuous extent. They communicate with the exterior when mature, by means of small slit-like apertures placed at the bottoms of small irregularly shaped depressions which are to be seen with some difficulty scattered over the coral surface (Plate 35, fig. 2, G G). Only male specimens of *Sporadopora* have been obtained as yet. No doubt, in the case of ampullæ containing female gonophores, a comparatively wide opening in the surface of the corallum is formed to allow of the escape of the fully formed planula.

The actual tissue of the corallum must be in *Sporadopora* and in most other Stylasteridæ excessively dense and compact, since the masses formed by it, although, as described, excavated by canals in all directions, are heavy.

In the older parts of the stems and their bases, the corallum appears to become compact and stony, and crystalline in fracture by obliteration of the canals and pores. In some specimens, portions of the surfaces of the stems which have once been dead have undergone rejuvenescence by the spreading of a thin layer of living coral over them from adjacent healthy regions.

The dead coralla are overgrown by a Flustra and other Bryozoa, and form bases of attachment to large masses of other Stylasteridæ, such as *Errina labiata*.

Since the calcareous meshwork is closer at the surface of the corallum, its meshes must necessarily become enlarged by re-absorption as growth proceeds. Cavities also such as those of the ampullæ must be filled up as the corallum grows. The irregular cavities existing beneath the ampullæ in some cases, as shown in Plate 35, fig. 1, probably represent spaces occupied in an earlier condition of the coral by gonophores. Sometimes also old ampullar cavities remain unfilled up, situate beneath the more superficial and active ones.

The tissue of the corallum is very like that of *Millepora* in histological structure, but appears somewhat more granular in texture, and less fibro-crystalline than it.

Soft structures of Sporadopora dichotoma. (Plate 36.)

Cœnosarc.—The tortuous canals and pores by which the coralla of all the Stylasteridæ are traversed, are occupied in all the genera alike in the living

condition of the coral by a series of meshworks of correspondingly branching, twisting, and anastomosing canals, which compose the cœnosarc or common body of the compound organism in each case. In *Sporadopora*, only a comparatively thin layer on the surface of the coral is occupied by living soft structures. These living structures are separated from the non-living deeper masses of the corallum by the action of acids, and then appear as a sheet of soft tissue composed of cœnosarcal meshwork zooids and gonophores, which may be called the living lamina.

The canals of the cœnosarc are composed of a very thin and transparent membranous wall, covered on the outer surface by a layer of ectoderm cells, and on the inner lined by endoderm cells. In general structure the canals closely resemble those of the cœnosarc of *Millepora* as described and figured by me. ("On the Structure of Species of *Millepora* occurring at Tahiti, Society Islands," Phil. Trans. Roy. Soc., 1877, p. 9, Plate 3, fig. 16).

The ectoderm layer covering the cœnosarcal canals varies much in thickness, being thickest in the more superficial parts of the cœnosarcal meshwork. I was, unfortunately, unable to examine its structure in the fresh condition, because the trawl by which the specimens of *Sporadopora* and of most of the other genera were obtained came up late in the day, and the short daylight available sufficed only for the investigation of more important matters.

Although a definite cell structure is not to be made out everywhere in the ectoderm of the cœnosarc, as for example in the surface layer of the coral, it seems probable from the appearances presented by specimens hardened in osmic acid, that such characterizes it throughout. The layer investing the canals is mainly composed (Plate 44, fig. 13) of transparent inflated nucleated cells which vary in size, so that the stratum is in some places two cells thick, in others only one. Amongst these cells occur nuclei and certain cells in which nematocysts of two kinds to be presently described are contained in various stages of development.

The calcareous matter of the corallum must be secreted by this ectodermal layer of the cœnosarcal canals, but I have not been able to observe how this takes place, or whether by means of any particular form of cell.

In the membranous layer of the canals no structure was detected. The endodermal lining of the canals is composed of abundance of spheroidal pigmented cells, containing a nucleus and granules of pigment of various sizes, and closely similar in appearance to those occurring in *Millepora*. The pigment in the present species is of a brick-red colour. Besides these cells, smaller transparent, colourless, spheroidal cells occur in the endodermal layer, and also free pigment granules and effete pigment cells, devoid of granular contents (Plate 44, fig. 14). The arrangement of these several constituents of the endoderm within the lining of the canals was not determined. No doubt in all the Stylasteridæ the inner surface of the canals is, as usual, ciliated, although cilia were not able to be made out in any case, owing to the action of reagents on the tissues.

As will be seen by reference to Plate 36, the cœnosarcal canals form in *Sporadopora* a very complex network, which brings, by means of the freest anastomoses in all directions, the several members of the compound organism into complete circulatory connexion with one another.

The interspaces in the meshwork occupied in the recent condition of the coral by hard masses of the corallum, are larger and wider in the deeper regions of the cœnosarc than nearer to the external surface. For here the meshwork is much closer, and the mass of soft living tissue much greater in proportion to the calcareous structures secreted by it, than is the case in the deeper regions. Further, the deeper canals are of greater calibre than those nearer the surface. Towards the deepest regions of the cœnosarc the canals are shrunken and atrophied, and pass off into effete and almost dead fragments of tissue, which form the inner boundary of the living lamina.

The largest trunks of the meshwork are those which proceed directly from the bases of the zooids and gonophores. These are soon reduced in size by branching, and are lost in the general anastomosis.

Around the sacs containing the zooids the canals of the cœnosarc have a special radiate disposition (Plate 43, fig. 3). The radial canals occupy an area circular in outline, extending all around the outer sides of the sacs of the zooids. They pass directly inwards radially, from the margins of the areas where they take origin from the general meshwork to join themselves on to the walls of the zooid sacs, towards the centres of the areas. They branch but seldom on their course, and then only towards their outer origins, where they not uncommonly bifurcate.

As may be seen from the figure, the radial canals, which lie at successive depths from the surface, do not correspond in any way in position with those above or below them, but are quite irregular as far as radial disposition is concerned. In vertical sections, however, of the living lamina (Plate 36), these radial canals are seen to succeed one another at tolerably regular intervals, in vertical disposition, with a somewhat regular series of interspaces between them.

This radial disposition of the canals is less marked around the sacs of the larger dactylozooids than around those of the gastrozooids, and is hardly apparent around those of the smaller dactylozooids. Traces of it are to be seen around the sacs of the gonophores, as at G′, Plate 36. Although towards the periphery of the area occupied by them these radial canals contain endoderm cells, and appear similar in structure to the other canals of the cœnosarc, towards their inner extremities, where they join the zooid sacs, they become diminished in size, and often appear as mere slips of transparent tissue, having a fibrillate appearance.

Muscular filaments, continued from ovoid muscular cells embedded in the walls of the zooid sacs, pass outward along the radial offsets, and are attached to them in the region about the mouths of the sacs (Plate 43, fig. 3, R M).

Attached to the radial offsets, and often extending over the interspaces between adjacent ones, slips of a fine transparent membrane, containing minute nuclei and

striated in appearance as if composed of fine fibrillæ, are constantly to be seen, but they seem to occur at altogether irregular intervals, and only towards the more superficially lying parts of the zooid sacs (Plate 43, fig. 3 ; Plate 36, A A).

A continuous layer of ectodermal tissue extends over the outer surface of the coral. No distinct cell structure was made out in this surface layer in *Sporadopora*, although such probably exists, as it was clearly seen in the case of the surface layer of *Errina labiata*. The layer bridges over the gaps in the superficial meshwork of the cœnosarcal canals, and portions of it close in the mouths of the sacs of the zooids when the zooids are in the retracted state. Over the mouths of the sacs and radial canals of the retracted gastrozooids these special parts of the surface layer appear as discs of membrane, with very small apertures in their centres, and showing a radial fibrillation diverging from these central openings, which seems as if caused by contraction of the tissue in order to close the aperture.

Embedded in the surface layer are numerous nematocysts of two kinds, larger and smaller. These are figured Plate 43, fig. 9. The larger nematocysts are of the form of cylinders, very slightly bent. Their ends from which the threads are shot are bluntly pointed, whilst their opposite extremities are rounded. The thread at rest is coiled up spirally within the cell, in the usual manner (Plate 43, fig. 9, *a*). The emitted thread has an elongate enlargement upon it near the cell, which is beset with a spiral of spines (*a′*). The remainder of the thread is simple. These larger nematocysts have a length of about ·0016 of an inch.

The smaller kind of nematocysts are of an ovoid form, slightly flattened on one side, and, like the larger kind, more pointed in shape towards the end from which the thread emerges. They measure ·00064 of an inch in length. They have a small bladder-like enlargement on their emitted threads, but it is, as far as was ascertained, devoid of spines.

In both kinds of nematocysts the threads are shot out, not in a line with the length of the cell, but at a slight angle to this, and in continuation of the curves of the cells.

Thread cells of almost exactly similar structure to these two occur in all the genera of Stylasteridæ, the soft parts of which are described in the present paper.

The nematocysts are developed in transparent cells of the ectoderm, which always contain a nucleus of finely granular appearance. The young nematocyst is seen developing within the cell with the nucleus lying beside it, and in proportion as the nematocyst increases in size and maturity, the nucleus diminishes in bulk (Plate 43, fig. 9, *c*, *d*, *e*).

Nematocysts of both kinds are to be seen in abundance in all stages of development in the ectodermal cells of the more superficial regions of the cœnosarcal meshwork. Both larger and smaller nematocysts are present in abundance, scattered in the superficial layer of the ectoderm.

The larger form of nematocysts also occur in well differentiated nematophores, which occur disposed irregularly amongst the zooids in the superficial region of the coral

(Plate 36, N N). The nematophores are irregularly semicircular in vertical section, with the flat side of the semicircle coinciding with the surface of the superficial layer of the ectoderm. Except on this flat side they are bounded by a membranous wall, which forms a sac open above. The open mouth of the sac is crammed with nematocysts of the larger kind, closely packed side by side, with their pointed ends directed to the surface. The cells are so closely packed that, in a section of the superficial layer taken parallel to the surface through the nematophores, no interstices can be seen between them (Plate 43, fig. 3, N). The lower part of the cavity of the nematophore is filled with nuclei and parent cells of the nematocysts. The nematophores, as viewed from the surface of the superficial layer, are seen to have an irregular outline, showing a tendency to be somewhat oblong, with curved boundaries.

No triple-spined nematocysts, such as those occurring in *Millepora* and in most other Hydroids, were detected as existing in any of the Stylasteridæ. The two kinds described as occurring in *Sporadopora dichotoma* appear to be present in all members of the family, with very slight variations in form indeed.

Zooids.—The zooids in *Sporadopora dichotoma* are of two kinds, dactylozooids and gastrozooids: the former occupying the smaller, and the latter the larger, style-bearing pores, already described as characteristic of the corallum.

Dactylozooids.—I have named the mouthless zooids of the Stylasteridæ "dactylozooids" because, although they are invariably destitute of tentacles, they are reduced to the condition of simple tentacles themselves, and evidently perform a tentacular function.

The dactylozooids are closely similar in form and structure in all the genera of Stylasteridæ hitherto examined, and differ only in dimensions. They are simple, elongate, conical bodies, just like the ordinary tentacles of Hexactinians in form, and are devoid of mouth or any opening to the exterior. They are attached to, and, when unprotruded, retracted within membranous sacs or sheaths, which rest within the corresponding pores of the corallum. In *Sporadopora*, the sacs of the zooids, the walls of which are shown in longitudinal section in Plate 36, F F, are composed of a transparent membrane, derived from the ectoderm, and continuous with its surface layer. The membrane has numerous fine nuclei dispersed in its substance, and is strong and tough. It is lined on its inner surface next the cavity of the sac by a layer of small transparent cells, which are shown in the figure cited above.

On their outer surfaces, the walls of the zooid sacs are abutted on by the peculiar radial offsets of the cœnosarcal meshwork already described. These offsets appear to lose their tubular character as they near the walls of the sacs, and, as far as was seen, no openings occur in the sac walls communicating by means of these radial canals with the cœnosarcal circulation, although such an arrangement was supposed to exist when the first hasty examination of specimens was made.

The sacs are attached to the bases of the zooids, being continuous in those regions with the ectodermal covering of the zooids. They closely invest the retracted zooids, and are thus cylindrical in form in their deeper parts; whilst above the level of the

retracted zooids they contract gradually in diameter, to terminate at the surface of the coral in small openings, which are usually seen to be quite closed by contraction of the surrounding superficial membrane in hardened specimens. The sacs lie loose within the pores of the coralla; that is, they are smaller in diameter than their containing calcareous cavities, but they are held in place by the attached radial offsets of the cœnosarc, which issue from the numerous openings in the walls of the pores to join on to them (Plate 35, fig. 1, G Z).

The dactylozooids of *Sporadopora* vary much in size, the smaller being of less than half the dimensions of the largest. They are elongate-conical in form, and are composed of an ectoderm, endoderm, membranous and muscular layers. They have an axial tubular cavity within, which communicates directly at their bases with the larger deeply-situate canals of the cœnosarcal meshwork.

The ectoderm forms, in the retracted zooids, a thick external layer, which is thrown by the contraction of the zooid into a series of transverse folds (Plate 36, D Z). No doubt, in the expanded condition of the zooid the ectoderm would appear much thinner. The outer suface of the layer is thickly beset with nematocysts of the smaller variety, which are so closely packed side by side, with their pointed ends outward, that in the retracted zooid no interstices between them are to be made out (Plate 43, fig. 2, E). Beneath this armature of nematocysts the main thickness of the ectodermal layer is composed of finely granular matter filled with ovoid nuclei and nematocysts, in various stages of development. No definite cell-structure could be determined in the layer, but fine lines, having a radial disposition in transverse sections of the zooid, seemed to indicate that the layer is composed in reality of somewhat prismatic-shaped cells, disposed in it radially to the central axis of the zooid.

At the inner surface of the ectodermal layer is a layer of very distinctly differentiated muscular slips, which have a longitudinal disposition (Plate 43, fig. 2, M; Plate 36). These muscular slips do not form a quite continuous layer, being separated from one another, as appears in transverse section, by a definite series of intervening intervals. These muscles are fine, and difficult to detect towards the tips of the zooids, but increase in thickness towards their bases. In these regions of the zooids they are extremely conspicuous, and spread out in a thick layer over the large main vessels of the cœnosarc in immediate connexion with the bases of the zooids, passing beneath the ectoderm of these canals, and being inserted into their walls. The muscles act evidently as the retractors of the zooids. Since they are more highly developed in the case of the gastrozooids, they will be further described when these are under consideration.

United with the muscular layer and inseparable from it, is a layer of membrane which is continuous with the membranous layer of the cœnosarcal canals, and forms a complete sac within the zooids. This basement membrane shows, in the contracted zooids, a transverse striation (Plate 43, fig. 6), which was at first supposed to indicate the existence of a layer of circular muscular fibres crossing the described longitudinal muscles. No definite circular fibres could however be detected, and the appearance is probably due to contraction of the membrane.

The inner surface of the membrane is lined by endodermal cells. In the contracted zooid, these form a layer two, three, or four cells thick. The cells are globular, clear, and transparent, and contain a nucleus (Plate 43, fig. 2; Plate 36). On the actual inner surface of the layer, bounding the zooid cavity, is a layer of cells similar in character to, but much smaller than, those composing the main mass of the layer. No doubt the inner surface of the cavity of the zooid is ciliated in living condition; cilia were, however, not detected. Towards the base of the zooid cavity, the transparent cells are replaced in the endoderm by the spherical pigmented cells, which are the principal constituent of the endoderm of the cœnosarc.

The dactylozooids have a tendency to be attached by their bases to one side of the bottoms of their sacs, rather than to the lowest extremities of the sacs. When this is the case, as in Plate 3, D Z, the zooid in the retracted condition is partly doubled up upon itself, and not merely drawn directly in. The main retractor muscles, however, pass almost directly downwards to their insertion into the cœnosarcal canals. In consequence of this arrangement the bottoms of the sacs are, when it occurs, pulled somewhat to one side. This form of attachment of the dactylozooids occurs mostly amongst the larger examples, no doubt because their greater length requires such an arrangement in order to allow of more complete retraction by the aid of the doubling of the zooid. This tendency to lateral attachment in the dactylozooids, as occurring in *Sporadopora*, where the zooids are diffusely scattered over the coral surface, is of interest because the same tendency is shown by the dactylozooids in nearly all the Stylasteridæ; and in some, as in *Cryptohelia*, *Allopora*, &c., it is the normal and only method of attachment.

Gastrozooids.—The gastrozooids in *Sporadopora dichotoma* are cylindrical in form, with four short tentacles set on to the body equi-distantly in a single whorl. Above the line of origin of the tentacles rises the dome-like hypostome, which in the retracted condition of the zooids has a height equal to that of about one third of the entire height of the zooid body.

The zooid in its inferior region is circular in section, but superiorly in the region where the tentacles are given off and in that of the hypostome, it assumes the form in section of a rectangle with the corners rounded off and the sides indented, the tentacles being situate at these corners of the rectangle.

Within the zooid is a wide gastric cavity, into the axis of which, in the retracted condition of the zooid, the calcareous style of the gastropore protudes for two-thirds of the height of the cavity (Plate 36, *St*).

The mouth at the summit of the hypostome appears when viewed from above as a cruciform opening leading directly to the gastric cavity. The gastric cavity communicates by tubular offsets with the axial cavities of the tentacles, and at its base it becomes at its periphery continuous with the cavities of four large canals. These canals subdivide almost immediately into smaller trunks which anastomose with the general cœnosarcal meshwork.

The gastrozooids are structurally composed of the same number of layers as the dactylozooids. The ectoderm forms on these zooids a somewhat thinner layer than on the dactylozooids. Definite cell structure was not made out in it. It is, however, full of nuclei, and is no doubt definitely cellular in the living condition. It is not, as in the case of the dactylozooids, thickly beset with nematocysts, but contains very few of these bodies (Plate 43, figs. 1 and 5).

On the inner surface of the ectoderm in combination with the basement membrane occurs a muscular layer which is very highly developed. The layer is composed of a series of longitudinally disposed muscular slips, which are set side by side with narrow interspaces, so as to form a thick layer (Plate 43, fig. 6). This layer is extremely thick and dense towards the base of the zooid, as will be seen from Plate 36, M, and becomes gradually thinner and less conspicuous towards the hypostome. The muscular slips are stout and closely set towards the base of the zooid, and prominent objects in transverse sections of it in that region (Plate 43, fig. 5), whilst they are widely separate and fine, and far less numerous towards the upper regions of the zooid (Plate 43, fig. 1, M), where little is to be seen but the transparent basement membrane. The muscular slips are composed of very distinctly differentiated cells which have mostly a fusiform shape (Plate 43, fig. 8), with the tails of the cells usually somewhat bent. Many cells are found to occur amongst the mass which are apparently in the act of division, two fusiform bodies being connected together by a string, or broad mass, of protoplasm. Such cells are so numerous that possibly a considerable proportion of the muscular elements remain permanently in this compound condition. The cells are closely fitted together side by side to form the muscular slips which, where most developed, have a breadth of three or four cells (Plate 43, fig. 7).

The longitudinal muscular slips pass from the bases of the zooids to spread out beneath the ectoderm of the four main canals of the cœnosarc, in which the cavities of the zooids terminate inferiorly.

Fused with the muscular layer, occurs, as in the dactylozooids, a continuous layer of membrane. This basement membrane is transparent, and the only structure which I have seen in it is a striation transverse to the longer axes of the zooids, which, as already stated in reference to the dactylozooids, I at first believed to give evidence of the existence of circular muscular fibres in the zooids. Such fibres I have however been unable to discover on closer examination.

Beneath the membranous layer lies the endoderm. This is composed, towards the upper region of the zooid and in the hypostome, of elongate ovoid cells with an inflated appearance, very transparent, each containing a small nucleus. These cells, as is well seen in transverse sections (Plate 43, fig. 1, G), are packed side by side to form the endodermal lining of the zooid, with their longer axes directed inwards, radially, towards the axis of the zooid, except towards the uppermost region of the zooid, where the direction of these cells is modified by the peculiar rectangular form assumed by the zooid. These elongate cells are closely similar to those occurring in a similar situation

in other Hydroids, and there can be little doubt that they are gastric in function. It will be observed that they do not occur in the endoderm of the mouthless dactylozooids. Towards the base of the zooid cavity these cells become shorter and shorter in length, until in the deepest regions they become mere small globular transparent cells, like those composing the endoderm of the dactylozooids. Towards the base of the zooid they are further overlaid by a layer of the pigmented endoderm cells, which form the endodermal lining of the general cœnosarcal meshwork. The lining of the cœnosarcal canals thus becomes continuous with that of the zooid cavity (Plate 36).

The calcareous style projecting up into the cavity of the zooid has reflected over it from its base a covering of ectoderm, and over that it is protected within the zooid cavity by a layer of ordinary pigmented endodermal cells (Plate 36, *St*).

The tentacles of the alimentary zooid of *Sporadopora dichotoma* were the only ones amongst those of all the Stylasteridæ which I was able to observe in the fresh condition, and time did not allow of more than a cursory glance at these even. It sufficed, however, to show that the tentacles are, as in the case of *Millepora*, knobbed at their tips (Plate 43, fig. 4), and that their stems display the usual characteristic transverse segmentation of the endoderm.

The knobs of the tentacles are ovoid in form and are densely beset with nematocysts of the smaller variety. The ectodermal layer of the stems of the tentacles contains few or no nematocysts.

Gonophores.—Although the soft parts of at least three different colonies of *Sporadopora dichotoma* were examined, these specimens proved all to be male. In all the specimens gonophores were very abundantly present. They occupy the ampullar chambers in the calcareous corallum already described (Plate 35, fig. 1, G). The male gonophores are ovoid bodies with their long axes directed at right angles to the surface of the coral. Sometimes only one such body is present in an ampulla, sometimes two or three. The outer extremities of the gonophores are sometimes drawn out into a short tail-like prolongation (Plate 36, G). The bodies vary considerably in dimensions. Often a gonophore which is fully mature and just ready to discharge its contents at the summit of its ampulla (as seen in Plate 36, G), has beneath it in the deeper part of the same ampulla an immature gonophore, around which latter the ampulla is less dilated.

The gonophores are composed of a spadix, which is extremely conspicuous in the fresh condition of the tissues, because it is full of red endodermal cells, and thus deeply pigmented, and a mass of testis cells or spermatozoa. The spadix is cylindrical in form, with a rounded extremity. It occupies the axis of the deeper region of each gonophore. It thus forms the core of the spheroidal body, the remainder of the mass of which is composed of spermatozoa or the cells from which they are developed in various stages of advancement. These cells and spermatozoa are contained within a fine and transparent but tough membrane, which invests the whole body of the testis, being derived from the ectoderm. I believe that a layer of the ectoderm invests the

spadix within the testis, but am not certain. I could not determine from which layer the spermatic cells are developed.

The spermatozoa are developed in the same manner as in other Hydroids. In Plate 36, G, is figured the usual mass of small spermatic cells in an unripe testis. Above this is a ripe testis which is shown as not cut right through its axis, it being bent over a little from the perpendicular to the surface. Hence the spadix is not seen in the section.

The ripe spermatozoa (Plate 43, fig. 12) have conspicuous heads which are elongate bodies curved into a bow shape. They are compressed and flattened in the plane of the curve, so that though broad and conspicuous when viewed on the flattened sides, they appear almost linear when seen on edge. At the extremity of the head where the tail is attached, a small rounded vesicle was observed in all cases to be present.

The bases of the gonophores are continuous with large canals of the cœnosarcal meshwork, the endoderm of the spadix being continuous with that of these canals.

(2.) GENUS *PLIOBOTHRUS* (POURTALES).

The genus *Pliobothrus* was formed by POURTALES (Bull. Mus. Comp. Zool., Cambridge, Mass., No. 7) to include specimens dredged by the United States Coast Survey off the coast of Florida, in from 100 to 150 fathoms. POURTALES rightly placed the new genus amongst the Hydroids, but, judging from the structure of the hard parts alone, associated it with *Millepora*. Count POURTALES, however, most kindly placed at my disposal specimens of *Pliobothrus symmetricus* preserved in spirit, and in excellent condition; and these have yielded tolerably complete evidence as to the structure of the soft parts. Moreover, the two small specimens transmitted to me proved to be of opposite sexes. I have observed both sexes only in the case of one other genus of the Stylasteridæ, namely, *Cryptohelia*. The structure of the soft parts of *Pliobothrus* proves the coral to belong undoubtedly to the Stylasteridæ. The specimens of *Pliobothrus symmetricus* examined by me were dredged off Florida Reef, in 100 to 300 fathoms.

Corallum of Pliobothrus symmetricus.

The corallum is described and figured by POURTALES ('Deep Sea Corals,' Ill. Cat. Mus. Comp. Zool., Harvard Coll., Cambridge, Mass., 1871, p. 57, Plate iv., figs. 7 and 8). He describes three kinds of pores as existing in the corallum. In reality, there are only two kinds of true pores present, viz., the larger circular-mouthed gastropores and the smaller dactylopores, which open at the summits of short tubular projections from the general surface of the corallum. The third kind of pores is described by POURTALES as very small linear disposed over the whole cœnenchyma, and arranged in rows. These are merely spaces between the trabeculæ of hard tissue forming the cœnenchym of the corallum, and are occupied by canals of the cœnosarcal meshwork

in the recent condition of the coral. They do not contain any form of zooid. It is to be noted that in *Pliobothrus tubulatus*, a second species (POURTALES, *l.c.*, p. 58), the projecting tubules of the tubulated pores are much longer than in the case of *P. symmetricus*, and thus form a stepping-stone in the series towards the condition existing in *Errina*. The pores of both kinds in *Pliobothrus* are devoid of styles. The gastropore cavities are tubular in form for a short depth from the surface, and then expand suddenly into a wide basin-shaped chamber, which lodges the similarly formed base of the gastrozooid, and from the margins of which proceed numerous large canals running mostly to the bases of neighbouring dactylopores. The corallum is very coarsely porous, otherwise the finer structure is much as in *Sporadopora*. The ampullæ are, as in *Sporadopora*, buried beneath the surface of the corallum. POURTALES remarks on them as "occasional round cavities found in the centre of the branch, filled with a yolk-like substance contained in a membrane."

Structure of the Soft Parts. (Plate 41, fig. 2.)

The cœnosarcal meshwork of *Pliobothrus symmetricus* is very like that of *Sporadopora* in general arrangement, as will be seen by reference to the figure (Plate 41, fig. 2). The tubes composing it are, however, much finer and smaller in diameter, and the components generally of the coral are on a smaller scale.

There is the usual surface layer of ectoderm present, and the nematocysts which occur are of the two forms found in the whole of the Stylasteridæ. The offsets of the cœnenchymal meshwork, which join the sheaths of the gastrozooids, show only a very indefinite trace of the radiate arrangement which is so marked in *Sporadopora*. A trace of the arrangement does, however, exist (Plate 41, fig. 2, X X).

The gastrozooids are devoid of tentacles. In the contracted condition they consist of an upper cylindrical portion (Plate 41, fig. 2, Z), and a wider saucer-shaped basal region, to join the margins of which the lower part of the cylindrical portion gradually widens out inferiorly. Canals are given off from the margin of the basal saucer of the zooid all round, and pass to join the general cœnenchymal meshwork; but no canals at all are given off from the rounded under surface of the zooid. The upper surface of the cylindrical portion of the zooid is nearly flat, and is occupied by the mouth of the zooid, which is a cruciform slit bounded by elongate gastric endoderm cells, closely similar to those described as existing in *Sporadopora*.

The dactylozooids are simple elongate-conical bodies devoid of mouths, with a minute structure closely similar to that of the corresponding zooids of *Sporadopora*. In the retracted condition they are thrown into a series of transverse folds, which are indicated by fine transverse lines in the figure (Plate 41, fig. 2, T Z, T Z). The zooids appear to be retracted directly within their sheath, and not to be attached on one side of their base.

The gonophores are contained in ampullæ, which are often sunk deep within the corallum; and it is not apparent by what means the large mature planulæ find their

way to the exterior. I have not had sufficient material at command to determine whether the ampullæ, as they enlarge, come gradually to communicate with the surface of the corallum by means of absorption of the intervening hard tissues. It seems probable that they may do so.

The ova are solitary, one only being developed in each growing ampulla. Each ovum is developed within the cup of a cup-shaped spadix (Plate 41, fig. 2, O). The ovum is provided with a germinal vesicle and spot. It is covered by a fine layer of ectoderm, which is reflected over it from the surface of the spadix. It is not patent how fertilization takes place—that is to say, how the spermatozoa find their way to the sometimes deeply-seated ova. As the ovum advances in development and increases in size, the spadix enlarges with it (Plate 41, fig. 2, G). Subsequently, however, in later stages, the spadix appears not to increase further; and when in relation with a nearly fully-developed planula appears proportionately small.

The nearly mature planula (Plate 41, fig. 2, P) is a large object of an ovoid form, with a long diameter greater than the extreme width of the gastrozooids. Its ectoderm and endoderm are plainly differentiated. The endoderm is composed mainly of oil-cells, but contains also a few fully formed nematocysts of the larger variety. The ectoderm, a thick layer, shows the characteristic striation vertical to the outer surface of the planula, the striæ being composed of granules and nuclei arranged in linear groups. As far as could be ascertained from the scanty material at command, it appeared that the ectodermal layer is formed in development by the process of delamination. No trace of an invagination in the embryo was observed.

In very advanced stages the planulæ become folded to a slight extent, as in the case of those of *Errina labiata* (Plate 37), in order to accommodate their length within the ampullæ.

The male stocks of *Pliobothrus symmetricus* are in every way similar in structure to the female, with the exception that they bear male gonophores instead of female in their smaller ampullæ.

The male gonophores (Plate 41, fig. 3) are sacs containing a number of small ovoid bodies, which contain spermatozoa or sperm-cells in various stages of development. The exact structure of these smaller bodies, and of their relations to the endoderm, were not determined.

(3.) GENUS *ERRINA* (GRAY).

The genus *Errina* was formed by GRAY to contain the *Millepora aspera* of LINNÆUS and ESPER. GRAY gave a short diagnosis of the genus in the Proc. Zool. Soc., 1835, p. 85, from specimens in the British Museum; and this was supplemented by SAVILE KENT, in a paper published in the same journal for 1871, p. 282, by further reference to the same specimens. A specimen dredged by H.M.S. 'Challenger' off the mouth of the Rio de la Plata in 600 fathoms, is clearly referable to this genus, but represents a new species, for which the name *Errina labiata* is adopted.

Corallum of Errina labiata. (Plate 34, fig. 7.)

The corallum occurs in the form of arbuscular multi-ramified masses, which have an extreme height, in the specimens obtained, of about 5 inches. The mass of branches and branchlets has a tendency to form an irregularly flabellate expansion, which in the largest specimen obtained has a breadth of about 4 inches. The main stems, which are irregularly oval in section, being flattened in the plane of the flabellate expansion, have a longer diameter of about two-thirds of an inch. They, as well as the remainder of the corallum, are composed of a compact, hard, glistening, white, calcareous tissue. At their bases, this tissue spreads over and encrusts objects to which the coral mass is adherent. In one specimen obtained, the support thus fastened on is a large dead mass of *Sporadopora dichotoma*. The main stems have a surface which appears smooth and even to the naked eye, but when magnified is seen to be scored in all directions by small more or less tortuous canals, which in the recent state contain the superficial ramifications of the cœnosarcal meshwork. In specimens in which certain regions of the main stems are dead and somewhat corroded, these scorings of the surface are much more conspicuous than on the recently living regions, and give the surface a roughly engraved appearance. The finer branches have a tendency to develope mostly on one face only of the flabellate expansion, one face of the main stems being frequently devoid of such branches. The branches and branchlets are nearly circular in section, and have an hirsute or finely spinous appearance. This appearance is due to their being beset all over their surfaces with small nariform projections, the wide openings of which are all turned towards the tips of the branches. These nariform projections vary much in form, being often drawn out into tubes opening by a slit-like mouth on the side next the tip of the branch, and frequently coalescing, especially towards the tips of the branches, so that two or three of the projections have a common base.

These projections are the prolongations of the walls of the dactylopores beyond the main surface of the corallum. Their cavities, the pores, are simply tubular without any style, and extend for a short distance into the mass of the branch, on which they are situate in an oblique direction, in continuance of the oblique inclinations of the nariform projections. The dactylopore projections are very numerous and closely set towards the tips of the branchlets, more widely scattered upon the surfaces of the branches and almost absent on the main stems.

Scattered over the surfaces of the branches and branchlets are the mouths of the gastropores, which are tubular cavities larger than the dactylopores, but with a similar oblique direction towards the axes of the branches, and are provided with a calcareous style, with a finely dentate surface (Plate 37, S T). The mouths of the gastropores are irregularly circular in outline, their margins being frequently broken and indented by the confluence with the pore cavities of the superficial channels of the surface of the corallum. The gastropores are frequently situate beneath the bases of the

dactylopore projections, so as to be covered by these as by a projecting lip; and in places the margins of the gastropores themselves are drawn out into scale-like lips, though these lips are nearly always fused with nariform projections of contiguous dactylopores. Gastropores are frequently to be seen occurring isolated and solitary on the branches.

The ampullæ are, in this genus, conspicuous bodies, since they appear as hemispherical projections from the surfaces of the branches of about the size of a mustard-seed. In vigorous specimens they are closely crowded together in masses on both sides of the branches and branchlets in various regions of the flabellum. The ampullæ commence as small cavities in the surface layer of the corallum of the branches, and gradually enlarging in accordance with the development of the ovum contained in each, project more and more, until those containing mature, or nearly mature, planulæ appear as the conspicuous projections above described. A hemispherical cavity, excavated in the surface of the corallum, corresponds with each ripe ampulla, but the excavation is usually not deep enough to render the entire ampullar cavity spherical in form. The cavity has rather the form of a sphere with one side flattened somewhat. In accordance with the gradual expansion of the ampullar cavity, its outer wall, which is finely reticular in structure, becomes thinner and thinner until, no doubt, it at last breaks away entirely for the escape of the imprisoned planula. The empty hollows remaining after this process is complete are abundantly present on the surfaces of the branches, and are often to be seen remaining on the older regions of the main stems, although in these older regions there is a tendency to obliteration, by interstitial calcareous deposit, of all pores and ampullæ.

The mass of the corallum is composed, as in other Stylasteridæ, of hard calcareous tissue, permeated in all directions by meshworks of canals. The canals generally are, in the present genus, larger in proportion to the size of the zooids than in most other forms (Plate 37), and the meshworks formed by them are comparatively widely open. The main canals have a general tendency to traverse the axes of the stems and branches, spreading out at an inclination corresponding with that of the pore cavities towards the surfaces. This arrangement necessarily results from the mode of growth. In the older regions of the stem the corallum becomes more compact and stony by obliteration of many of the canals, but the main canals appear never to become entirely obliterated, even very low down towards the bases of the stems.

Soft structures of Errina labiata. (Plate 37.)

Cœnosarc.—The cœnosarcal meshwork in *Errina labiata* is more widely open in its structure than in *Sporadopora dichotoma* (Plate 37). Hence the mass of soft structures separated from the corallum by decalcification is comparatively soft and less able to maintain the original form of the corallum. In the present species, however, in all the actively living branches it is not, as in *Sporadopora dichotoma*, a mere surface layer of

the coral which is living supported by dead corallum below, but the deeper canals of the cœnosarc retain their vitality even to the very axes of the branches. The general arrangement of the cœnosarcal canals is seen in Plate 37. Closer meshworks compose the mass near the surface, and in deeper regions the canals are larger and form wider and longer meshes, and constitute an axial system of main canals by which the various distant zooids are brought into relation with one another. Around the sacs of the gastrozooids an irregular radial arrangement of the canals immediately adjoining the sacs is to be observed, representing the more regular radial disposition described as existing in *Sporadopora dichotoma.*

The histological structure of the cœnosarcal canals is closely similar to that occurring in those of *Sporadopora.* The endodermal pigmented cells are of a light brick red colour, and hence the entire coral in the recent state is thus coloured. The pigment is, however, soluble in alcohol, and thus quickly extracted in specimens preserved in that fluid, but it is insoluble in glycerine. A continuous superficial layer is present on the surface of the coral, as shown in Plate 37, and it is composed of polygonal nucleated cells (Plate 11, fig. 10).

Errina is the only genus of Stylasteridæ in which the definite cellular structure of the surface layer of the ectoderm could be determined, although no doubt a similar structure exists in that of all the species of the family.

In places, the cells composing the layer appear to overlap and sometimes to form a double layer, as seen in the figure. Possibly this appearance is due to the action of reagents.

Nematocysts of two kinds, larger, and smaller occur, and of the usual forms. The larger are mostly gathered into thickly set masses or nematophores (Plate 37, N N), but occur also scattered, or in twos or threes, within the surface layer (Plate 44, fig. 10, N). These scattered nematocysts have the appearance of lying within the polygonal cells composing the surface layer (Plate 11, fig. 10), as is the case in *Hydra viridis,* as shown by F. E. SCHULTZE.*

The smaller nematocysts occur scattered in the surface layer (Plate 44, fig. 10, N), and thickly set in the tentacles of the gastrozooids and outer surfaces of the dactylozooids.

Zooids.

Dactylozooids.—These are simple elongate mouthless conical bodies closely similar to those of *Sporadopora* but somewhat more attenuated in appearance (Plate 37, D Z). They are attached to the bases of sacs which line the cavities of the nariform dactylopores of the corallum, the walls of which sacs are continuous in structure with the surface layer of ectoderm.

Gastrozooids.—These are cylindrical in form (Plate 37, G Z), with a rounded conical hypostome and four tentacles set in a single whorl at its base. The tentacles are in

* "Über den Ban und die Entwicklung von *Cordylophora lacustris.*" Leipzic: W. ENGELMAN, 1871. Taf 6, fig. 10, *s. rr.*

the contracted condition clavate in form. The base of the zooid rests on the style of the containing gastropore, which in the retracted condition of the zooid appears to project into the gastric cavity to a considerable distance as in *Sporadopora*. The ectodermal covering of the gastrozooids is composed of transparent ovoid cells (Plate 44, fig. 4), which form a layer resting upon a substratum containing numerous nuclei and bounded by the basement membrane. The gastric endodermal lining of the zooids is composed of elongate cells of closely similar nature to those occurring in *Sporadopora*. The mouth appears, when closed, as a crucial slit; four main canals usually lead from the base of the zooid cavity to the cœnosarcal meshwork.

Fresh zooids are added to the colony by means of buds arising from the surface layer of the cœnosarc at points where this is joined by offsets of the superficial canals of the cœnosarcal meshwork. Such a bud is represented in Plate 37, D. The part of the superficial layer immediately surrounding the bud is depressed and forms the sac of the zooid.

Gonophores.—Only female examples of *Errina labiata* were obtained for examination. The female gonophores are closely similar in structure to those already described as occurring in *Pliobothrus symmetricus;* but there is this great difference—that whilst in *Pliobothrus* the ampullæ and their contained ova and planulæ remain until maturity immersed in the corallum beneath its surface, in *Errina* the ampullæ project more and more above the surface as development proceeds.

The spadix in *Errina labiata* is at first cup-shaped (Plate 37, S), the walls of the cup being composed of a very thick layer of endoderm. The cavity of the cup is directed towards the surface of the coral, and within it rests the large single ovum with its distinct germinal vesicle and spot. Each ampulla contains invariably only one spadix and ovum. The ovum is covered over in the cup by a reflection of the ectodermal investment of the spadix (Plate 44, fig. 4).

The stages of yelk division were not detected. The ovum becomes developed into the condition of a planula within the ampulla. As development proceeds, the embryo becomes gradually greatly increased in size, and assumes a form corresponding to that of the containing ampulla already described. As the process proceeds, the spadix becomes divided at its margin into a series of lobes, which lobes sub-divide, branch and unite to form a network, and encroach over the surface of the embryo until more than half of the proximal surface of the embryo becomes thus embraced by the reticulate cup of the spadix (Plate 37, S′).

The ectodermal layer of the embryo seems to be formed from the general mass by delamination. No trace of any process of invagination was observed; but all stages were seen which would appear to prove that the ectoderm layer is gradually differentiated at the surface from the outer elements of the mass. The ectodermal layer when first observable as distinct, appears finely granular in structure, whilst the abundant endodermal mass is composed in large part of highly refracting oil-globules. The ectoderm, as development proceeds, shows a striation directed perpendicularly

to the surface of the embryo all over, and this condition is very conspicuously marked in the fully-developed planula (Plate 37, E C). The mature planula is elongate-ovoid in form, and is slightly folded once upon itself in order to accommodate itself to the confined space within the ampulla. The layer of ectoderm described as investing the surface of the ovum and derived from the spadix, persists as a covering of the mature planula until set free (Plate 37, B).

In fine sections of mature planulæ the fine structure of the ectoderm and endoderm is well seen. The ectoderm forms a thick layer composed of alternately placed transparent and opaque tracts disposed vertically to the surface of the planula. The more opaque tracts contain numerous nuclei and thread cells in process of development. The dark tracts fuse together towards the inner region of the layer, and form a continuous mass full of nuclei which rests upon the basement membrane, as yet little differentiated but still clearly indicated (Plate 44, fig. 9, B).

When the planula is viewed from the surface the transparent areas of the ectoderm are seen to be enclosed by the opaque tracts which spread round them: a condition more clearly marked in the case of the planulæ of *Cryptohelia.*

The endodermal mass of the planula is composed of much granular matter, in which are embedded numerous small transparent cells and nuclei, also oil-globules of various sizes, and many nematocysts in various stages of development (Plate 44, fig. 9, E N).

(4.) GENUS *SPINIPORA*, GEN. NOV. (H. N. M.)

Amongst the other Stylasteridæ obtained off the mouth of the La Plata in 600 fathoms, was a single specimen of a form to receive which I have made a new genus, *Spinipora.* It is closely allied to *Errina,* but shows sufficient differences in the structure both of the hard and soft tissues to warrant its being placed, at present at least, in a separate genus.

Corallum of Spinipora echinata.

The corallum (Plate 34, fig. 3) is in the form of a single irregularly cylindrical stem, bearing at its summit, in the only specimen procured, a couple of similarly shaped branches. The base of the stem is somewhat swollen, and encrusts the object to which it adheres. The whole surface of the corallum is thickly beset with spinous projections which being all inclined towards the tips of the branches stand out beyond the main surface of the stem to a distance of as much as one-tenth of an inch, the diameter of the stem itself being about three-tenths of an inch. The spines are spout-like in form, more or less conical, with the ends usually truncated, and their upper surfaces—that is, those turned towards the tips of the branches—channelled out into deep and wide grooves. The grooves usually commence on the surface of the spines as slits, and widen out to terminate at the truncate ends of the spines in wide spout-like mouths. The groove-like excavations are continued as tubular cavities for a short

distance into the axes of the spines, beyond the slit-like commencement of the grooves. The grooves are the cavities which are occupied by dactylozooids—are, in fact, the dactylopores, which are here excavated within long projecting spines, and are widely open on one side for nearly their entire length. The small continuation of the groove within the axis of each spine represents the normal dactylopore.

Two kinds of dactylopores occur in the present form: the larger ones already described, and much smaller pores, which are mostly placed on the bases of the spinous processes, but occur also more sparingly on the general surface of the stem. These smaller pores often have the sides of their mouths slightly raised above the surface which they perforate.

The main surface of the stems and branches of the corallum is grooved by short canals, which are just open to the surface and run short courses, being never much branched and usually crooked (Plate 35, fig. 4). These channels correspond with those described as occurring in *Errina*, and are occupied in the recent condition of the coral by the most superficial reticulations of the cœnosarcal meshwork.

Lying in deep depressions between the bases of the spinous projections are the gastropores, which are deep pits with circular mouths, at the margins of which dactylopores of the smaller kind frequently open. The gastropores are provided with styles, which are very deeply situate and have brush-like tips, and are much like those of *Sporadopora*, but not so elaborately branched. The substance of the corallum of *Spinipora echinata* is hard and compact in structure, and white.

Soft Structures of Spinipora echinata. (Plate 38.)

Cœnosarc.—The cœnosarc consists of the usual reticulation of canals (Plate 38), offsets of which pass into and ramify within the dactylopore spines as at B, Plate 38. There is a well-developed continuous surface layer of ectoderm, which invests the spinous processes and entire surface of the coral, and feebly maintains, in decalcified specimens, the form of the corallum. The layer is, as in other genera of the family, continued into the pores of the corallum to form the sacs of the zooids. The nematocysts are closely similar to those of *Errina*.

Dactylozooids.—These are of two forms, larger and smaller. The larger dactylozooids are attached by elongate bases along nearly the whole lengths of the bottoms of the groove-like dactylopore cavities. The ends of these elongate bases nearest the coral stems assume a cylindrical form, and are continued into the pore-like prolongations of the grooves, to become continuous with canals of the cœnosarcal meshwork. In Plate 38, two dactylopore spines, B B, are shown as cut open in order to exhibit this arrangement. The pore-like continuations of the dactylopore grooves are lined by continuations of the surface layer representing the zooid sacs. The free parts of the dactylozooids spring from the elongate attached parts not far from the tips of the spines. In the contracted condition they appear as short, stout, bluntly conical bodies,

which are slightly curved and bent inwards towards the coral stem, and at the same time directed towards its upper extremity. Since the larger dactylozooids were all found in the described condition in spirit specimens, it would appear that they are incapable of being retracted to a greater extent. The pores are certainly not deep enough to allow of their entire retraction within them, and the mode of attachment of the bases would not allow of such retraction. No doubt the zooids, when active and expanded, are long and attenuated, and the long spines on which they are borne are very possibly to be regarded as contrivances for giving them a long reach. A tendency to attachment by the side of the base, within the zooid pore, has been already noticed as occurring in the dactylozooids of *Sporadopora dichotoma*.* It is here the normal condition, and much more fully completed. A closely similar method of attachment and retraction of the dactylozooids occurs in all the genera of Stylasteridæ, which form regular cyclosystems of zooids.

The smaller dactylozooids are simple bluntly-conical bodies, of less than one-third the size of the larger form. They occupy the smaller dactylopores, and are retracted directly within these when at rest (Plate 38, D D).

Gastrozooids.—These are cylindrical in form, with a dome-like hypostome and six apparently simple conical tentacles, set on in a single whorl. The zooids are, as usual, retracted within sacs lining their pores. The tentacles in the retracted condition of the zooids are doubled together over their hypostomes, with their tips bent inwards and downwards towards them. The zooid bases terminate in four large canals of the cœnosarcal meshwork, and are firmly united to the styles of the pores.

Gonophores.—No generative elements were discovered in the single specimen of this coral obtained for examination.

(5.) GENUS *STYLASTER* (GRAY).

The genus *Stylaster*, which gives its name to the family Stylasteridæ, was established by GRAY, in 1831, for the reception of *Stylaster roseus*, the old *Madrepora rosea* of PALLAS, and *Oculina rosea* of LAMARK and others. The species the structure of which is here to be described was obtained off the mouth of the La Plata. It appears to have been hitherto undescribed.

Corallum of Stylaster densicaulis, *sp. n.* (H. N. M.)

The corallum (Plate 34, figs. 5, 5A) is flabellate in form, with a very stout main stem and branches, which make with one another angles of from 25° to 30°. The main stem and larger branches are oval in section, the longer diameter of the ellipse being at right angles to the plane of the flabellum. The stem and branches give off numerous comparatively small and short ramifying branchlets from their lateral margins. Occasionally as an exception a branchlet is given off from one of the faces of the flabellum at right angles to it, thus distorting its fan-like form.

* See p. 437.

The pores are arranged in regular symmetrical cyclo-systems, a circular group of dactylopores surrounding in each system a single centrally-placed gastropore. The pores of both kinds occur only arranged in these systems in this species.* The cyclo-systems so closely simulate in appearance the calicles of ordinary Hexactinian corals, that the genus *Stylaster* and its allies, such as *Allopora* and *Cryptohelia*, have hitherto been placed amongst the Oculinidæ. The cyclo-systems in the present species appear as small cylindrical masses of calcareous matter, which have a somewhat greater diameter at the free extremity than at the base. In the growth of the coral new systems bud off from the sides of the older cylinders, at the tips of the branchlets. The cylinders thus newly formed have their axes at right angles to those of the old systems to which these are attached, but in the same plane with them, which is also that of the entire flabellum. The branchlets of the corallum, already described as given off by the main stem and branches, are composed of zooid systems thus related to one another. In the more recently formed twigs the arrangement described is plainly apparent, and they have thus a zigzag appearance ; but in proportion as the branchlets are traced nearer and nearer to the stems from which they spring, this zigzag arrangement becomes more and more obliterated by deposit of cœnenchym, and in the older regions of the corallum, on the sides of the main branches and stem, the mouths only of the zooid systems remain unburied by the swollen dimensions of the support.

No pore systems occur on either of the flabellar faces of the stem or branches. Short branchlets, as well as single pore systems, are evidently swallowed up, to some extent, by the spread of cœnenchym and increase of the dimensions of the stem, and all stages of the process appear at the lateral margins of the stem near its base. But in order to secure an excessive strengthening of the stem, with the least amount of encroachment upon early-formed pore systems, the stem swells to the greater extent in the direction of its surfaces which correspond with the faces of the flabellum and bear no pore systems. Hence, as already described, it becomes oval in section, being flattened in a plane at right angles to that in which the younger branchlets are compressed.

The cyclo-systems are groups of zooid pores as already described, which have a regular symmetrical arrangement, a single gastropore in each system being surrounded by a circlet of dactylopores. The centrally placed gastropore in each system is a wide tubular cavity, with a circular transverse section. This pore is much deeper than its surrounding dactylopores, and has at its bottom a short stout style, with a brush-like conical tip (Plate 35, fig. 3, S). Just above the level of the top of the style is a circlet of small rough projections, which stand out from the wall of the gastropore, and contract its bore at this point.

* In another species of *Stylaster*, *S. granulata*, dredged off Ascension Island in 420 fathoms, small isolated dactylopores were observed to occur on the surface of the corallum, as a rare exception, apart from the pore systems. One such was observed situate on the side of a cylindrical cyclo-system, and two others at the margin of an ampullar prominence. These were very probably occupied, in the recent state of the coral, by small dactylozooids, the rudiments of those which, in an earlier stage of evolution of the Stylasteridæ, overspread the surface of the ancestral form, as in *Sporadopora*.

Around the mouth of the gastropore is a circlet of from about ten to fourteen dactylopores, arranged symmetrically at equal distances from one another and from the centre of the mouth of the gastropore. The mouths of these pores are elongated towards the axis of the gastropore, so as to open into, and become continuous with, the cavity of this latter pore (Plate 35, D Z, D Z). The openings of the dactylopores are continued down, as wide slits, for some distance on the upper part of the wall of the gastropore, so that the pores have, as it were, two mouths placed at right angles to one another and confluent with one another, the one opening to the exterior, the other into the cavity of the gastropore. The cavity of each dactylopore consists of a wide upper chamber in the region of the widely open mouth (Plate 35, T Z, T Z), and a narrow tubular continuation of this, which traverses the corallum in a direction parallel with that of the axis of the gastropore for about half the length of the latter. Against the outer wall of the pore is a small ridge-like excrescence, with an hirsute surface, which is the style of the dactylozooid (Plate 35, fig. 3, S′), and which is described by POURTALES as "a rudimentary septum in the shape of a hairy fringe" (POURTALES, *l.c.*, p. 34).

The dactylopores in each cyclo-system are separated from one another by thin plates of calcareous matter, which are directed inwards radially towards the axis of the gastropore (Plate 35, fig. 3, P), and which at first sight have all the appearance of the septa of hexactinian corals, and have hitherto been mistaken for such by observers. They are, however, composed each of two thin laminæ of dense calcareous matter, united by somewhat less compact calcareous substance, which is freely perforated by canals for the passage of offsets of the cœnosarcal meshwork. The thin laminæ are merely the juxtaposed walls of the adjacent dactylopores. These radially disposed plates, which may be termed pseudosepta, have their inner edges continued down the wall of the gastropore for a short distance beyond the margins of the mouths of the dactylopores, as well-marked vertical ridges, which soon become merged in the general surface in their course (Plate 35, fig. 3).

The cylindrical masses formed by each cyclo-system are sometimes flat, often gently rounded at the top. Their summits are irregularly circular in outline, but have an indented border, the indentations corresponding with the centres of the pseudosepta in position, and representing the intervals between the opposed dactylopore walls, which are here not obliterated by growth of cœnenchym.

The cyclo-systems, when viewed from above in a line looking directly into the mouths of the pores, show, in all essential particulars, the same structure as that which occurs in *Allopora profunda*, which is represented diagrammatically in Plate 35, fig. 13. The styles of the tenticular zooids, S S, appear as small projections in the interspaces between the pseudosepta, and were taken by POURTALES and others for septa of a second order.

The cyclo-systems have been described as circular in outline of summit, because this may be regarded as their normal condition ; but very many of them are distorted

in various ways. One edge of the summit of the system is frequently elevated above the other, and this elevation is on the side of the same face of the flabellum in all the calicles; whilst the dactylopores, on the opposite margin of the system, are frequently more or less aborted. This condition forms a step towards that occurring in *Cryptohelia,* where all the cyclo-systems have their mouths turned towards one face of the flabellum. The cyclo-systems in the present species are also frequently elongated in a direction in the plane of the flabellum, and in the case of those systems which are placed at the sides of the main branches, parallel with the line of extension of these branches.

Besides being permeated completely by fine canals, the cœnenchym of the pore systems is excavated by numerous rather large lacunar cavities, especially near the base of the style and place of origin of an ampulla (Plate 35, fig. 3).

The ampullæ appear, on both faces of the branchlets, as conspicuous rounded prominences, set in groups, and often fused together into large papillated masses. They do not occur on the flabellar faces of the main stem or branches. They present internally a nearly spherical cavity, which communicates freely by openings with the canal systems of the cœnenchym (Plate 35, fig. 3).

Soft Structures of Stylaster densicaulis. (Plate 40.)

Cœnosarc.—The outer surface of the coral generally and of the cylindrical cyclo-systems, is invested by a continuous surface layer of cœnosarc (Plate 40). This layer dips down to line the dactylopores, and form the small tubulate sacs of the contained zooids, and also is reflected into the wide cavity of the gastropore, the inner lining of which is the greatly expanded sac of the gastrozooid, which zooid, deeply seated at the bottom of the sac, occupies a very small area of its space (Plate 40, A). Beneath the surface layer the cœnosarcal meshwork forms a fine reticulation of smaller canals, and a similar fine reticulation lies immediately beneath the lining membrane of the gastropore (Plate 40). In the walls of the cyclo-systems, between these two finer reticulations, a series of larger canals form an intermediately placed network, in which the branches have a general direction parallel to the axis of the gastropore, and form a direct communication between the bases of the dactylozooids and the large canals which spring from the bases of the gastrozooids. Offsets of this reticulation pass up into the canals in the interior of the pseudosepta. The three reticulations described are intimately connected together by abundant anastomoses. In Plate 40, B B, the interior of a zooid cyclo-system is represented with the sac of the gastropore and superficial lining network removed, in order to display the connexions of the deeper reticulation with the dactylozooids, and its general arrangement. The connexions of the reticulations with one another are well seen at the cut edges of the bisected zooid systems, as shown in the plate.

A tortuous and complicated mass of large canals springs from the bases of the

gastrozooids at their margins, but not from their under surfaces. Some of these large canals turn almost immediately after springing from the gastrozooids upwards, through the wall of the zooid system, to join the main network already described as communicating with the dactylozooids. The remainder of the large canals form a tortuous reticulation, which passes down through the cœnenchym of the corallum, by the side of the immediately adjoining zooid system, to anastomose with the corresponding reticulation arising from the base of the gastrozooid of this latter. The walls of the ampullæ, as shown in the figure, are traversed by a fine reticulation of the cœnosarcal canals beneath their covering derived from the superficial layer of ectoderm.

Nematophores, composed of nematocysts of the usual larger form, are placed on the pseudosepta, between the dactylozooids (Plate 40, N N).

Zooids.—One form of dactylozooid and one of gastrozooid only is present.

Dactylozooids.—These, in the retracted condition, are short cylindrical bodies, with a rounded, blunt-conical, free extremity. They widen out towards their attached extremities, and are united to the sides of the dactylopores which are outermost in the systems, and to their styles, by elongate bases, which are drawn out below into narrow prolongations which join the cœnosarcal meshwork. The zooids are, in fact, attached in an almost precisely similar manner to that in which the dactylozooids of *Spinipora echinata* are fixed within their groove-like pores. The free cylindrical portions of the dactylozooids in the present species are bent upwards, so as to extend in the wide upper cavity of the dactylopore, in a direction parallel to that of the axis of the gastropore. They are seen thus projecting in the centrally placed zooid system represented on Plate 40, D Z, showing partly free above the inner margin of the dactylopore sac, partly seen through the transparent sac of the gastrozooid. A curved line, crossing them transversely, marks the point where the sac of the gastrozooid becomes bent over, and unites with that of the dactylozooid. The dactylozooid surfaces, as well as those of the tentacles of the gastrozooids, are thickly set with nematocysts of the usual smaller form.

Gastrozooids.—These are short and broad cylindrical bodies, somewhat contracted in diameter towards the middle of their length. They terminate above in a dome-like hypostome with the mouth opening at its apex, and are provided with a single whorl of light tentacles set on immediately below the hypostome. The tentacles are, in the contracted condition, very short and stout, with swollen, rounded knob-like extremities, which reach to a height only just exceeding that of the summit of the hypostome. At the margins of their bases the gastrozooids (Plate 40, G G) are drawn out into a series of large radially-disposed canals, which lead directly into the cavities of the zooids, and the further disposition of which has been already described. The immediate under surface of the gastrozooids is devoid of canal offsets, and is attached to the centrally placed style.

The histological structure of the zooids in the present species of *Stylaster* closely corresponds with that already described as existing in those of *Sporadopora dichotoma.*

The gastrozooids in the present form, and their tentacles, are so short that it seems improbable that these zooids are able to emerge from the summit of the gastropore in the expanded condition of the coral. The dactylozooids probably become, when active, long and filiform, and acting as tentacles bend inwards to supply the gastrozooid with food.

Gonophores.—Only male specimens of *Stylaster densicaulis* were obtained. Each male ampulla contains two or three ovoid gonophores, which are attached to large offsets of the cœnosarcal meshwork at one end of their longer axes. They have an internal spadix, and in finer structure seem to differ very little from those of *Sporadopora.* They are shown as seen through the transparent walls of the ampullar sacs in Plate 40, G G.

(6.) GENUS *ALLOPORA* (EHRENBERG).

To this genus I have referred a coral dredged off the mouth of the La Plata, on account of the very considerable irregularity with which the pore systems grow out from one another. The coral seems to represent a species hitherto undescribed, which I term *Allopora profunda.*

Corallum of Allopora profunda, *sp. n.* (H. N. M.)

The corallum (Plate 34, figs. 6, 6A) is composed of a stout stem, bearing numerous branches. The branches ramify to some extent in the same plane, so as to form a sort of flabellum; but this flabellum is curved considerably in the direction of its height, and its lateral margins are also bent over sharply towards the same curved face. The main stem has a sinuous course, and the branches are all more or less curved in direction. The stem and branches are oval in transverse section, being flattened in the plane of the flabellum. The corallum is white, and its surface is minutely granular. The pores occur in regular cyclo-systems; when young they project from the terminal branchlets in the form of small cylindrical masses, which are slightly expanded in diameter at the free extremity. These cyclo-systems show a tendency to a regular alternate arrangement, the base of each system abutting on the side of the preceding, and the axes of the systems being inclined to one another at an angle of about 45° in the general plane of the flabellum. This tendency is, however, to a large extent obscured by irregularities. One face of the flabellum, viz., that rendered convex by the curving of the whole mass, is entirely devoid of cyclo-systems; whilst a considerable number are scattered over the surface of the branches on the concave face. As the branches thicken by growth of cœnenchym, the cylindrical masses of the cyclo-systems become buried, and only their free ends remain in view, as the mouths of pore systems on the surfaces of the branches. Even these mouths become partially overgrown in the active regions of the coral, and in the older parts of the stem frequently obliterated. The cyclo-systems consist of a deep gastropore, provided with a style, and surrounded by from twelve to sixteen dactylopores. The dactylopores are provided with a small hirsute style, as in *Stylaster densicaulis.*

A diagrammatic view of a cyclo-system, as viewed from above the mouths of the pores, is given in Plate 35, fig. 13. The styles are supposed to be brought into view by deep focussing of the lens. The form and arrangement of the pores are almost exactly similar to that already described as occurring in *Stylaster.*

The very small ampullæ are spherical cavities, which are usually entirely sunk beneath the surface, but sometimes near enough to it in situation to raise upon it very small conical elevations, which easily escape notice, and are present only here and there. The ampullæ are present in abundance in the walls of the pore systems and at their bases.

Soft Structure of Allopora profunda.

Cœnosarc.—A surface layer of ectoderm covers the surface of the coral, as in *Stylaster densicaulis,* and is reflected into the pores to form the sacs of the zooids. The cœnosarcal canals form a fine superficial reticulation at the surface of the coral, beneath the surface layer, and spring from a deeper meshwork of larger canals which, as in the *Stylaster* already described, have a mainly longitudinal course within the thickness of the walls of the pore systems, parallel to the axes of the systems, and lead almost directly from the bases of the dactylozooids with which they anastomose to the large canal offsets given off at the periphery of the bases of the gastrozooids. At the inner surface of the gastropore are finer canals springing from this main meshwork, and from these spring a series of offsets which pass in a direction radial to the axis of the gastropore, to abut on and become united with the outer surface of the sac of the gastrozooid.

The radial offsets are disposed irregularly, at unequal distances from one another, and at all heights in the gastropore (Plate 39, R R). The inner ends of the radial offsets are often enlarged where they abut on the wall of the sac of the gastrozooid, and they are often forked at their outer extremities, where they spring from the cœnosarcal meshwork. They appear to be homologous with the radial canals already described as occurring in a similar connexion in *Sporadopora dichotoma* (Plate 43, fig. 3). In transverse sections of a zooid system, these radial offsets have much the appearance of mesenteries of an Anthozoan coral cut across, and in some sections they show a certain amount of regularity in disposition at the particular level selected for the cut (Plate 44, fig. 12).

These radial structures are here termed offsets, and not canals, because, although in some instances they appear to be similar in construction to the ordinary cœnosarcal canals, and usually show similar structure to these at their outer extremities, they usually consist towards their middles and inner extremities of simple bands of transparent fibrous tissue. The exact structure could not be determined, but it seems probable that these radial bands represent radially disposed offsets of the canal meshwork, which have become developed into fibrous organs with an elastic or muscular function, which is brought to bear on the zooid sac. In the case of the radial canals of *Sporadopora dichotoma,* distinct muscular elements were observed as forming part of their structure.

Zooids.

Dactylozooids.—The dactylozooids and their sacs in *Allopora profunda* are so closely similar in form and structure to those of *Stylaster densicaulis,* that they need no further description.

Gastrozooids.—The sacs of the gastrozooids in the present species differ from those in *Stylaster densicaulis* in being of smaller diameter in proportion to the dimensions of the pore cavities, and in being held in place by means of the radial offsets already described. It is possible that the wall of the sac of the gastrozooid lies nearer to the wall of the gastropore in the recent condition of the coral than is represented to be the case in Plate 39, G Z, and in Plate 44, fig. 12; but all the spirit specimens examined yielded a similar result when decalcified. The sac of the gastrozooid is, as usual, a reflection of the surface layer of the ectoderm. In the contracted condition it forms a long tubular cavity, somewhat narrowed in the region just above the gastrozooid and at the mouth, and dilated towards the centre. At its mouth, the marginal fold of the sac rises in the form of a flattened dome, somewhat above the level at which the openings of the sacs of the dactylozooids commence.

The gastrozooids are very deeply seated at the bottoms of their sacs. They are dome-like in form, with expanded bases. A whorl of tentacles, set on at some distance from the summit of the dome, marks the commencement of the large rounded hypostome. The tentacles are twelve in number, and are set on in a single whorl. They are elongate-ovoid in form. From the base of the zooid a series of radially disposed large canals pass outwards to be distributed, as in *Stylaster densicaulis,* a certain number of their branches forming a tortuous meshwork, offsets from which pass to join those of the gastrozooid of the adjacent system.

The structure of the zooid clyco-systems is clearly displayed in Plate 44, fig. 12, which is, in some respects, somewhat diagrammatic, but is taken from an actual transverse section. The section is taken above the level of the gastrozooid, which hence does not appear. The sac of the gastrozooid is, however, seen in section, together with its radial supports. The dactylozooids seen in section show the three layers of tissue of which they are composed, viz., ectoderm, basement membrane and muscular layer, and endoderm; and sections of their styles are introduced to show the position of these. The two finer reticulations of the cœnosarcal meshwork, inner and outer, are also well seen, with the larger canals in the interval between them, which at this height in the wall of the system are confined to the interspaces between the dactylozooids.

Gonophores.—Male examples only were obtained of the present species. The ampullæ are covered by the surface layer of the ectoderm, and the superficial reticulations of the cœnosarcal meshwork. Within, they contain a sac (Plate 39, G) in which are developed two or three gonophores of an ovoid form, which are attached to offsets of the cœnosarcal canals, and which show the usual elements characteristic of the various stages in the development of spermatozoa in the family, which elements are

massed around a spadix, as in *Sporadopora*. The process of development was not closely followed in the present species.

(7.) GENUS *ASTYLUS*, GEN. NOV. (H. N. M.).

I have formed the above genus for a Stylasterid with regular cyclo-systems, dredged off the Meangis Islands in 500 fathoms. The coral is, like *Cryptohelia*, devoid of styles in both kinds of zooids, and differs in structure in no important particular from this genus, with the exception that it has no solid lid-like covering overhanging the mouths of the zooid pores. It possesses, however, a curious tongue-like process deeply seated in the calicle, which probably is the homologue of this lid.

Corallum of Astylus subviridis.*

The corallum (Plate 34, fig. 4) consists of a short stem, which breaks up into a few primary branches. These, with their slender secondary branches and branchlets, which are very few in number, ramify in the same plane, and form a small flabellum. The stem and branches are circular in transverse section throughout their length, except where distorted by the presence of zooid cyclo-systems upon them. They are composed of a hard and compact pearly-white calcareous tissue, the outer surface of which is marked by a series of conspicuous fine rounded ridges, which separated by shallow grooves follow the directions of the stem and branches with parallel course, each ridge preserving its integrity for a long distance, except on the pore-bearing face of the flabellum, where the ridges are interrupted by the prominent cyclo-systems. The branches are somewhat swollen at the points where cyclo-systems are attached to them. The whole corallum is, as in other Stylasteridæ, permeated by networks of canals. The axes of the branches are traversed by bundles of large main canals, which place the cyclo-systems in relation with one another.

The cyclo-systems are all, with one exception, which is evidently abnormal in the present specimen, placed on one face of the flabellum, with their axes at right angles to its plane. The systems appear as globose bodies, with flattened tops, which are much wider in diameter than the branches on which they rest, and stand out prominent and entirely free from one another, at regular intervals along the course of the branches. The globose appearance of the systems is due to their being each encircled by a broad prominent zone of confluent ampullæ, which zone has a rounded surface, rendered somewhat irregular by the occasional prominence of individual ampullæ. Immediately above this zone, the edge of the summit of each system appears as a delicate lamina, which slightly overhangs the outer wall of the system all around (Plate 35, fig. 8). The summits of the systems are circular in outline, with a series of

* The Hydroid here named *Astylus subviridis* was referred to in my abstract paper on the "Structure of the Stylasteridæ" (Proc. Roy. Soc., 1876, p. 95), as "a *Stylaster* resembling *Cryptohelia*."

indentations in the marginal lamina, as in *Allopora profunda*, corresponding with the centres of the outer ends of the pseudosepta. A diagrammatic view of a cyclo-system, as viewed from above the mouths of the pores, is given on Plate 35, fig. 15.

The arrangement of the pores in the systems is closely similar to that in *Stylaster densicaulis* and *Allopora profunda*. There is a centrally-placed gastropore in each, which is surrounded by a ring of dactylopores with slit-like mouths. The gastropore in the present genus, however, appears in the form of two chambers, an upper and a lower, which communicate with one another by a constricted aperture. The upper chamber (Plate 35, fig. 8, G P) communicates with the exterior superiorly by a short tubular passage, bounded by the inner ends of the pseudosepta. The walls of the chamber are curved, so that, taken in conjunction with its upper prolongation, it is flask-shaped. At the base of the chamber its walls are curved inwards, so as to bound a horseshoe-shaped aperture, which leads to the lower gastropore chamber beneath. The aperture is rendered horseshoe-shaped by the projection from its margin on one side of a tongue-like process of calcareous matter, which is directed horizontally, with a slight upward curve across the aperture, reaching as far as its centre (Plate 35, fig. 8, B; fig. 15, A).

The tongue-like process is a solid calcareous structure of a bent conical form, with a rounded extremity. It is grooved on its under surface in the direction of its length, and springs from the margin of the wall of the upper chamber of the gastropore, which is thickened in this region by its stout roots. The process always points in a uniform direction, viz., in that of the length of the branch on which it is situate towards the tip of the branch. It thus has a similar direction to that of the lids of the cyclo-systems in *Cryptohelia pudica*. In this latter genus, a stout process of calcareous matter, prolonged from the support of the lid, forms a prominent ridge on the wall of the upper chamber of the gastropore in an homologous situation (Plate 35, fig. 7). It seems probable, therefore, that this tongue-like process in *Astylus* represents either a rudiment of a lid like that of *Cryptohelia*, which in an ancestral form protected the mouths of the whole of the zooids of each system, but is in *Astylus* withdrawn deep into the central cavity of the system, so as to protect the gastrozooid only; or that the reverse is the case, and that the condition in *Cryptohelia* represents a further development of that seen in commencement in *Astylus*.

The separation of the gastropore into two chambers by a constriction is already foreshadowed in *Stylaster densicaulis*, as has been described, by the circlet of excrescences which there form a prominent zone in the gastropore above the level of the tip of the style (Plate 35, fig. 3, A).

The wall of the upper chamber of the gastropore in *Astylus subviridis* terminates below in a thin margin, and behind the wall a cavity, continuous with that of the lower chamber of the pore, runs up to communicate by offsets with the tubular portion of the dactylopores. This cavity, in the recent condition of the coral, lodges the main upward-directed canal offsets of the gastrozooid.

The lower chamber of the gastropore is a cavity with a rounded bottom, which is excavated within the substance of the branch supporting the pore system. The cavity communicates with the upper chamber by the horseshoe-shaped opening, and with the dactylopore as already described. With adjacent cyclo-systems it communicates by means of the axial canals of the branches. There is no trace of a style at the bottom of the gastropore.

Around the mouth of the gastropores the mouths of the dactylopores appear as elongate slit-like openings, radially directed towards the axes of the systems. The outer peripherally-placed margins of these slits are rounded, whilst internally the slits join the cavity of the gastropore. The pseudosepta intervening between the dactylopores are, in origin, double laminæ, as in *Stylaster densicaulis,* but in the present form appear as thin plates, which have so regular a radial arrangement and so wide an extent that they simulate the septa of Hexætrinian corals more closely than do those of any other Stylasterid.

The inner extremities of the summit borders of the pseudosepta by their arrangement form a circular aperture leading to the cavity of the gastropore. There are from eighteen to twenty-one dactylopores in each cyclo-system. The upper wide slit-like chambers of the dactylopores are continued into small short tubular cavities below, as in *Stylaster densicaulis;* but these are entirely devoid of a style. The mouths of these tubular cavities are set in a circle, at the bottoms of the interspaces between the pseudosepta, at points about equidistant between the inner extremities of the pseudosepta and the outer margins of the chambers which they enclose (Plate 35, fig. 15).

The ampullæ are confined to the zones around the pore systems, and do not occur on the branches. Their cavities are usually kidney-shaped.

Soft Structures of Astylus subviridis.

The general arrangement of the soft structures is represented on Plate 41, fig. 1.

Cœnosarc.—The usual surface layer is present, which is continuous with the sacs of the zooids. A fine superficial reticulation of smaller cœnosarcal canals (Plate 41, fig. 1, S, S) extends over the surfaces of the branches and ampullæ, and coral generally, beneath the surface layer. The axes of the branches are occupied by meshworks of large canals, which lead from one cyclo-system to another, and place the whole of the systems in free communication with one another.

Large canals are given off from the periphery of the gastrozooids. Some of these communicate directly with the axial meshwork of canals, whilst another set passes upwards in the wall of each cyclo-system to join, after a certain small amount of ramification and anastomosis, the basis of the dactylozooid. From the surface of the meshwork of these latter canals, which adjoins the dactylopore cavity, a few transverse smaller canals are given off, which pass inwards radially to be attached to the wall of the pore-sac, and represent the more fully-developed "radial offsets," already described as occurring in *Allopora profunda* (Plate 41, fig. 1, R).

The ampullar sacs are embedded in a meshwork of offsets of the larger canals, and each of the gonophores is attached to one or more stout canal branches.

Stout offsets of the deeper canal meshwork traverse the interior of the pseudoseptal laminæ, and especially near the summits of the pseudosepta large tortuous branches pass radially outwards between the dactylozooid sacs, and, branching at their outer extremities, join the surface network at the margins of the cyclo-systems (Plate 44, fig. 2). Just over the outer extremities of each of the pseudosepta, at the margin of the top of each cyclo-system, and in the angles between the outer margins of the dactylopores, are situate ovoid nematophores. A single nematophore is placed in each above-described position. The nematophores are ovoid sacs, closely packed with about three tiers of nematocysts of the larger form, placed with their longer axes parallel to those of the containing sacs (Plate 44, fig. 2, N).

The endoderm of the soft parts in the present form were observed to have, in the fresh condition, a dusky green colour. The pigment is soluble in alcohol, and yields a green solution, which produces a well-marked absorption-band in the spectrum when examined spectroscopically. The position of this band was, however, unfortunately not determined.

Zooids.

Dactylozooids.—The dactylozooids have bases of closely similar form to those of the dactylozooids in *Stylaster densicaulis* and *Allopora profunda*, and are attached in the same manner within their sacs with the exception that they have no styles. The free portions of the zooids differ, however, from those in the species just mentioned, in that they are in the contracted condition, longer, more slender, and more gently tapered towards the extremities. Moreover, instead of being retracted within their sacs in a vertical position, *i.e.*, one parallel to the length of the sac, they are in the present form placed out of harm's way by being doubled down within the mouth of the sac of the gastrozooid (Plate 41, fig. 1, D Z, D Z).

Gastrozooids.—The sac of each gastrozooid is narrowed at the horseshoe-shaped opening, already described as leading, in the corallum, from the upper chamber of the gastropore, to the lower chamber in which the gastrozooid lies. The sac is reflected over the surface of the tongue-like process, and passing into the lower chamber, becomes attached to the zooid near the margin of its base. The tongue-like process projects in front of the mouth of the zooid, and must prevent the protrusion of the zooid, except in a crooked direction.

The gastrozooid itself is basin-shaped below, with a cylindrical mass above, the bottom of which gradually expands to join the margin of the basin. The cylindrical upper portion has a flat top perforated by the mouth, which is in the form of a crucial slit, and is abutted on by regularly disposed elongate gastric cells of the endoderm. Numerous large canals are given off from the periphery of the lower basin-shaped portion of the zooid, but none from the under surface of the basin. The disposition of these canals has already been described. The gastrozooids are devoid of tentacles.

Gonophores.—Only one specimen of the present form was obtained and it was of the male sex. The male gonophores appear as large rounded lobulated masses resting within the ampular sacs, and springing from stout offsets of the cœnosarcal meshwork, which pass into the sacs to reach them. Usually two tiers of ampullar sacs encircle each cyclo-system, being contained in the zone of ampullæ described in the account of the corallum.

The minute structure of the lobulated masses is shown in Plate 43, fig. 10. A membranous sac derived from the ectoderm and containing abundant nuclei in its tissue, S, lines the ampullar cavity and encloses the generative lobules. One or two large offsets of the canals of the cœnosarcal meshwork penetrate this sac, and with the ends of these the central mass of the generative structures is continuous. This central mass is composed of spherical nucleated cells filled with granules, and closely similar in appearance to the endoderm cells which line the cœnosarcal canals; and apparently the endodermal lining cells of the canals, from which the mass springs, are continuous with those composing its substance. All over the surface of this central mass of cells, which is invested with a thin layer of ectoderm, small globose sacs arise as buds, and gradually increase in size until they assume the form of the ovoid masses, which, being thickly set over the surface of the central mass, and hiding it from view, give to the active generative mass the lobulated appearance figured in Plate 41, fig. 1, G.

The young lobules when first formed appear as small rounded sacs with a thin wall of ectoderm, and containing a very few cells apparently derived from the main central mass. These cells become multiplied in number as the sac increases in size with progressive development. The sac as it enlarges becomes gradually pedicellate, and when mature is attached to the central mass by a narrow pedicle of some length. The walls of the pedicle are continuous with the ectodermal wall of the sac, which wall contains well-defined nuclei in its substance. Within the sac of the lobule a second sac, composed of a finer membrane, encloses the mature or developing generative elements. The wall of this inner sac is not prolonged into the cavity of the pedicle, but passing across its commencement shuts off the main cavity of the lobule from this latter.

The cells contained within the young lobule maintain a closely similar appearance to ordinary pigmented endoderm cells, until they have become multiplied into a large mass. On further increase they change their structure and appear as spherical perfectly transparent masses, each of which contains a large nucleus which becomes most intensely stained when treated with carmine. These transparent nucleated cells, which are closely similar in appearance to those figured by ALLMAN from the male gonophores of *Laomedea flexuosa*,* multiply further by division, becoming very minute but retaining the same structure (Plate 43, fig. 10, C).

From each of these minute cells a spermatozoon is developed. The head of the

* ALLMAN, "Gymnoblastic or Tubularian Hydroids." Ray Soc., 1871, part 1, p. 65, fig. 316.

spermatozoon appears to be developed out of the nucleus of the cell, which as the process proceeds becomes first attached to the wall of the cell on one side, and is then gradually drawn out in the form of a curved elongate mass along the wall of the cell until it assumes the form of the head of the spermatozoon, being curled round within the cell nearly into a circle. The various stages in development are shown on Plate 43, fig. 11.

The mature spermatozoa were not observed in the fresh condition. Their appearance as seen in specimens hardened in alcohol is shown on Plate 43, fig. 11, *g*. They form closely felted masses within the ripe lobules, which masses do not entirely fill the cavities of the inner sacs of the lobules.

In the cavities of the pedicles of the more mature lobules a tissue containing a few transparent rounded cells was seen to be present. This may represent a spadix. No rounded spadix such as that occurring in *Allopora* is present in the interior of the lobules. The histological details were preserved with very great completeness in the present form when hardened in spirit and decalcified, so much so that Plate 43, fig. 10, might almost have been executed with a camera lucida from a fine section of a gonophore stained with carmine. It is, however, impossible to determine without close study of fresh material so difficult a problem as the determination whether the male elements are derived from the ectoderm or endoderm. The apparent development from endoderm cells, in the present instance, may be entirely misleading; the presence of hard skeletons in the Stylasteridæ unfits them for research on such points. It seems improbable that they differ in this respect from other Hydroids. E. VAN BENEDEN* has shown that in *Hydractinia* the spermatozoa are developed from the ectoderm, and G. v. KOCH † has observed the same fact in two species of Tubularia.‡

(8.) GENUS *CRYPTOHELIA* (M. ED. and H.).

A deep sea coral, dredged in many parts of the world by the 'Challenger,' is referable to the above genus, and although the specimens vary a great deal, seems not distinct from MILNE EDWARDS' and HAIME'S species, *C. pudica*. The specimens, the anatomy of which is here described, were dredged off the mouth of the La Plata.

Corallum of Cryptohelia pudica.

The corallum is well figured by MILNE EDWARDS and HAIME,§ and described‖ by these authors as having the form of a small espalier tree, with all the branches comprised in the same vertical plane, and all the calicles turned to the same side.

* Recherches faites au laboratoire d'embryologie de l'université de Liege. Vol. 1, 1876, p. 2.

† Mittheilungen über Cælenteraten. Morphol. Jahrbuch. Bol. II., 1876, s. 84.

‡ Note added Sept. 24, 1878. The matter, however, seems variable or as yet undetermined.

§ MILNE EDWARDS et J. HAIME. Ann. des Sci. Nat., 3e sér., t. xiii., plate 3, fig. 1, 1850.

‖ Hist. Nat. des Coralliaires, Paris, 1857, t. ii., p. 127.

As far as the form and arrangement of the branches is concerned, the corallum of *Cryptohelia* differs in no important particular from that of *Astylus subviridis* which has just been described. The striæ on the surface of the branches are in the present form finer and run for shorter courses than in *Astylus subviridis*, and well marked prominent ridges are not formed between them.

Regular cyclo-systems are present in *Cryptohelia* which are all turned towards one face of the flabellum. Their mouths are not elevated above and isolated from the surfaces of the branches as in *Astylus*, but the branches swell vertically as well as horizontally where cyclo-systems are present, and the cœnenchym of the branch thus rises in a gradual curve to the level of the margin of each cyclo-system (Plate 35, fig. 7). There are from about fifteen to twenty-two dactylopores in each cyclo-system, in form and arrangement almost identical with those of *Astylus subviridis*.

The margin of one side of each cyclo-system is raised up into a stout projection, which is inclined slightly over the mouth of the system for a short distance. After running this inclined course the projection spreads out into a thin broad lamina, with a rounded border, which extends horizontally over the mouth of the cyclo-system and hangs as a lid or cover over its entire extent (Plate 35, fig. 7). The inclined portion of the projection is stout and thickened, and is strengthened by being continuous at its base with the adjacent cœnenchym of the branch. It is thickened to the greatest extent in the direction towards the centre of the cyclo-system, and so much so that its substance projects within the cavity of the upper chamber of the gastropore as a prominent ridge. This ridge becoming gradually less marked as it descends, is continued downwards to the margin of the aperture leading from the upper to the lower chamber of the gastropore, and appears as a prominent thickening of the wall of the upper chamber in this region (Plate 35, fig. 7, A). The dactylopores are aborted and absent in the region of the cyclo-system overgrown by the base of the lid. The lateral margins of this base are often grooved by dactylopores on either side, which have the appearance of having been pushed aside, as it were, by the growth of the projection. The thin horizontal lamina constituting the lid of the cyclo-system is often not quite smooth in surface but somewhat undulate or crumpled as it were. The lids are all directed with great regularity towards the tips of the branches on which the cyclo-systems to which they belong rest; the supports of the lids arising from the sides of the cyclo-systems nearest the origins of the branches.

The gastropores are divided into two chambers as in *Astylus*. In the present form the lower chamber is relatively smaller than in *Astylus subviridis*. Its communications with the dactylozooids are closely similar to those in *Astylus* (Plate 35, fig. 7). The opening between the two chambers in *Cryptohelia* is circular, not horseshoe-shaped as in *Astylus*.

Ampullæ occur only in connexion with the cyclo-systems in *Cryptohelia pudica*. In the female specimens examined by me, only one ampulla is developed in connexion with each system. It may lie on either side of the system, but not on the back of the

flabellum. The ampullæ are rounded cavities of irregular form, which, when mature, are so large as to be as wide as the side of a cyclo-system, and occupy it entirely (Plate 42).

Numerous specimens of *Cryptohelia pudica*, the soft parts of which are not preserved, have several ampullæ developed in connexion with each cyclo-system. These are concluded to be male examples. The ampullæ are not nearly so large as in female specimens, and do not give evidence of their presence by forming swellings on the surface of the corallum.

Soft Structures of Cryptohelia pudica. (Plate 42.)

Cœnosarc.—This differs in structure in no essential particulars from that of *Astylus subviridis.* Similar axial canal systems are present in the branches and similar surface networks, but these latter are finer and more complicated in the present form than in *Astylus.* The lid and its support consists of a reflection of the surface layer of ectoderm, beneath which is a prolongation of the surface network of the cœnosarcal canals, and in the thicker portion of the stem of the lid run abundance of prolongations of the deeper and larger vessels (Plate 42, L). Rounded nematophore sacs, closely similar to those of *Astylus subviridis*, are dotted about over the upper surface of the lid, and, as in *Astylus*, a single one of these bodies is placed at the margins of each cyclo-system over the outer extremity of each pseudoseptum (Plate 42, N, N). The pigmented endoderm cells are coloured brick-red as in *Sporadopora dichotoma.*

Zooids.—The zooids of both kinds most closely resemble those of *Astylus subviridis.*

Dactylozooids.—These are elongate-conical in form, tapering to a point. Their bases are attached as in *Astylus subviridis.* In retraction the part of them nearest the base is doubled back in the wide slit-like chamber of the dactylozooïd towards the periphery of the cyclo-system, and then the remainder of the zooid is bent over in the reverse direction and doubled down into the mouth of the gastrozooid (Plate 42, D, Z).

Gastrozooids.—These are flask-shaped and closely similar in structure to those of *Astylus subviridis*, being, like it, devoid of tentacles (Plate 44, fig. 1). The mouth appears at the flat summit of the neck of the flask as a cruciform aperture. The cavity of the zooid is lined with the usual gastric endodermal cells of elongate form, and the layer formed by these cells becomes, as in the gastrozooid of *Sporadopora dichotoma*, thinner as the base of the zooid cavity is approached. There is a thick investing ectoderm layer in the upper part of the zooid, between which and the endoderm layer is a well-marked layer of longitudinal muscular fibres, which fibres are, as in *Sporadopora*, continued for insertion along the main canal offsets of the base of the zooid (Plate 42, M).

The gastrozooid sac is attached just beneath the origin of the neck of its flask-shaped mass. The main canal offsets spring from the periphery of the rounded base of the zooid, with a radiating disposition (Plate 44, fig. 1). They curve upwards to be distributed, as in *Astylus subviridis.* The calcareous wall of the upper chamber of the

gastropore lies in the interval between these canals and the outer surface of the sac of the zooid. No canals spring from the under surface of the zooid.

Gonophores.—A fragment of a male specimen of *Cryptohelia,* obtained off the Japanese coast, was examined in a cursory manner, and it was seen that, at first sight at least, it resembled *Astylus subviridis* in the structure of its gonophores. Unfortunately it was mislaid, and I have been unable to find it again.

All other specimens of *Cryptohelia* available for the examination of the soft structures proved to be female only. The ampullæ in *Cryptohelia* are occupied by thin walled sacs. Those in connexion with newly-formed cyclo-systems at the tips of the branches of the corallum are small, and contain only a few gonophores in early stages (Plate 42, G); but those attached to older systems are often of enormous relative dimensions, and appear as long reniform bodies (Plate 42, G′), which are almost as large as the masses of the cyclo-systems themselves in volume, and contain gonophores in all stages from the very earliest upwards, and one or two mature planulæ.

The early stages in the development of the ovum of *Cryptohelia* were examined in the fresh condition of the soft parts, without decalcification or use of spirit, the ampullæ being broken open and the gonophores removed from the freshly-dredged coral.

The earliest stage in the formation of a female gonophore observed is the massing together of a small quantity of the endoderm cells of one of the canals of the cœnosarc, which enter the gonophore sac (Plate 44, fig. 3). In the next stage observed, a cup-shaped spadix of endoderm cells is fully formed, the cup being attached to the cœnosarcal canals by a pedicle. In the hollow of the cup rests a fully formed ovum, with a well-defined germinal vesicle and spot, its main mass being composed of fine rounded particles. Only a single ovum is developed in relation with each spadix. A thin reflection of the ectodermal investment of the spadix covers the ovum within its cup (Plate 44, fig. 4, E).

The ova must be in some manner impregnated within the gonophore sac. As development proceeds the ovum increases in size, and the germinal vesicle and spot disappear, and the ovum appears entirely composed of thickly-set oily globules. At the same time the margin of the cup of the spadix, which increases in dimensions in accordance with the ovum, becomes divided into a series of small rounded lobes, about twelve in number, which embrace the lower part of the ovum. The cells composing the spadix and its lobes being coloured dark chocolate, the contained colourless ovum contrasts strongly with its support in appearance in the fresh condition of the structures.

The ovum, as it enlarges, becomes gradually drawn out into an ovoid form (Plate 42, G). On further development the margin of the growing spadix becomes fringe-like in appearance, the lobes composing it lengthening and becoming forked at their extremities (Plate 42, S P). The ovum in this stage is much dilated, and drawn out into an elongate ovoid form. Its contents are nearly transparent and highly refractive,

but dotted all through their mass with sparsely-scattered oil globules of various sizes (Plate 42, OV). The reflection of the ectoderm at this stage still covers the ovum within its cup. A space is enclosed all round the gonophore by this ectodermal membrane, between the margin of the spadix and the ovum. This is filled by a perfectly transparent fluid.

In the next stage observed (Plate 42, SP′, OV′) the spadix is still further complicated at its margin by subdivision of its lobes, which form a sort of network over one-half of the surface of the ovum, terminating in a fringe of numerous tentacular-like lobes. The ovum is a large ovoid mass, composed of fine rounded particles densely packed together.

In the next stage observed, the developing ovum has already assumed the elongate-cylindrical form of a planula (Plate 42, P1). The stages by which the planula breaks its connexion with the spadix were not traced. The earliest planulæ observed appeared to be composed entirely of a uniform mass of fine rounded particles, like those constituting the substance of the latest stage seen in relation with the spadix. The formation of the ectoderm appears to take place by delamination. As the planula developes it becomes much elongated, and an outer layer becomes gradually more and more plainly observable on its surface as distinct from a general mass beneath it (Plate 42, P 2). The early-formed ectoderm layer (Plate 44, fig. 5) is composed of closely set, very fine rounded particles; whilst the inner mass, or endoderm, is made up of larger transparent oil globules. As development proceeds, the ectoderm layer thickens and becomes highly transparent, and being colourless contrasts with the more opaque red-pigmented endoderm within.

The mature planula measures nearly a quarter of an inch in actual length, and is so long that it has to be doubled up in order to allow of its accommodation within the gonophore sac. The planula has a thick, highly transparent, gelatinous-looking ectoderm, and a darkly pigmented endoderm. It is long and worm-like in form (Plate 42, P3). The surface of the ectoderm is marked out into polygonal areas, which are defined on the surface of the planula at an early period of development (Plate 44, fig. 6).

A vertical section of the ectoderm of the mature planula (Plate 44, fig. 7) shows that this thick layer is composed of a transparent gelatinous-looking mass, which is traversed by tracts of small rounded non-transparent elements, which stretch vertically to the surface of the planula, from the surface of the endoderm to that of the ectoderm. These tracts are continued outwards from a layer of similar elements, which rests at the base of the ectoderm, directly upon the surface of the endoderm. The opaque tracts are disposed at roughly regular intervals, and form vertical layers which, rising to the surface of the ectoderm and meeting one another, enclose the polygonal areas already described. In these tracts, apparently out of the opaque elements composing them, numerous thread cells of the larger kind are developed, and are more abundant and thickly set towards the surface of the planula; hence, when the lines enclosing

the polygonal areas are viewed from the surface of the planula, they appear mainly composed of rows of nematocysts viewed end on, but partly also of the already described opaque rounded bodies (Plate 44, fig. 8). Some of the nematocysts contained in the ectoderm of the mature planula were observed to have their contained threads fully developed.

Planulæ were not examined in the fresh condition, hence the ciliation of their surface doubtless occurring was not observed. In the most mature planula investigated the endoderm consisted of pigmented cells, like those of the endoderm of the mature coral, but evidently in a condition of rapid increase, and of oil globules of various sizes and fine granular matter. The endoderm mass did not show any trace of a central cavity, but appeared homogeneous and solid. The gonophore sacs seem to be permanent in *Cryptohelia pudica*, and the production of planulæ within them to be carried on as a continuous process.

Growth by Budding.—In ordinary growth of the coral by budding, every part of the coral surface would appear capable of producing complete cyclo-systems, for in one specimen procured a new cyclo-system has been abnormally produced as a bud from the upper surface of the lid of an older cyclo-system.

General Remarks.

Summaries of the characteristics of the Hydrocorallinæ and their subdivisons will be given in the sequel under the heading "Classification." A few further points are required to be noted here. The Hydroid affinities of the Stylasteridæ need no discussion; they are borne out by every item of structure.

As in almost all Hydroids, the sexes are on distinct stocks, and these stocks, like those of Sertularins, have a tendency to grow in a flabellate form with alternate gemmation. In having the number of the tentacles borne by the gastrozooids regular in number in each species, possibly in each genus, the Stylasteridæ differ from the Milleporidæ, in which the number is variable. The connexion of an absence of the styles in the gastropores with a flask-shaped form of gastrozooid devoid of tentacles is remarkable. It occurs in apparently otherwise widely separated genera, *Astylus* and *Pliobothrus*. It is possible that the tentacles of the gastrozooids in all the genera would show traces at least of having knob-like or club-shaped ends were they able to be examined in the fresh condition.

The gonophore sacs within the ampullæ, as containing several distinct gonophores, in several genera at least, seem entitled to the term "gonangia," according to Allman's terminology. It seems uncertain whether the central mass in *Astylus*, from which the sperm-developing lobules are budded off, is to be considered as a blastostyle or not; no definite spadices were observed within these lobules.

The radiate arrangement of the cœnosarcal canals around the sacs of the zooids,

which is so remarkably developed in *Sporadopora* and *Allopora,* and traces of which appear in nearly all the genera, is very remarkable. It gives the soft structures of *Allopora* at first sight, a still closer resemblance in arrangement to that occurring in *Anthozoans,* than does the very curious simulation which exists in its corallum. The resemblance is, however, in both instances merely superficial, and of no genetic significance.

The branched and fringed processes of endoderm described as embracing the embryos in *Errina* and *Stylaster* appear to correspond with the similarly branched structures in *Cordylophora lacastris,* described and figured by ALLMAN and F. E. SCHULTZE.* I have described them as outgrowths of the spadix, but possibly the cup-shaped endodermal structure supporting the ova should not be so designated.

The endoderm of the Stylasteridæ is always coloured, and seems most frequently to assume various shades of red or violet colouration, but in *Astylus subviridis* it is green. The corallum itself is in some species coloured, especially, it would appear, in *Distichopora,* but no doubt in many instances the colouration ascribed to the calcareous structures is in reality due to endoderm dried up within the interstices of the corallum.

In a former paper I conjectured that possibly shallow water Stylasteridæ might bear free gonophores, and perhaps medusiform ones, and that the occlusion of the gonophores within calcareous structures, and their adelocodonic condition, was due to the fact that the forms examined lived in the deep sea. This suggestion was in accordance with the observations of ALLMAN, who has found fixed sporosacs in all deep-sea Hydroids examined by him.† I find, however, from specimens sent me by Count de POURTALES, that ampullæ are especially well developed on the shallow water *Stylaster roseus ;* those in the female stocks being very large and prominent. There can, therefore, be little doubt that these structures occur throughout the family.

In all the Stylasteridæ in which the gastropores have styles, the gastrozooids must be protusible in the expanded condition to a very slight extent. And the fact that in some genera the gastrozooids lose their tentacles seems to bear out this supposition. No doubt in active life the dactylozooids extend like long and filiform tentacles and catch and convey food to the gastrozooid, which nourishes them in return by means of its basal canals and the general circulation. It is to be noted that in those genera in which the gastrozooids have no tentacles, tentacles are wanting in the entire stock.

The nariform and tubular projections of *Errina* are no doubt contrivances for extending the reach of the dactylozooids, whilst at the same time protecting them. In *Acanthopora* the bases of the dactylozooids are pushed out to a remarkable distance from the gastropore mouths, and subsidiary dactylozooids of a smaller kind seem to be necessary to ensure the conveyance of the food to the gastrozooid.

* F. E. SCHULTZE, Ueber den Bau und die Entwicklung von *Cordylophora lacastris.* Leipzig: W. ENGELMANN, 1877, p. 34, plates 3, 4.

† ALLMAN, "Gymnoblastic or Tubularian Hydroids," Vol. II., p. 155. *Nature,* Oct. 28, 1875, p. 556.

G. O. SARS, who is the only naturalist who has observed a Stylasterid alive, never saw the zooids raise themselves above the levels of the mouths of their cyclo-systems.

In the building up of the corallum, which must be deposited, as in *Millepora*, by the ectodermal covering of the cœnosarcal canals, absorption of already formed hard structures must take place during the gradual increase in size of the ampullæ and the widening of canals, which, as shown in the figures, are larger in bore in the deeper than in the younger superficial regions of the corallum. A re-deposit must also take place constantly, for old ampullæ, in the deeper parts of the coralla, are to be found in all stages of obliteration. Sometimes in some genera a rejuvenescence of parts of the corallum takes place; a previously dead area becoming overgrown from its margins by a living lamina, which spreads over and covers it.

PARASITES.

The coralla of nearly all Stylasteridæ are liable to become much distorted in growth by the presence upon them of parasites of various kinds, each of which appears by the special kind of irritation which it offers to produce a particular form of abnormal growth in the part of the corallum it infests, producing thus, as it were, an animal gall. The commonest distortion is the reduction of the stem of a coral or branch, or of one side of these, into a hollow canal or deep furrow, more or less roofed over by a thin wall. This condition is produced by the adherence to the growing stem of an *Aphroditacean Annelid.* It has been noticed and described by Count de POURTALES * and VERRILL, in *Stylaster erubecsens* and *Allopora Californica.* I have seen it in *Cryptohelia, Stylaster, Allopora,* and *Errina.* On *Errina labiata,* a parasitic filiform Nemertean also occurs which twines itself round the tips of the branches in many coils. The branches thus irritated grow out into a burr-like mass of projecting points which are evidently hypertrophied dactylopore prominences, and sometimes assume almost the appearance of the normal spines of *Spinipora.*

The most interesting parasite observed was a form found in the gastric cavities of the gastrozooids of *Pliobothrus symmetricus* contained in small capsules. These were badly preserved, but there seemed little doubt that they contained the remains of larvæ of a Pycnogonid, so that the deep-sea Pycnogonids, which are so abundant, very possibly pass their early stages in deep-sea Stylasteridæ. The formation of a calcareous corallum has not vitiated the capabilities of the Stylasterid Hydroids as hosts for Pycnogonid larvæ. The gastrozooids containing the larvæ were partly aborted.

CLASSIFICATION.

I place the Stylasteridæ with the Milleporidæ in a separate sub-order of the Hydroids, which I term Hydrocorallinæ, in accordance with a suggestion which I

* Bull. Mus. Comp. Zool., Harvard, VI., p. 136.

made in a paper "On the Structure of *Millepora*," in the Phil. Trans., Vol. 167, Pt. I., 1877, p. 132. The placing of the two families together seems justified in the present stage of knowledge concerning them; but the Milleporidæ, in the general form of their zooids, seem allied to the gymnoblastic Hydroids, whereas the presence of distinct gonangia in the Stylasteridæ seems to ally these latter to the calyptoblastic group. Ampullæ seem certainly to be absent in Milleporidæ, and their gonophores are, therefore, probably developed free of the corallum. Further research may lead to the separation of the two families. The characters of the sub-order Hydrocorallinæ and of the families Milleporidæ and Stylasteridæ are given in the sequel in a concise tabular form, and also in a series of more extended and comprehensive statements in which no known detail of importance is omitted.

The components of the family Stylasteridæ have hitherto been classified from a knowledge of the structure of the corallum alone, and even this has been but imperfectly investigated in most instances; further, the descriptions given of the genera and species have been distorted by the violent efforts made by naturalists to discover septa and interseptal chambers in the so-called calicles of these supposed anthozoan corals.

The descriptions of the genera at least thus required to be rewritten, and modified according to the present knowledge of the structure of the members of the family. This has been attempted in the sequel where the characters of the genera given embrace those derived from the structures of the soft tissues as well as of the hard. Unfortunately, the soft structures are known in only one species in almost all the genera, and in almost all in but one sex. Hence the classification here given will doubtless need subsequent modification. It merely professes to be an attempt to define the genera in the best manner now possible.

In the case of two genera, *Distichopora* and *Labiopora*, nothing is known of the soft structures. Four new genera—*Sporadopora*, *Labiopora*, *Spinipora*, and *Astylus*—are described. Count de POURTALES' genus *Lepidopora* is merged in *Errina*, from which, in the absence of information concerning the soft structures, it can hardly be considered distinct. The lid-like coverings of the gastropores, by the presence of which the genus *Lepidopora* is distinguished, are most frequently composed of fused dactylopore projections, and do not consist of special elevations of the margins of the gastropore mouths themselves. Although this latter is sometimes the case, *Errina labiata*, a new species of which the structure is described in the present paper, seems to form a gradation between the species described as of the genus *Lepidopora* and *Errina aspera*. Count de POURTALES originally placed his *Lepidoporas* under the genus *Errina*.

Cyclopora (VERRILL) and *Stenohelia* (KENT) are further omitted from the list. The latter was formed to include *Allopora Madeirensis*, which seems to come very near to *Astylus* and *Cryptohelia* in that it has the cyclo-systems all directed towards one face of the flabellum; but the presence of a style in the gastropores is decisive in excluding

it from this association, and probably points to the existence in it of a gastrozooid bearing tentacles.

The separation of the genera *Allopora* and *Stylaster* is difficult. The different forms of the gastrozooids, and the presence in that of one genus of six, and in that of the other of twelve tentacles, may prove characteristic of the genera. Count de POURTALES sent me specimens of *Stylaster roseus* and *Allopora miniata* in spirit, both species of their genera different from those of which I had determined the anatomy. The soft parts were unfortunately badly preserved in the specimens, but the gastrozooids, although their tentacles could not be counted, appeared in form to correspond with those before observed in the other species of the same two genera. A tendency to alternate budding can be made out in all *Alloporas*. It seems probable that the strong tendency to the development of the cyclo-systems on the sides of the branches only in the flabellum will prove a good characteristic for the separation of the *Stylasters* from the *Alloporas*, which would then include all those species in which the faces of the stem and branches were covered with cyclo-systems. The genus *Endohelia* of M. EDWARDS and HAIME, as already remarked by Count de POURTALES* and myself,† does not seem in any way separable from *Cryptohelia*. Short characters of the several genera of the Stylasteridæ are given in the table immediately following; more extended descriptions follow.

* "Deep Sea Corals," *l.c.*, p. 34.

† H. N. MOSELEY. "On the True Corals dredged by H.M.S. 'Challenger,'" Proc. Roy. Soc., No. 170, 1876, p. 557.

TABULAR Synopsis of the Characters of the Sub-order Hydrocorallinæ, its Families and Genera.

Sub-order	Family				Genus
HYDROIDS forming a corallum, with two kinds of zooids, gastrozooids and dactylozooids. *Sub-order:* HYDROCORALLINÆ.	Dactylozooids with numerous tentacles. Ampullæ absent. *Family:* MILLEPORIDÆ.				*Millepora.*
	Dactylozooids devoid of tentacles. Gonangia contained in ampullæ. *Family:* STYLASTERIDÆ.	Pores sporadic, or not in cyclo-systems. Gastropores with styles. Dactylopores without them.	Dactylopores of one kind only.	Pores of both kinds simple. Gastrozooids with four tentacles	*Sporadopora.*
				Dactylopores at the tips of tubular projections. Gastrozooids without tentacles	*Pliobothrus.*
				Gastropores sometimes covered with a projecting scale. Dactylopores within nariform projections. Gastrozooids with four tentacles	*Errina.*
				Pores simple in a triple linear row at the lateral edges of the branches of the flabellum, rarely on its faces	*Distichopora.*
			Dactylopores of two kinds, larger and smaller.	Larger dactylopores within nariform projections arranged in regular rows. Smaller dactylopores at the sides of these	*Labiopora.*
				Larger dactylopores within long spine-like projections. Smaller dactylopores in simple cavities at their bases. Gastrozooids with six tentacles	*Spinipora.*
		Pores occurring in regular cyclo-systems only. Styles present in both kinds of pores, or absent altogether.	Both kinds of pores with styles. Gastrozooids with tentacles.	Cyclo-systems budding from one another somewhat irregularly. Gastrozooids with twelve tentacles	*Allopora.*
				Corallum increasing by regular alternate gemmation of the cyclo-systems from one another. Gastrozooids with eight tentacles	*Stylaster.*
			Styles absent. Gastrozooids without tentacles. Gastropores with two chambers.	Summits of cyclo-systems covered by a lid	*Cryptohelia.*
				Cyclo-systems without a lid	*Astylus.*

CHARACTERS OF THE SUB-ORDER HYDROCORALLINÆ, AND OF THE FAMILIES AND GENERA CONTAINED IN IT, MODIFIED TO INCLUDE THE RESULTS ATTAINED BY THE PRESENT INVESTIGATIONS.

SUB-ORDER *HYDROCORALLINÆ* (H. N. M.).*

Compound Hydroid stocks, growing by gemmation. Hydrophyton consisting of a meshwork of ramified cœnosarcal canals, composed of an ectoderm and pigmented endoderm, lodged within channels permeating a hard calcareous support, "corallum," which is deposited by the ectodermal investment of the canals, and forms masses of very various shape. Surface of the Hydrophyton covered with a continuous layer of ectoderm. Zooids of two forms, the one provided with a mouth and gastric cavity, "gastrozooid," the other mouthless and simply tentacular in function, "dactylozooid." Tentacles, when present, mostly with knobbed extremities. A well-defined muscular layer present in the zooids. Zooids lodged within chambers excavated in the substance of the Hydrophyton, "gastropores" and "dactylopores," lined by reflections of the surface layer of the ectoderm, forming the "sacs" of the zooids. Zooids of the two forms either scattered irregularly over the surface of the stock, or gathered into groups more or less regular, in each of which a centrally-placed gastrozooid is surrounded by a ring of dactylozooids. Cavities of zooids communicating with cœnosarcal meshwork by large canal offsets.

I. *Family Milleporidæ* (L. AGASSIZ).

Corallum irregular in growth, arborescent or encrusting, composed of a thin superficial living layer, supported by a dead mass made up of successive preceding dead layers. Pores devoid of styles, divided into a series of vertically succeeding chambers by transverse calcareous partitions, "tabulæ." Usually scattered irregularly, but in some species grouped with tolerable regularity into systems, in which a centrally-placed gastropore is surrounded by a ring of dactylopores. Nematocysts of two kinds present—the one, the three-spined form, occurring only in Hydroids; the other ovoid in shape, with a thread beset with a spiral of spines. Gastrozooids short, cylindrical, with from four to six tentacles with knob-like tips, set in a single whorl. Dactylozooids long, filiform, and tapering, with an irregular number of short knob-bearing tentacles set on at irregular intervals. Gonophores unknown, but not contained within special cavities in the substance of the corallum "ampullæ."

Genus 1.† *Millepora*, LINNÆUS (Syst. Nat., ed. 10, t. i., p. 790, 1858).—Genus with the characters of the family.

* Phil. Trans. Roy. Soc., Vol. 167, pt. 1, 1877, p. 132.

† This seems to be the sole genus which can be now included in the family. *Heliopora* I have shown to be an Alcyonarian (Phil. Trans. Roy. Soc., Vol. 166, pt. 1), and I have confirmed Prof. VERRILL'S

II. *Family Stylasteridæ* (GRAY).

Corallum arborescent, with a strong tendency to assume a flabellar form, and to the development of the zooid pores on one face only of the flabellum, or on the lateral margins only of the branches composing it. In some genera a superficial layer only of the coral is living; in others, nearly the entire mass retains its vitality. Pores with tabulæ in two genera also. The gastropores usually provided with a conical calcareous projection, "style," at their bases. In some genera, a rudimentary style present only in the dactylopores. Pores scattered irregularly, or grouped into more or less symmetrical systems, composed of a centrally-placed gastropore surrounded by a circlet of dactylopores. In some genera the mouths of the dactylopores appear as elongate chambers, disposed radially towards the centre of the gastropore into which they open, and the chambers being separated from one another only by thin partitions, "pseudosepta;" the systems, "cyclo-systems," simulate closely calicles of Hexactinian corals. Nematocysts of two kinds, large and small, and of uniform shape in all the genera. Three-spined nematocysts absent. Gastrozooids cylindrical or flask-shaped in form always entirely retracted within the gastropores when at rest; those of the former shape with from four to twelve tentacles, set in one whorl, and regular in number in all the gastrozooids in each species; those of the latter devoid of tentacles. Dactylozooids simple elongate-conical bodies, devoid of tentacles, sometimes capable of entire retraction within the pores, sometimes not. Stocks of distinct sexes. Gonophores adelocodonic, developed within sacs, "gonangia," which are contained within special cavities in the substance of the corallum, "ampullæ." Stocks of the two sexes alike in form as far as known, except in the size of the ampullæ, which are larger and more prominent in the females. Ampullæ containing in male stocks several gonophores; in female, in some genera, a single gonophore, in others several. Spadix, in the female gonophores, cup-shaped, embracing a single ovum only, which becomes developed into a planula within the gonangium.

Genus 1. *Sporadopora*, gen. nov., H. N. M. =*Polypora*,* H. N. M. (Proc. Roy. Soc. No. 172, 1876, pp. 94, 95).—Corallum pure white, composed of finely reticular but compact cœnenchym, forming stout vertical stems, usually compressed from before backwards, so as to be oval in transverse section. Stem giving off a limited number of irregularly dichotomous branches, which are flattened like it, and tend to coalesce by their lateral margins and assume a flabellate form, which is sometimes somewhat

results as to the nature of *Pocillopora*, which is a Hexactinian. There can be no doubt that *Seriatopora* is closely allied to *Pocillopora*, and it is apparently by an oversight that Prof. HUXLEY has retained *Pocillopora* amongst the Millepores in his 'Manual of the Anatomy of Invertebrated Animals,' London, 1877, p. 168. There seem to be no fossil genera, other than *Millepora* itself, which can with certainty be referred to the family.

* I was kindly informed that *Polypora* was inadmissible, as being already in use by Mr. ETHERIDGE, junr., F.G.S., &c.

curved. Surface of the corallum smooth and nearly even. Pores of both kinds with simple circular mouths, irregularly scattered. Gastropores larger, less numerous, with a deeply seated brush-like style, and very thin and delicate tabulæ placed at irregular intervals. Dactylopores devoid of a style. Ampullæ, in male stocks, ovoid, entirely immersed beneath the surface of the corallum. Pores and ampullæ more abundant on one face of the flabellum than on the other. Gastrozooids cylindrical, with four club-shaped tentacles, dividing at their bases into four main canals. Dactylozooids of various sizes, retracted entirely within the pores when at rest. Gonophores, in male stocks, ovoid, with a club-shaped spadix; one, two, or three present in each gonangium, attached directly to offsets of the cœnosarcal canals. Female stocks unknown.

Genus 2. *Pliobothrus*, POURTALES.—Corallum branching, with a tendency to form a flabellum. Surface smooth, marked with small linear openings arranged in rows, which in the recent state contain branches of the superficial cœnosarcal meshwork. Inner parts of the corallum very coarsely porous. Pores irregularly scattered. Gastropores circular-mouthed, their cavity tubular above, but expanding below into a basin-shaped chamber, without a style, often with one or two tabulæ. Dactylopores showing as minute openings at the tips of small tubular projections, devoid of styles. Ampullæ rounded cavities; in the female very large, in the male smaller; placed deeply, often in the axis of the corallum. Gastrozooids flask-shaped, devoid of tentacles, communicating with the cœnosarcal meshwork by numerous offsets arising all around their bases. Dactylozooids entirely retracted when at rest. In the female a single gonophore in each gonangium; in the male, a group of gonophores (?) in each ampulla.

Genus 3. *Errina*, GRAY.—Corrallum branching with a tendency to form an irregular flabellate expansion. Pores most abundant at the tips of the branches; irregularly scattered. Dactylopores with delicate nariform or scale-like projections, which vary much in form, being sometimes drawn out into tubes opening on one side by a slit as the pore mouth, but often coalescing, so that two or three projections have a common base and form large scales perforated by the pores; devoid of styles; scales all with a tendency to incline towards the tips of the branches. Gastropores with irregularly circular mouths, often seated in depressions; with a deeply seated style. The mouths of the gastropores frequently covered by the dactylopore projections inclined more or less over them. Sometimes the margin of the gastropore itself is raised up on one side into a scale inclined over the pore mouth, but this is usually fused with neighbouring dactylopore projections. Ampullæ on both sides of the flabellum; prominent in the female. Gastrozooids cylindrical, with four club-shaped tentacles and four basal canals. Dactylozooids entirely retracted. Gonophores in the female solitary in the gonangia. The free margin of the cup-shaped spadix becomes converted into a ramified fringe, embracing the embryo as development proceeds. Planula as in *Pliobothrus*. Structure of male stocks unknown.

Genus 4. *Labiopora*, gen. nov., H. N. M. (Type specimen in British Museum, mistaken by GRAY for a Bryozoon, and described by him as *Porella Antarctica.*) (Proc. Zool. Soc., 1872, p. 746, plate lxiv., fig. 4).—Corallum minutely reticulate in texture, composed of a few rounded branches with tapering extremities. The entire surface covered with nariform projections, with elongate cavities, which are arranged in rows along the lengths of the branches, often disposed with great regularity for long stretches. The projections of very uniform shape and rising from the branches to a uniform height. All inclined in the directions of the tips of the branches. The elongate cavities, which are extended in the direction of the lengths of the branches, have a defined rounded margin at their ends, situated towards the tips of the branches, but gradually merge at their opposite extremities in the deep and complex hollows by which the surface of the coral is excavated, and which are made up of the confluences of cavities of adjacent nariform projections with the other irregularities of the surface. Dactylopores devoid of styles; two kinds present, larger and smaller. The nariform projections are the outgrown margins of the larger dactylopores, which are continued into the substance of the corallum from the cavities of the projections as tubular pits. The smaller dactylopores have mouths of the same general form as those of the larger ones, but with their longer diameters directed at right angles to these latter. They have their walls fused with those of the nariform projections, or often appear as if excavated in the sides of these. They are of one-third or one-fourth the dimensions of the larger pores. Mouths of the gastropores deeply seated in depressions at the bases of the nariform projections. Circular in outline. Gastropores provided with deeply seated styles with brush-like tips. No ampullæ in the unique specimen. Soft structures unknown.

Genus 5. *Spinipora*, gen. nov., H. N. M.—Corallum branching. Branches rounded. Entire surface thickly beset with long spinous projections inclined towards the tips of the branches. Spines conical, grooved deeply on their sides turned towards the tips of the branches so as to present spout-like openings, which are the mouths of the larger dactylopores. Dactylopores of a smaller kind also present; their mouths appear as minute oval apertures scattered over the bases and sides of the spines. Styles absent in the dactylopores. Gastropores deeply seated in hollows between the bases of the spines; with deeply placed styles. Ampullæ absent in the unique specimen. Dactylozooids of two kinds, the larger attached by elongate bases within the spout-like cavities of the larger dactylopores, incapable of retraction within the pores; the smaller minute; entirely retracted when at rest. Gastrozooids cylindrical, with six tentacles and four basal canals. Gonophores unknown.

Genus 6. *Allopora.*—Corallum branching, but frequently not so as to form a flabellum. Pores in regular cyclo-systems only, excepting in *A. Nobilis*, where some of the systems are not perfected. Tendency to alternate gemmation present, but weak, and usually obscured by an abundant growth of cœnenchym. Cyclo-systems always scattered over the faces of the branches, as well as situate at their lateral margins; often entirely

sporadic in disposition. Dactylopores with a more or less rudimentary style affixed to those parts of their walls which are outermost in the systems. Gastropores, simple tubular, with a brush-like style. Ampullæ sometimes prominent, sometimes scarcely showing at the surface. Dactylozooids attached by elongate bases to the sides of their pores occupied by the styles; partly retracted within the pores, partly bent upwards when at rest within the wide pore mouths. Gastrozooids dome-like in shape, with twelve tentacles and numerous basal canals. Gonangia in male stocks containing two or three ovoid gonophores with club-shaped spadices. Structure of gonophores of female stocks unknown.

Genus 7. *Stylaster*, GRAY.—Corallum arborescent usually flabelliform. Pores in regular cyclo-systems only. A strong tendency to the development of these cyclo-systems on the lateral margins of the branches only. Cyclo-systems arising from one another by alternate gemmation. Dactylopores and zooids as in *Allopora*. Ampullæ usually prominent on both faces of the flabellum. Gastrozooids cylindrical, with numerous basal canals and eight tentacles. Gonophores of male stocks as in *Allopora*. Structure of females unknown.

Genus 8. *Astylus*, gen. nov., H. N. M.—Corallum forming a small and delicate flabellum. Pores in regular cyclo-systems, all placed on one face of the flabellum. Cyclo-systems forming cylindrical masses prominent from the branches, and with their axes directed at right angles to the plane of the flabellum. Style absent in both kinds of pores. Gastropores divided into two chambers, an upper and lower, by a constriction of their walls. Opening between the chambers rendered horseshoe-shaped by the projection across it, in the direction of the tips of the branches, from that side of its margin placed nearest the bases of the branches, of a tongue-like excrescence. Ampullæ in the male stocks in a ring around the cyclo-system masses; none scattered on the branches. Dactylozooids, when at rest, doubled down within the upper chambers of the gastropores. Gastrozooids flask-shaped, devoid of tentacles, with numerous basal canals. Gonangia in the male stocks containing a central mass of cells, from the surface of which are developed as buds numerous pedicellate lobular sacs, in which the spermatozoa are produced. Female stocks unknown.

Genus 9. *Cryptohelia*, M. EDWARDS and HAIME.—Corallum closely resembling that of *Astylus* in all respects, excepting that the cyclo-system masses are not so prominent, that the opening between the upper and lower chambers of the gastropores is circular in outline, and that a lid-like lamina of calcareous matter is directed horizontally across the mouths of all the cyclo-systems. The lids are supported on stout columns arising from the margins of the cyclo-systems and inclined over them. They spring from the sides of the systems nearest the bases of the branches, and are directed towards the tips of the branches. In female stocks only a single ampulla and gonangium developed in relation with each cyclo-system. No ampullæ on the connecting branches. In the males several ampullæ in the walls of each cyclo-system. Soft structures as in *Astylus*. In female stocks numerous gonophores present in each

gonangium in all stages of development. Spadix cup-shaped, developing, as in *Errina,* into a fringed network at the margin. A solitary ovum developed in relation with each spadix. Planula very long and worm-like.

Genus *Distichopora,* LAMARCK (Plate 35, figs. 6 and 16).—Corallum branching flabelliform with branches usually flattened in the plane of the flabellum; composed of very compact cœnenchym. Pores confined to narrow lines or rows running along the exact centres or 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 in 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 tubulate tissue, in which the successively-developed curved pore-tubes stand out fanwise, separating from one another the compact masses of cœnenchym forming the opposite faces of the branches. The branches may therefore be readily split into two halves along this tubular tract. Older gastropores with immensely long filiform styles. Styles much shorter in the younger gastropores. Dactylopores devoid of styles. Ampullæ sometimes on one, sometimes on both faces of the flabellum, prominent and often forming confluent masses. Soft structures unknown.*

SPECIES OF STYLASTERIDÆ AT PRESENT KNOWN.

A list of all the species of Stylasteridæ, at present described, here follows. The list is not to be considered as constituting a revision of the species. Access has been had to only a limited number of specimens, and as in the case of many of the species good figures, or indeed any figures at all, are wanting, and the descriptions founded on a false theory as to the nature of the organisms described are necessarily imperfect, a revision has not been found possible. Indeed, such can only be carried out when the soft structures of more species shall have been examined. The list, such as it is, represents an attempt to draw attention to all the species of which an account has been published. Few references are given, those only in each case being selected which are the latest and will supply all further references required when consulted, or those which indicate figures of the species described. The localities are appended in most instances in order to show the distribution of the members of the family.

* See Postscript, p. 502.

LIST OF THE SPECIES OF STYLASTERIDÆ AT PRESENT KNOWN.*

Family Stylasteridæ, GRAY, Ann. and Mag. Nat. Hist., vol. xix., 1847.

(I.) Genus *Sporadopora,* gen. nov., H. N. M. *Polypora,* H. N. M., Proc. Roy. Soc., No. 172, 1876, pp. 94, 95.

Species 1. *Sporadopora dichotoma,* sp. n., H. N. M., Plate 34, figs. 3 and 4. *Polypora dichotoma,* H. N. M., Proc. Roy. Soc., No. 172, 1876, pp. 94, 95. Dredged by H.M.S. 'Challenger,' Feb. 14, 1876, in lat. 37° 17′ S., long. 53° 52′ W., off the mouth of the Rio de la Plata, from 600 fathoms.

(II.) Genus *Pliobothrus,* POURTALES, Bull. Mus. Comp. Zool. Harvard, No. 7; 'Deep Sea Corals,' p. 57. See Ill. Cat. Mus. Comp. Zool. Harvard, No. 10.

Species 1. *Pliobothrus symmetricus,* POURTALES, Bull. Mus. Comp. Zool., No. 7; 'Deep Sea Corals,' p. 57, pl. iv., figs. 7 and 8. Dredged off Florida and Key West, in from 98 to 154 fathoms.

Cold area of North Atlantic, in 500 to 600 fathoms, P. M. DUNCAN, "Madreporaria of the 'Porcupine' Expedition," Trans. Zool. Soc.. vol. viii., pt. v., p. 336.

Off Sombrero Island, Danish West Indies, in 460 fathoms, MOSELEY, "Corals dredged by H.M.S. 'Challenger,'" Proc. Roy. Soc., No. 170, 1876, p. 548.

Species 2. *Pliobothrus tubulatus,* POURTALES, 'Deep Sea Corals,' p. 58, pl. iv., fig. 9. Off Havana, in 270 fathoms.

(III.) Genus *Errina,* GRAY, Proc. Zool. Soc., 1835, p. 35; SAVILE KENT, Proc. Zool. Soc., 1871, p. 282.

Species 1. *Errina aspera,* GRAY, *l.c.* *Millepora aspera,* ESPER, Supp. 1, t. 18; LAM., ii., p. 202.

Species 2. *Errina carinata,* POURTALES, 'Deep Sea Corals,' p. 39, pl. vi., fig. 5. Off Havana, in 270 fathoms.

Species 3 (?). *Errina fissurata,* GRAY, Proc. Zool. Soc., 1872, p. 745. Described from a drawing of the living coral. Specimen lost. Affinities doubtful. Dredged in the Antarctic Ocean.

Species 4. *Errina glabra.* *Lepidopora glabra,* POURTALES, 'Deep Sea Corals,' p. 40, pl. vii., figs. 8 and 9. Off Havana, in 270 fathoms.

Species 5. *Errina cochleata.* *Lepidopora cochleata,* POURTALES, 'Deep Sea Corals,' p. 40, pl. iii., figs. 17, 18, and 19. Off Havana, in 270 fathoms.

Species 6. *Errina Dabneyi.* *Lepidopora Dabneyi,* POURTALES, 'Deep Sea Corals,' pp. 40, 41, pl. vii., figs. 10 and 11. Fayal, Azores. Depth (?).

* In the preparation of the present list, I was kindly assisted by Dr. F. BRÜGGEMANN, of the British Museum.

Species 7. *Errina labiata*, sp. n., H. N. M., Plate 34, fig. 6. Off the mouth of the Rio de la Plata, 600 fathoms.

(IV.) Genus *Labiopora*, gen. nov., H. N. M.

Species 1. *Labiopora Antarctica*, Plate 2, fig. 5. *Porella Antarctica*, GRAY, Proc. Zool. Soc., 1872, p. 746, pl. lxiv., fig. 4. Antarctic Ocean. Mistaken by GRAY for a Bryozoon allied to *Porella Cervicornis.*

(V.) Genus *Spinipora*, gen. nov., H. N. M.

Species 1. *Spinipora echinata*, sp. n., H. N. M., Plate 34, fig. 2; Plate 35, fig. 4. Off the mouth of the Rio de la Plata, 600 fathoms.

(VI.) Genus *Allopora*, EHRENBERG, Corall. des roth. Meer., p. 147, 1834.

Species 1. *Allopora oculina*, EHRENBERG, *l.c.* Coast of Norway, 50 to 100 fathoms, G. O. SARS, Fork. Selsk. Chr., 1872, p. 115.

Species 2. *Allopora miniata*, POURTALES, 'Deep Sea Corals,' p. 37, pl. iii., figs. 14, 15, 16. Off Florida, 100 to 324 fathoms.

Species 3. *Allopora Californica*, VERRILL, Proc. Essex Institute, iii., p. 37.

Species 4. *Allopora venusta*, VERRILL, Trans. Connect. Acad., i., p. 517.

Species 5. *Allopora nobilis*, KENT, Proc. Zool. Soc., 1871, p. 279, pl. xxv.; = *explanata*, KENT, *l.c.*, p. 250, pl. xxv.; = *Allopora venusta*, VERRILL (?).

Species 6. *Allopora subviolacea*, KENT, Proc. Zool. Soc., 1871, p. 280, pl. xxv.

Species 7. *Allopora profunda*, sp. n., H. N. M., Plate 34, fig. 7. Off the mouth of the Rio de la Plata, 600 fathoms.

Species 8. *Allopora pygmæa*. *Dendracis pygmæa*, RÖMER, Beschreibung der Norddeutschen tertiaren Polyparien; MEYERS, 'Palæontographica,' bd. iv., p. 243, taf. xxxix.; bd. ix., fig. 13, *a*, *b*, *c*. Described as a Bryozoon Fossil in 'Oligocœne' of LATTORF.

Allopora tuberculosa. *Dendracis tuberculosa*, RÖMER, *l.c.*; fossil in 'Oligocœne' of LATTORF.

(VII.) Genus *Stylaster*, GRAY, Zool. Miscell., p. 36, 1831.

Species 1. *Stylaster flabelliformis*, M. EDWARDS and HAIME, Hist. Nat. des Cor., t. ii., p. 129. Isle of Bourbon, 160 fathoms.

Species 2. *Stylaster gracilis*, M. ED. and H., Hist. Nat. des Cor., t. ii., p. 129. Australia.

Species 3. *Stylaster roseus*, M. ED. and H., Hist. Nat. des Cor., t. ii., p. 130. American Ocean; littoral on the Florida reefs, two feet below low water mark; POURTALES, 'Deep Sea Corals,' p. 83.

Species 4. *Stylaster sanguineus*, M. ED. and H., Hist. Nat. des Cor., t. ii., p. 130; Ann. des Sci. Nat., t. xiii., p. 96, pl. 3, fig. 2, 1850. Coast of Australia; New Zealand; Florida, shallow water; POURTALES, 'Deep Sea Corals,' p. 83.

Species 5. *Stylaster gemmascens*, M. ED. and H., Hist. Nat. des Cor., t. ii., p. 131.

Indian Ocean; North Atlantic, 530 fathoms, 'Porcupine,' P. M. DUNCAN, Trans. Zool. Soc., vol. viii., pt. v., p. 332; at great depths in the Foldenfjord, Norway, G. O. SARS, *l.c.*, p. 115.

Species 6. *Stylaster granulosus*, M. ED. and H., Hist. Nat. des Cor., t. ii., p. 131; Ann. des Sci. Nat., 3 ser., t. xiii., p. 97, pl. 3, fig. 3, 1850.

Species 7. *Stylaster bella*, DANA, Zooph., p. 696, pl. 60, fig. 6. *Cyclopora bella*, VERRILL, Proc. Essex Inst., v., p. 38, 1866. Paumotu Archipelago. (Without style?)

Species 8. *Stylaster amphiheloides*, KENT, P. Z. S., 1871, p. 277, with figure.

Species 9. *Stylaster punctatus*, POURTALES, 'Deep Sea Corals,' p. 36; Ill. Cat. Mus. Comp. Zool. Harvard, No. 8, pl. vii., figs. 8, 9. Off Florida, 9 to 315 fathoms.

Species 10. *Stylaster Duchassaingii*, POURTALES, 'Deep Sea Corals,' p. 35; = *Eximius*, KENT, Proc. Zool. Soc., 1871; = *Elegans*, DUCH. and MICH.? Near Tortugas, 43 fathoms; off Point Calvo, Brazil, 400 fathoms, 'Challenger.'

Species 11. *Stylaster filogranus*, POURTALES, 'Deep Sea Corals,' p. 35, pl. v., figs. 13, 14. West of Tortugas.

Species 12. *Stylaster asper*, KENT, Proc. Zool. Soc., 1871, p. 278, with figure.

Species 13. *Stylaster erubescens*, POURTALES, 'Deep Sea Corals,' p. 34, pl. iv., figs. 10 and 11. Off Florida reef, 120 to 324 fathoms.

Species 14. *Stylaster rosso-americanus*, BRANDT, Z. wiss Zool., xxii., p. 292. Name given only; no figure or description.

Species 15. *Stylaster tenuis*, VERRILL, Bull. Mus. Comp. Zool. Cambridge, i., p. 45. No figure.

Species 16. *Stylaster elegans*, VERRILL, Bull. Mus. Comp. Zool. Cambridge, p. 45. No figure.

Species 17. *Stylaster densicaulis*, sp. n., H. N. M., Plate 34, fig. 5. Off the mouth of the Rio de la Plata, 600 fathoms.

Species 18. *Stylaster complanatus*, POURTALES, 'Deep Sea Corals,' p. 36, pl. ii., figs. 16, 17. *Stenohelia complanatea*, KENT, Ann. and Mag. Nat. Hist., Feb. 1870. Off Havana, 270 fathoms; off Sombrero Island, Danish West Indies, 460 fathoms, 'Challenger.'

Species 19. *Stylaster Madeirensis*, JOHNSTON, Proc. Zool. Soc., 1862. *Stenohelia Madeirensis*, KENT, Ann. and Mag. Nat. Hist., 1870, vol. v., p. 120, with figure. Madeira, on long fishing line; off Cape Verde Islands.*

(VIII.) Genus *Astylus*, gen. nov., H. N. M.

Species 1. *Astylus subviridis*, sp. n., H. N. M. Off the Meangis Islands, 500 fathoms.

* See Postscript, p. 503.

(IX.) Genus *Cryptohelia*, M. ED. and H., *l.c.*, p. 127.

Species 1. *Cryptohelia pudica*, M. ED. and H., Ann. des Sci. Nat. 3 ser., t. xiii., fig. 3, pl. 3, fig. 1, 1850; = *Endohelia Japonica* (?), M. ED. and H., Hist. Nat. des Cor., t. ii., p. 128, of which no figure is extant. New Guinea, Japan, Atlantic, West Indies, S. Pacific, Japan, 390 to 1,530 fathoms, 'Challenger;' MOSELEY, Proc. Roy. Soc., No. 170, 1876, p. 548.

Species 2. *Cryptohelia Peircei*, POURTALES, 'Deep Sea Corals,' *l.c.*, p. 37, pl. ii., figs. 18 and 19. Off Havana, &c., 270 to 600 fathoms. = *C. pudica* (?).

(X.) Genus *Distichopora*, LAMARCK, Hist. des Anim. sans Vert., t. ii., p. 198.

Species 1. *Distichopora violacea*, M. ED. and H., Hist. Nat. des Cor., t. iii. p. 451; M. EDWARDS, 'Atlas Regne Animal, Zoophytes,' pl. 85, fig. 4, 4*a*, 4*b*, 4*c*. Island of Timor; Fiji.

Species 2. *Distichopora coccinea*, GRAY, Proc. Zool. Soc., 1860. Abundant at the Marshall Group, Pacific Ocean.

Species 3. *Distichopora nitida*, VERRILL, Bull. Mus. Comp. Zool. Cambridge, i., p. 46.

Species 4. *Distichopora cervina*, POURTALES, 'Deep Sea Corals,' p. 39, *note;* Ill. Cat. Mus. Comp. Zool. Harvard, No. 8, pl. vii., fig. 11. St. Thomas, Danish West Indies.

Distichopora foliacea, POURTALES, 'Deep Sea Corals,' p. 38, pl. iv., figs. 12, 13. Off Florida and Key West, 100 to 262 fathoms.

Species 6. *Distichopora sulcata*, POURTALES, 'Deep Sea Corals,' p. 38, pl. iv., fig. 14, pl. vii., fig. 7. Off Havana, 270 fathoms; off Cuba.

Species 7. *Distichopora barbadensis*, POURTALES, Ill. Cat. Mus. Comp. Zool. Harvard, No. 8, p. 43, pl. vii., fig. 10.

Species 8. *Distichopora rosea*, KENT, Proc. Zool. Soc., 1871. East coast of Australia.

Species 9. *Distichopora antiqua*, DEFRANCE; M. ED. and H., Hist. Nat. des Cor., t. iii., pp. 451, 452. Tertiary fossil at Chaumont and Valmondois.

PEDIGREE OF THE HYDROCORALLINÆ.

The line of descent of the various genera of the Stylasteridæ from a parent form seems to be traceable with especial clearness. All gradations are present by which simple circular mouthed pores sporadically scattered over the corallum become grouped and modified into cyclo-systems of the most symmetrical and complex character. Since styles appear in some genera in the dactylopores as well as in the gastropores, it seems probable that in the ancestral form or Archistylaster styles were present in both forms of pores. If the Milleporidæ prove closely related to the Stylasteridæ when

their gonophores have been investigated, it will follow that the two families have had a common ancestor, and that Hydroids have developed a calcareous support only once in their history and not in two separate instances. This common ancestor may be presumed to have had a hydrosoma composed, as throughout the sub-order Hydrocorallinæ; with its pores sporadic, with tabulæ and without styles, and with two kinds of zooids, with knob-bearing tentacles; with a tendency also of the dactylozooids to form ring-like groups around a gastrozooid.

From this form Archistylaster was developed with a branching corallum; with a strong tendency to assume a flabellate form, and to develop its pores only on one face of the flabellum, or at the sides only of the branches; with its pores sporadic and tabulate, and styles in both forms of them. The dactylozooids of Archistylaster were devoid of the knobbed tentacles, these were, however, retained by the gastrozooid. The gonangia were included in hollows in the corallum.

In *Sporadopora*, the most ancestral *Stylasterid* at present known, the styles of the dactylopores have disappeared, and they only reappear apparently by reversion in *Allopora* and *Stylaster*. Rudimentary tabula are present in *Sporadopora* and *Pliobothrus*, but disappear in succeeding genera. In *Pliobothrus* the margins of the dac tylopore mouths are raised up and prolonged into small tubuli, and the genus would thus lead to *Errina*, where the tubuli become nariform, were it not that in *Pliobothrus* the style of the gastrozooid is lost, and that the gastrozooid is devoid of tentacles and flask-shaped: a condition occurring again only in the most highly specialized members of the family *Astylus* and *Cryptohelia*.

Two separate modifications of the nariform projections of *Errina* are presented by *Porella* and *Spinipora*, in both which genera further complication ensues by the differentiation of two kinds of dactylozooids.

The process of the formation of cyclo-systems is seen in all stages in different parts of the surface of the single species *Allopora subviolacea*, as will be seen by reference to SAVILE KENT's figures,* or to the diagrams given on Plate 44 of the present Memoir, figs. 10, 11, and 12. In this coral five or six dactylopores are grouped in a circle around a single centrally placed gastropore. In some groups all the pores are simply circular (fig. 10). In others, shallow grooves, often only just indicated, lead radially from the dactylopores towards the gastropore. In others, these grooves are well marked and deep, and a complete cyclo-system is formed. It appears probable that this condition has been brought about by the continual bending inwards of the dactylopores to convey food to the gastropore. The grooves have been the result of the attempts of these zooids to reach the gastrozooid when further and further retracted. Thus, in most *Alloporas* and all *Stylasters*, all the pores have come to form regular cyclo-systems, in which the mouths of the dactylopores are drawn out into elongate chambers, and their tubular prolongations reduced to mere rudiments in many cases. At a very short distance below the surface in *Allopora subviolacea*

* Proc. Zool. Soc., 1871, Plate 25, fig. 2A.

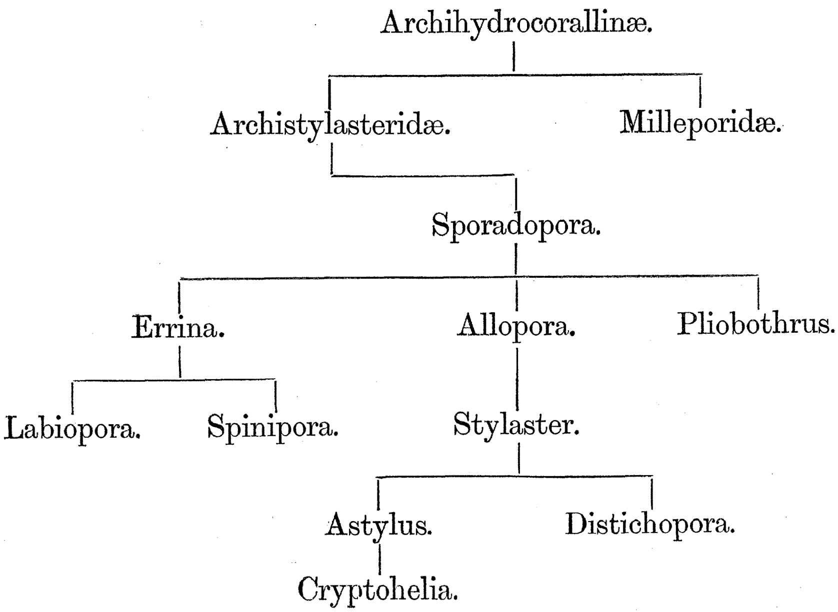
the pores are found to be in all the systems still entirely independent (fig. 12), and this condition is maintained at greater depths in all *Stylasters*.

In *Astylus* and *Cryptohelia* the tentacular zooids have come to place themselves out of harms way, not by retraction within their pores, but by being doubled down within the gastropore, which is divided in two chambers. They are thus enabled to maintain a greater length than they could were they obliged to be retracted within their own pores, and they thus obtain a longer reach.

Allopora Madeirensis (JOHNSTON) forms a gradation towards *Astylus* and *Cryptohelia* in that it has its cyclo-systems all turned towards one face of the flabellum, but differs in having styles in the gastropores. The lid of *Cryptohelia* may be a further modification of the tongue-like process in the gastropore of *Astylus*, or the reverse may be the case, the structure in *Astylus* being a reduction of that in *Cryptohelia*. If the former view be correct, then the tongue-like process represents the scale often present in *Errina* as a covering of the gastropore, and the lid of *Cryptohelia* is a further modification of this which is increased in dimensions and altered so as to cover an entire cyclo-system. It is to be noted that in becoming so remarkably modified into elongate slit-like cavities, the dactylopores of Stylasteridæ, with cyclo-systems, follow an ancestral tendency to modification, for these elongate pores are, taken separately, closely similar in form to the nariform dactylopores of *Errina* and its allies. They only have the lips of all the projections directed radially outwards.

From the appearance of rudimentary cyclo-systems in the pore rows of *Distichopora*, it seems probable that this genus represents an extreme modification of those *Stylasters* in which the systems are confined to the sides of the branches of the flabellum, closely opposed cyclo-systems having degenerated into a triple row of pores, in which the gastropores occupy the central row of the three (Plate 35, fig. 16).

The phylum of the Hydrocorallinæ may, therefore, be represented as follows :—



DISTRIBUTION IN SPACE AND TIME OF THE STYLASTERIDÆ.

The Stylasteridæ range all over the world, and exist at all depths from shallow water on the coasts to great depths in the open oceans. Two species occur close at home off the coast of Norway, viz., *Allopora oculina*, obtained by G. O. SARS in from 50 to 100 fathoms, and *Stylaster gemmascens*, which occurs at great depths in the Foldenfjord. The same species, originally described from the Indian Ocean, occurs in the North Atlantic in 530 fathoms. *Stylaster roseus* is abundant in a depth of two feet below low water mark on the coast of Cuba,* and *Stylaster punctatus* occurs in nine fathoms off Florida.† *Stylaster sanguineus* occurs at Florida and New Zealand, and I dredged a closely allied, if not the same, species in two fathoms on the Philippine coast. *Cryptohelia* came originally from New Guinea. It was dredged by the 'Challenger' in all parts of the world, and up to a depth of 1,530 fathoms. Some genera, as *Sporadopora* and *Spinipora*, are as yet known only from one locality, but no doubt their range will be extended by further dredging.

No Stylasteridæ are known from geological deposits older than the tertiary; indeed, until now a single species only of one genus, *Distichopora*, has been described as occurring in the fossil condition, viz., *Distichopora antiqua* from tertiary beds at Chaumont, in France. Fossil Stylasteridæ have, however, been confounded with Bryozoa, just as GRAY confounded the recent *Labiopora* with *Porella*. Two species of a genus termed *Dendracis*, figured by FR. A. RÖMER,‡ which occur in the Oligocœne of LATTORF, are evidently *Stylasterids*, and probably members of the genus *Allopora*, in which they have been introduced in the present paper in the list of species, as *Allopora tuberculosa* and *pygmæa*. Some calcareous structures from the *Cenoman* (=middle chalk) figured by the RITTER VON REUSS, in the same publication as that containing RÖMER'S paper,§ and placed with Heteroporella as Bryozoa, may very possibly prove allied to *Pliobothrus* on further examination. *Thalamipora*,‖ figured by the same author in the same paper, seems to be a *Stylasterid* bearing large female ampullæ, present in abundance and agglomerated, the pore systems being all at the ends of the branches, whilst a deep central gastropore in each system is surrounded by a circlet of from five to seven dactylopores. VON REUSS is in great doubt as to the affinities of this form, but concludes that it is a chambered foraminifer. It is probable that now that their importance and structure is more fully known, abundance of fossil Stylasterida will be made out. The structure of the Stylasteridæ appears to throw no light upon that of the Graptolites.

EXETER COLLEGE, OXFORD, *January* 21*st*, 1878.

* POURTALES' 'Deep Sea Corals,' p. 83.

† POURTALES, *l.c.*, p. 36.

‡ FR. A. RÖMER. 'Beschreibung der Norddeutschen tertiaren Polyparien.' MEYER'S 'Palæontographica,' bd. ix., p. 243, taf. xxxix., fig. 15, *a*, *b*, *c*.

§ RITTER VON REUSS. Die Bryozoen des unteren PLÄNER'S 'Palæontographica,' bd. xx., taf. xxxiii,

‖ *Ibid.*, p. 138.

Description of Plates.

Note.—The whole of the figures appended to the present paper relating to soft structures have been prepared so as to represent by means of ideal sections the conclusions as to structure arrived at by prolonged study of long series of preparations. It would have been impossible to give *facsimile* drawings of all the preparations from the study of which facts of importance were arrived at, and thus to lay the evidence before the reader in a pictorial form. The practice of illustrating scientific papers treating of minute anatomy by figures which profess to be *facsimiles* of preparations, and in which often all defects due to breakage of sections or obliquity of the line of cutting are reproduced, seems to me to be much to be deplored, and only tends to create confusion and needlessly increase the number of figures without in any way enhancing the credit which will be given to the results. The drawings can never be so accurate as to stand in the place of preparations. They will always represent to some extent the author's views as to what is to be observed in the preparations. It seems far better that in the modern stage of the science of finer anatomy, drawings should represent the results attained, in as complete and concise a form as can be devised, so as to convey these results to others almost at a glance, if possible.

In the present figures all the histological details, as well as the major features of the structures represented, *have been drawn accurately to scale by means of a series of micrometic measurements.* The amount of magnification in diameters is given at the bottom of each plate or figure. Since in the majority of the plates ideal sections through complex canal meshworks are represented, the canals composing the meshworks are necessarily shown as cut open in all directions.

PLATE 34.

Drawings of the Coralla of several species of Stylasteridæ of which the corresponding soft tissues are described in the present paper.

Fig. 1. *Sporadopora dichotoma.* Young vigorous specimen which was obtained in the living condition. Natural size.

Fig. 2. *Sporadopora dichotoma.* Older specimen reduced in size to one-half of its dimensions to show the method of branching in the more fully grown specimens.

Fig. 3. *Spinipora echinata.* Enlarged to twice the natural size.

Fig. 4. *Astylus subviridis.* Several of the branches of the specimen are broken off. Natural size.

Fig. 5. *Stylaster densicaulis.* Portions of a corallum of the natural size.

Fig. 5A. Portion of a tip of a branch enlarged.

Fig. 6. *Allopora profunda.* Natural size.

Fig. 6A. Portion of same enlarged.

Fig. 7. *Errina labiata.* Natural size. The form of the stem of the corallum is much distorted in places by parasitic annelids.

Fig. 7A. Portion of a branch enlarged.

PLATE 35.

Fig. 1. Section vertical to the surface of the corallum of *Sporadopora dichotoma* showing the structure of the hard parts. The general mass is seen to be excessively porous in appearance, being traversed in all directions by canals which, in the recent condition of the coral, contain the elements of the cœnosarcal meshwork. The perforations and canals are smaller towards the surface of the corallum, and coarser in the deeper regions. The cavities in the mass occupied by the zooids and gonophores are excavated within it, and have their walls freely perforated, like the remainder of the corallum.

G Z. Mouth of a gastropore.

S. Style terminating above in a delicate brush of spicules.

T. Thin calcareous tabula.

D Z, D Z. Pores of large and small dactylozooids.

G. Cavity or ampulla occupied by a male gonophore, which is in this genus entirely sunken beneath the surface of the corallum.

Fig. 2. View of the surface of the corallum of *Sporadopora dichotoma* as seen by reflected light.

G Z, G Z. Mouths of gastropores.

D Z, D Z. Mouths of dactylopores.

G, G, G. Shallow depressions in which the ampullæ open to the surface.

Fig. 3. Portion of the corallum forming a single calicular system of *Stylaster densicaulis* laid open by a vertical incision in order to show the arrangement of the hard parts, and enlarged.

G Z. Gastropore.

S. Style of the gastrozooid.

A. Circlet of small rough projections of the corallum, which stand out from the wall of the gastropore just above the top of the style.

D Z, D Z. Dactylopores of the cyclo-system.

P. Walls of the corallum separating the adjacent dactylopores from one another, the pseudosepta of the cyclo-system.

S′. Style of a dactylozooid. This is seen adhering to the outer wall of one of the dactylopores, which is laid completely open in order to show it *in situ.*

Fig. 4. Portion of the corallum of *Spinipora echinata* enlarged to show its outward form. The corallum is covered with long grooved spines, which carry the larger dactylozooids. On the sides of these spines, and about their bases, are numerous simple or slightly lipped smaller pores, occupied by a smaller form of dactylozooid. Deeper in between the bases of the spines lie the pores of the gastrozooids, provided each with a style.

D Z, D Z. Pores of the larger dactylozooids, appearing as grooves in the long projecting spines.

D Z′, D Z′. Pores of the smaller dactylozooids.

G Z, G Z. Pores of the gastrozooids.

Fig. 5. Portion of the corallum of *Labiopora Antarctica* much enlarged. From a drawing by Mr. CHARLES STEWART, F.L.S.

G Z, G Z. Pores of gastrozooids with their styles just visible in their depths.

D Z, D Z. Pores of larger dactylozooids.

D Z′, D Z′. Pores of dactylozooids of the smaller kind.

Fig. 6. View of one of the inner surfaces of a fragment of the corallum of *Distichopora coccinea*, which has been split in half through the line formed by the pores of the gastrozooids; showing the arrangement of these pores, and their very long styles.

G Z, G Z. Pores of gastrozooids.

G Z′. Young similar pore which has as yet little depth.

S, S, S. Styles; that on the extreme left remarkably long.

Fig. 7. Somewhat diagrammatic view of a zooid system of *Cryptohelia pudica*, divided vertically in half by a section passing through the axis and in the direction of the length of the branch on which the system is situate. The dotted areas indicate cut surfaces of calcareous substance, the structure of which is not filled in in the drawing. The gastropore consists of two portions, an upper and lower, separated from one another by a circular constricted aperture. The wall of the upper portion ends below in a thin incurved border bounding the circular aperture, and from the border behind this wall all round a narrowed prolongation of the lower chamber of the gastropore passes up, and leads above by a series of offsets to the lower terminations of the tubular portions of the dactylopores, conveying, in the recent condition of the coral, the main canals springing from the gastropore. The support of the lid of the pore system sends a stout prolongation downwards to fuse with the wall of the upper chamber of the gastropore.

G P. Upper chamber of the gastropore.

G P′. Lower chamber of the gastropore.

D P, D P. Dactylopores.

C. Space behind the wall of the upper gastropore chamber leading to the dactylopore tubules.

L. Lid covering the cyclo-system.

Fig. 8. Pore system of *Astylus subviridis* laid open by a vertical incision through the axis and in the direction of the length of the supporting branch.

G P. Upper chamber of the gastropore.

G P′. Lower chamber of the gastropore.

B. Tongue-like process of the lower border of the wall of the upper chamber of the gastropore, which projecting horizontally in the direction, in each system, of the tips of the branches, converts the aperture leading between the two chambers into the form of a horseshoe.

A. Base of the tongue-like process and part of the wall of the upper chamber cut through.

C C. Space behind the wall of the upper gastropore chamber, leading, as in the last figure, to the dactylopores.

G, G. Ampullæ.

Figs. 9–16. Diagrammatic representations of the arrangements of the gastropores and dactylopores in the several genera of Stylasteridæ, to show the manner in which cyclo-systems and their pseudosepta have become developed in this family.

The following letters apply similarly throughout the series.

G Z. Gastropore. S. Its style.

D Z. Dactylopore.

Fig. 9. *Sporadopora dichotoma.* The pores of both kinds are irregularly scattered over the surface of the corallum.

Fig. 10. *Allopora nobilis.* A number of dactylopores are grouped in a circle around a single centrally-placed gastropore.

Fig. 11. A system of pores from another part of the same specimen of *Allopora nobilis.* Shallow grooves run from the central gastropore to the encircling dactylopores, a cyclo-system being thus commenced.

Fig. 12. Horizontal section through the foregoing group at a slight depth from the surface to show the existence of styles in the pores of the dactylozooids.

Fig. 13. *Allopora profunda.* The connecting grooves between the pores of the cyclo-system are deeper. The system is regular, and the interval between the dactylopores have all the appearance of septa.

Fig. 14. *Allopora mineacea.* (Copied from POURTALES 'Deep Sea Corals,' plate 3, fig. 16.) Here the styles of the dactylozooids are brush-like in form, just like those of the gastrozooids.

Fig. 15. *Astylus subviridis.* There are no styles present in either kind of pore. The pseudoseptal system is complete. The open mouths of the tubular con-

tinuations of the dactylopores appear as a circlet of circular openings at the bottoms of the wide pseudo-interseptal spaces. The gastropore has two mouths, an upper circular and wider one, and a deeper constricted opening, which is rendered horseshoe-shaped by the projecting tongue of calcareous matter B.

Fig. 16. *Distichopora coccinea.* The pores are entirely confined to the central lines of the sides of the branches of the flabelliform coral. The pores here occur in regular straight rows. The gastropores form a median row, and on each side of this is a single row of dactylopores, the mouths of which are elongate in form with their longer axes directed towards the gastropores.

PLATE 36.

Section vertical to the external surface of the decalcified living lamina of *Sporadopora dichotoma.*

The main mass is seen to be composed of a network of ramifying and freely anastomosing canals. The canals are of larger diameter towards the base of the section, where they are continuous with the body cavities of the zooids; but in the most inferior region they are again smaller, being here somewhat atrophied and effete. Towards the outer surface of the coral the canals are of smaller diameter and enclose smaller interspaces than the larger deeper canals. The interspaces throughout the meshwork are, in the recent condition of the coral, filled by the calcareous corallum.

Lying in special cavities of the meshwork are seen a gastrozooid and two dactylozooids in the retracted condition, together with two sets of male gonophores and three nematophores. The calcareous style of the gastrozooid is introduced in order to show the position which it occupies in the retracted condition of the zooid.

G Z. External opening of the sac of a retracted gastrozooid.

O. Mouth of the gastrozooid.

S. Gastric cavity lined in its upper part by large elongate ovoid gastric cells; in its lower, by ordinary endoderm cells.

T. One of the tentacles of the zooid, of which a pair are seen in section.

M. Longitudinal muscular layer of the zooid. The muscles are continued down on to the four main cœnosarcal canals leading from the base of the zooid.

E. Ectoderm layer of the zooid.

C. Cavity of one of the four large canals into which the zooid cavity divides at its base in order to become continuous with the canal system of the cœnosarc. This canal is here shown as cut open, and is seen to be lined with endoderm cells, the layer of which is continuous with that lining the zooid cavity.

S′. The calcareous style, here introduced to show the position which it occupies

within the cavity of the zooid in the retracted condition of the latter. It is covered by a layer of ectoderm, and the endoderm lining layer of the zooid cavity is reflected over it.

F, F. Walls of the sacs of the zooids.

D Z, D Z. External openings of the sacs of two retracted dactylozooids, one of which is very small, the other of the largest size occurring.

B. Body cavity of the larger dactylozooid. In this zooid the ectoderm, E, is thrown into a series of folds in the retracted condition of the zooid. It presents on its outer surface a continuous layer of nematocysts. The zooid cavity is lined by a thick layer of endoderm. The zooid is attached to the side of the base of its containing sac, and is thus bent upon itself somewhat at its lower region.

R. Retractor muscles, continuations on to the main basal canal of the zooid of the longitudinal muscular layer, which is seen in section in the upper portion of the zooid.

N, N. Nematophores.

D. Surface layer of the ectoderm.

G, G′. Male gonophores. Those on the right seen in complete section, that on the left with its sac only opened, the generative masses being left intact. In G a ripe male sac filled with mature spermatozoa is seen situate nearest the surface of the coral, and beneath is an immature gonophore with its centrally placed spadix of endoderm. The axes of the two generative masses not lying in the same plane, the spadix is not seen in the upper riper sac, which is not divided by the section through the axis.

X, X. Spaces between the branches of the cœnosarcal network in the region immediately adjoining the sac of the zooid, where these branches have a peculiarly radiate arrangement, called here "inter-radial spaces."

A, A. Slips of fine membrane attached to the radial offsets.

PLATE 37.

Section vertical to the surface of a portion of a decalcified female stock of *Errina labiata,* showing the form and dispositions of the zooids and gonophores. The meshes of the cœnosarcal network are, as in *Sporadopora,* closer and smaller in the more superficial than in the deeper regions of the coral. The zooids are all inclined towards the tip of the branch of the coral.

D Z, D Z, D Z. Dactylozooids. In two of these the sac or lining membrane of the pore is shown as cut open, in order to exhibit its relations to the contained and partly retracted zooid.

D. A dactylozooid in process of development as a bud.

G Z. Mouth of the sac of a gastrozooid, which sac is cut open in order to show the contained zooid.

T. Tentacle of the zooid. O. Its mouth.

C. Gastric cavity. St. Style.

X, X. Spaces in the cœnosarcal network, homologous with the inter-radial spaces in *Sporadopora*.

Three gonophores are represented in the figure, showing three successive stages of development, the central one of the three being most advanced.

O V. Ovum. S. Spadix shown in section.

In the central gonophore the planula which is shown in section is doubled up somewhat, being fully developed, and ready to escape.

E C. Ectoderm of the planula.

E. Endoderm.

B. Membrane immediately covering the planula where not in contact with the spadix.

A. Surface layer of endoderm reflected over the wall of the ampulla.

In the remaining gonophore the developing planula and its spadix are shown entire, the surface membrane only covering the wall of the ampulla being seen in section.

P. Planula.

S′. Spadix showing the manner in which it forms a network and becomes digitate or fringed towards its outer margin.

N, N, N. Nematophores.

PLATE 38.

Longitudinal section through the axis of a branch of a stock of *Spinipora echinata*, decalcified, showing the cœnosarcal network and the surface membrane, with the various zooids in their mutual relations.

D Z, D Z, D Z. Indicate some of the larger dactylozooids, of which many are shown. These larger dactylozooids are situate near the extremities of spine-like processes of the corallum, represented here by the corresponding laminæ of soft tissue, extensions of the surface layer of ectoderm. The processes are grooved on the side lying towards the tips of the coral branches, for the reception of the zooids, which are all shown here as much contracted.

A, A. Examples of the fusing of two adjacent processes.

B, B. Processes represented as cut open in order to show the disposition of the bases of the dactylozooids within, and their connexion with the cœnosarcal network.

D, D. Small dactylozooids protruded from simple pores near the bases of the spine-like processes.

G Z, G Z, G Z. Gastrozooids seen; some retracted within their sacs, others partially

expanded. They have each a well-developed hypostome and six tentacles, and join the cœnosarcal network at their lower extremities by means of four main canals.

PLATE 39.

Vertical section, through one of the cyclo-systems of zooids of a male stock of *Allopora profunda* decalcified. Right and left of the centrally placed system seen in section, are represented parts of two other similar systems, which are shown as seen from their outer aspects by transmitted light, and not in section.

D Z, D Z. Dactylozooids retracted. Arranged in a circlet around the mouth of the pore of the gastrozooid.

P, P. Sacs, or soft tissue walls of the pores, of dactylozooids, separated from one another by pseudosepta. Two of these sacs are shown cut open to display the attachment of the bases of the zooids within them.

G Z. Sac of the gastrozooid, between which and the place occupied in the recent condition by the wall of the pore of the zooid is a wide space, traversed by radially disposed offsets of the cœnosarcal network, R R.

X, X. Interradial spaces between these effects.

Z. Gastrozooid with twelve tentacles, disposed in a single whorl, and an almost hemispherical hypostome. Large canals spring from the base of the zooid, and form communications with the basal canals of adjacent zooid cyclo-systems.

D Z′, D Z′. Dactylozooids in their sheaths seen from behind within the adjacent zooid cyclo-systems.

G, G, G. Gonophores. The sac of one of these is cut open to show the ovoid male generative masses and their spadices lying within.

PLATE 40.

Shows the structure of *Stylaster densicaulis* as seen in the decalcified condition. The cylindrical masses formed by three cyclo-systems of zooids are shown cut open, so as to demonstrate the arrangements of the zooids and cœnosarcal ramifications within them. The positions of the two additional cyclo-systems are indicated by outline. In the centrally placed cyclo-system the entire ramifications of the cœnosarcal canals are shown.

In the system displayed on the left side of the figure, the wall of the sac of the gastrozooid, and the superficial network beneath it, are removed, in order to show the connexions of the bases of the dactylozooids with the deeper canals.

In the system shown on the right in the figure, the details of the connexion of the base of the gastrozooid with the cœnosarcal canals only are given.

The gonophores are seen through the superficial networks existing in the walls of the ampulla.

Z, Z. Gastrozooids situate one at the base of each cyclo-system.

D Z, D Z. Dactylozooids. G G. Male gonophores.

N, N. Nematophores.

A. Reflection of the surface layer of the ectoderm forming the sac of the gastrozooid and lining the gastropore. The sac-wall is very thin and transparent. Curved lines crossing the dactylozooids transversely about their middles, in the central cyclo-system shown in the figure, mark the lower and innermost margins of the dactylozooid sacs, where these become continuous with the sac of the gastrozooid. In the cyclo-system shown on the left in the figure, the sac of the gastrozooid and the portions of the sacs of the dactylozooids fronting the gastropore are represented as removed, together with the superficial network of the cœnosarc immediately beneath them, in order to display the connexions of the deeper systems of large main canals which connects the zooids of the cyclo-system directly with one another.

B, B. Spaces in this deeper system of main canals.

PLATE 41.

Fig. 1. Shows the structure of the soft parts of *Astylus subviridis*. A single cyclo-system, divided in half, together with portions of the branch on which it rests, is represented in the figure. At the lower part of the figure the large cœnosarcal canals occupying the axis of the branch are seen passing right and left. These place the cyclo-system in connexion with the other adjacent cyclo-systems on the branches of the coral. The gastrozooid, which is devoid of tentacles, is seen resting retracted at the bottom of its sac (A).

The base of the gastrozooid is rounded and basin-shaped. Large canals spring from the margin of the basin to join the cœnosarcal meshwork, and carry into the general circulation the products of digestion; but none such arise from the direct under surface of the zooid.

G Z. Cavity of the upper chamber of the sac of the gastrozooid.

G Z′. Cavity of the lower chamber of the sac of the gastrozooid.

Z. The gastrozooid.

O. The mouth appearing as a crucial slit with symmetrically-arranged elongate gastric cells.

B. Tongue-like process of the wall of the gastropore which projects forwards horizontally over the summit of the retracted gastrozooid at a point where there is a sudden constriction of the pore. The projection of the tongue forms the opening of the constriction into a horseshoe-shaped aperture.

D Z, D Z. Dactylozooids retracted into their pores, and doubled down into the mouth of the sac of the gastrozooid.

P, P. Mouths of the sacs of the dactylozooids, occupying in the recent condition the dactylopores. These mouths are in this species elongate in outline, and simulate the interseptal spaces of anthozoan corals.

G, G. Male gonophores in special sacs, and springing from branches of the cœnosarcal network.

C. Deep axial cœnosarcal canals, of the branches of the coral on which the cyclo-systems rest.

S, S. Superficial networks of finer canals lying immediately beneath the superficial external layer of the ectoderm.

R, R. Radially disposed offsets of the cœnosarcal network springing from the sac of the gastrozooid.

X, X. Inter-radial spaces (*cf.* Plate 39, R R, X X).

Fig. 2. Shows the structure of the soft parts of a female stock of *Pliobothrus symmetricus*. The structure is exposed by means of a section vertical to the surface of the coral. The mass of the coral, the hard skeleton being removed, is composed of the usual cœnosarcal meshwork which is bounded externally by a continuous surface layer of ectoderm containing large nematocysts. Embedded in the meshwork are two kinds of zooids and the gonophores. The sac or sheath of the single gastrozooid shown in the figure is opened in order to display the zooid within.

Z. Gastrozooid. S placed in the neck of the sac of the gastrozooid.

X, X. Spaces in the meshwork corresponding to the inter-radial spaces in *Sporadopora*. Here the radial arrangement is hardly to be discerned.

D Z, D Z. Dactylozooids. The transverse lines drawn incircling the bodies of these zooids indicate folds into which the bodies of the zooids are thrown in extreme retraction.

O. Rests on a cup-shaped spadix, bearing a mature unimpregnated ovum, containing a germinal vesicle.

G. Impregnated ovum in an early stage of development.

P. Planula nearly mature contained within its sac.

Fig. 3. Male gonophore of *Pliobothrus symmetricus*.

PLATE 42.

Shows the structure of the soft parts of the *Cryptohelia pudica* displayed by decalcification.

The figure represents two cyclo-systems of zooids, together with the short branch of the coral connecting them. The cyclo-system on the left hand in the figure is represented as laid open by a vertical cut passing through the axis of the gastrozooid,

and the disposition of the several parts is here shown in detail. The breeding sac of this system is in an early stage of development. The dactylozooids are shown as protruded.

In the cyclo-system on the right hand the superficial membrane is mostly left entire, and the cyclo-system is not opened, but a view is obtained into the open mouth of the gastropore showing the dactylozooids doubled down into it. The breeding sac is here shown in its fullest activity, and containing a planula ready for emergence. The sac is represented as cut open in order to exhibit the contained structures.

G Z. Cavity of the sac of the gastrozooid.

O. Mouth of the gastrozooid, which is devoid of tentacles.

S. Digestive cavity of the zooid lined with elongate gastric cells.

M. Longitudinal muscular layer of the zooid. As in *Astylus subviridis*, numerous canals pass off from the margin of the rounded base of the zooid, but none from the under surface of the base itself.

D Z, D Z. Dactylozooids.

P, P. Mouths of the sacs of the dactylozooids.

L, L. Peculiar protective laminæ, or lids, folded in this genus in front of the openings of the cyclo-systems. In the case of the left hand system of the figure the ramifications of the superficial network of the cœnosarc, prolonged into the body of the lid, are shown, and also the nematophores with which the lid is provided. In the other system represented, the superficial layer of the cœnosarc is shown intact. The downward prolongation of the base of the lid, which should pass between the sac of the gastrozooid and its main upward canals, is omitted for clearness sake.

N, N. Nematophores. One of these is situate at the outer margin of the cyclo-system in each interval between the sacs of the dactylozooids.

G. Female gonophore contained, with two others in earlier stages, in a special brood-sac as yet not far advanced in development.

G′. Brood-sac in full development containing ova and embryos in all stages of development.

Ov, Ov′. Fertilized ova in advancing stages of development and cell multiplication.

P 1. Early stage of planula embryo. The thin ectoderm appears as just differentiated.

P 2. Planula fully advanced with more fully developed and thickened ectoderm.

P 3. Fully developed planula with highly differentiated ectoderm containing nematocysts, &c.

PLATE 43.

Shows certain details of structure of the soft parts of *Sporadopora dichotoma* and of *Astylus subviridis*.

Fig. 1. Section transverse to the longitudinal axis of a gastrozooid of *Sporadopora*

dichotoma, taken at a point above the junction of the tentacles with the body of the zooid. Hence the tentacles appear in this section as isolated structures.

S. Digestive cavity.

G. Large gastric cells with their nuclei.

M. Muscular layer and basement membrane at this region of the zooid comparatively little developed. Shows longitudinal fibres cut across.

E. Ectoderm here containing very few nematocysts but numerous nuclei.

T, T. Tentacles in section.

Fig. 2. Section transverse to the longitudinal axis of a large dactylozooid of *Sporadopora dichotoma*.

B. Body cavity of the zooid.

L. Endoderm consisting of a double layer of large transparent nucleated cells with smaller cells on its inner aspect.

M. Muscular layer and basement membrane showing a series of stout isolated fibres.

E. Ectoderm. This forms a thick layer which contains numerous nuclei and developing nematocysts, and at its outer surface is protected by a continuous layer, one cell deep, of nematocysts of the smaller form.

Fig. 3. Section parallel to the surface of the soft tissues of *Sporadopora dichotoma* taken at a very slight depth just beneath the superficial layer of the ectoderm. The soft structures about the mouths of the sacs of a gastrozooid and a contiguous dactylozooid are shown, and the radiate arrangement of the cœnosarcal tubes around the sac openings.

G Z. Lumen of the upper part of the sac of a gastrozooid.

R M. Wall of the sac containing radially disposed fusiform muscular elements which are prolonged outwards on to the radial offsets of the cœnosarc. The wall of the sac is lined internally by small rounded cells.

R, R. Radially disposed offsets of the cœnosarcal meshwork which pass inwards to join the outer surface of the sac all round.

A, A. Slips of fine transparent membrane containing nuclei attached to the radial offsets.

X, X. Inter-radial spaces.

D Z. Lumen of the sac of a dactylozooid with somewhat similar arrangement to that in the case of the gastrozooid.

N, N. Nematophores. Closely packed batteries of the larger form of nematocysts, which are here seen in transverse section.

Fig. 4. Tentacle of a gastrozooid of *Sporadopora dichotoma*, from a sketch made of the animal in the fresh condition.

K. Elongate knoblike tip of the tentacle thickly beset with nematocysts of the smaller form.

E. Ectoderm.

Tr. "Apparent septa."

C. Axial cavity of the tentacle.

Fig. 5. Section transverse to the axis of the zooid of a segment of the body wall of a gastrozooid of *Sporadopora dichotoma*, taken near the lower region of the zooid.

S. Wall of the sac of the zooid seen in section.

E. Ectoderm.

M. Muscular and basement layer showing a series of stout longitudinal slips in section.

L. Layer of transparent endodermal cells, the representatives in this region of the larger elongate gastric cells which exist higher up in the body cavity.

E N. Pigmented endoderm cells, such as line the canals of the cœnosarcal meshwork.

Fig. 6. Portion of the muscular layer of the body wall of a gastrozooid of *Sporadopora dichotoma* viewed from its inner surface. The layer is seen to be composed of a closely set series of longitudinal narrow muscular slips. The layer is crossed by fine transverse striations, the nature of which was not determined, no definite circular muscular fibres having been detected in the zooids. The striations probably are caused by wrinkles in the basement membrane.

Fig. 7. One of the longitudinal muscular slips of the last figure, much enlarged, to show that it is composed of fusiform nucleate closely-packed elements.*

Fig. 8. These fusiform muscular elements still more magnified.

Fig. 9. Nematocysts of *Sporadopora dichotoma*.

a. Elongate form of nematocyst occurring only in the nematophores and surface layer of the ectoderm, and that investing the more superficial cœnosarcal canals.

a'. The same, with the thread protruded.

b. Smaller form of nematocyst, abundant in the tentacles of the gastrozooids, ectoderm of the dactylozooids, and other regions.

b'. The same, with the thread protruded.

c. *d*. *e*. Successive stages in the development of the smaller form of nematocyst.

* N.B.—By error in plate, marked + 100 instead of + 600.

Fig. 10. Section through a portion of a male gonophore sac of *Astylus subviridis*, showing various stages in the development of spermatozoa (*cf.* Plate 41, G.)

S. Wall of the gonophore sac, a reflection of the ectoderm.

S′. Reflection of the same over one of the lobules of the generative mass.

S″. Thin membrane enclosing the spermatozoa within the lobule.

E N. Endoderm cells. These apparently continuous with those forming the lining of the canals of the cœnosarcal meshwork, X X, expand into a centrally-placed mass from which the lobules spring. The lobules as they approach maturity become attached by narrow pedicles.

a. One of the earliest stages in the development of a lobule.

b. More advanced stage showing a multiplication of the contained cells.

c. Further stage with more numerous and smaller spermatogenous cells.

d. Further stage. The character of the contained cells is changed.

e. More advanced stage.

f. g. h. Further stages. *h. h.* Containing mature spermatozoa.

Fig. 11. Successive stages in the development of the spermatozoa of *Astylus subviridis.*

a. Ordinary endoderm cell.

d. The opaque constituents of the cell are entirely condensed into the nucleus.

e. Smaller similar cell produced by division of the above.

e′. f. g. Successive stages showing the development of the spermatozoon from the nucleus.

Fig. 12. Ripe spermatozoa of *Sporadopora dichotoma* as seen in the living condition. A vesicle is present situate between the head and commencement of the filament of the spermatozoon. In the case of the lower spermatozoon of the three figured, the head, which is flattened, is viewed edge on.

PLATE 44.

Fig. 1. Gastrozooid of *Cryptohelia pudica*, removed from its sac, and viewed directly from above so as to be much foreshortened in the drawing.

A. The cruciform mouth, with a lining of elongate gastric cells.

B. Main canals given off from the outer margin of the base of the zooid all round. These soon branch, and join by their offsets the general cœnosarcal meshwork.

The zooid is seen to be devoid of tentacles.

Fig. 2. Part of a section, cut at right angles to the axis, of a cyclo-system of *Astylus subviridis,* showing the structures surrounding the pores of the dactylozooids at the margin of the system.

D. Transverse section of a dactylozooid, showing ectoderm, endoderm, and intermediate muscular layer.

P. Cavity of the sac of the zooid, occupying, in the recent condition, the wide upper chamber of the dactylopore.

D′. Another dactylozooid, seen in section. The zooid, being doubled back into the outer part of the dactylopore where cut in section, its cavity appears partly as a lumen at T′, partly as an elongate hollowed area, in which are seen the strong longitudinal retractor muscles of the zooid.

C, C. Tortuous canals, offsets of the general cœnosarcal meshwork, which pass radially outwards in the substance of the pseudosepta, between the pores of the dactylozooids. The canals ramify as they reach the outer margin of the calicular system, and join by their branches the superficial outer network of the cœnosarc.

N. Large ovoid nematophore, full of closely-packed nematocysts. One such nematophore is present in each interval between the outer margins of the mouths of the pores of the dactylozooids.

Fig. 3. Earliest stage in the development of the ovum in *Cryptohelia pudica.*

A bud-like mass of endoderm cells is gathered together within an offset of a branch of the cœnosarcal meshwork.

Fig. 4. The same, in a further stage of development.

O. Ovum, with germinal vesicle and spot.

S. Spadix, composed of endoderm cells.

E. Thin layer of the ectoderm, continuous with that covering the spadix, and investing the free surface of the ovum.

Fig. 5. Section through a planula of *Cryptohelia pudica*, in a very early stage.

E. Ectoderm.

En. Endoderm.

Fig. 6. Portion of a planula of *Cryptohelia pudica,* in a more advanced stage than the foregoing, viewed from the outer surface.

E. Ectoderm, transparent, and showing a demarcation into the polygonal areas.

En. Endoderm cells, seen through the transparent ectoderm.

Fig. 7. Section vertical to the surface of a planula of *Cryptohelia pudica* when fully developed and ready for exit from the broad sac.

En. Endoderm, composed mainly of oily globules.

E. Ectoderm, which is extremely thick, and for the most part transparent and gelatinous in appearance.

N, N. Nematocysts.

A. Tracts composed of small, rounded, non-transparent ectodermal elements, which run from the endoderm region at intervals ver-

tically, towards the surface of the planula. In these tracts the nematocysts are developed.

B. A layer of the same elements lying next to the outer surface of the endoderm.

Fig. 8. A portion of the same planula, viewed from the surface, to show the manner in which the surface is marked out into polygonal areas, by the special arrangement within the substance of the ectoderm of the nematocysts and tracts in which they are developed.

N, N. Nematocysts, seen in optical section.

A, A. Elements amongst which they are developed.

Fig. 9. Section, vertical to the surface, of a nearly-mature planula of *Errina labiata*.

E. Ectoderm, composed of alternate transparent and more opaque tracts, disposed vertically to the surface.

A. The more opaque tracts, containing numerous nuclei and young thread cells.

B. Basement membrane.

En. Endoderm, composed of fatty bodies and granules, and containing—

N, N. Developing nematocysts;

O. Large oil globules.

Fig 10. Portion of the surface layer of the ectoderm of *Errina labiata*, viewed from the outer surface.

S, S. Polygonal nucleated cells composing the layer. These in places overlap.

N, N. Nematocysts seen *in situ* within these transparent superficial cells.

Fig. 11. Section, vertical to the surface, of the ectoderm of a gastrozooid of *Errina labiata*.

E. Superficial layer, composed of inflated transparent nucleated cells.

E′. Inferior layer of the ectoderm containing numerous nuclei.

Fig. 12. Section, transverse to the axis, of a cyclo-system of *Allopora profunda*, taken at some little distance below the level of the mouths of the pores of the zooids, showing the sac only of the retracted gastrozooid in section, but both sacs and zooids of the dactylozooids. The whole is represented as decalcified, with the exception of the styles of the dactylozooids, which are introduced to show the position which they occupy in the recent state of the coral (cf. Plate 39).

R, R. Radially disposed offsets of the cœnosarc.

G Z. Cavity of the sac of the gastrozooid.

X, X. Interradial spaces between these.

D Z. Dactylozooid, showing in section its three composing layers, ectoderm, endoderm, and intermediate muscular and membranous layer.

C. Style of one of the dactylozooids, seen in section.
B. Large canals of the cœnosarc, occurring in the pseudosepta or intervals between the dactylopores.
S. Surface layer of the ectoderm. The main mass of tissue is composed of the finer ramifications of the cœnosarcal meshwork.

Fig. 13. Small portion of the cœnosarcal meshwork of *Sporadopora dichotoma*, greatly magnified in order to show the histological structure; as seen in osmic acid preparations.
C. Channel of the canal.
En, En. Endoderm layer.
M M. Membranous layer.
E E. Ectoderm.
T. Nematocyst in process of development.

Fig. 14. Two pigmented cells of the endoderm of the same, highly magnified.

POSTSCRIPT.

(Added September 24, 1878.)

Since the above paper was written, I have been able to examine the structure of the soft parts of a species of *Distichopora* (*D. Violacea*) of which I obtained specimens preserved in spirits from the Museum Godeffroy, in Hamburg.

The structure of the soft parts is essentially similar to that in *Errina*. In the dactylozooids, however, which are stoutly formed, there is present an excessively long muscular slip which runs down very far into the long tubular pores, and must be attached at the bottoms of these. The gastrozooids are short and cylindrical, with four small clavate tentacles. The gonophores appear identical in structure to those of *Errina* and *Pliobothrus*. Both male and female specimens were examined. The latter are distinguished by the prominence of the ampullæ. In the males, the ampullæ are invisible from the anterior, being sunk beneath the surface. All stages of development of the ova were seen, and they appear identical with those of *Errina* and *Pliobothrus*. In the male no spadix was made out within the gonangia, but these contained four or five ovoid masses full of spermatozoa and their parent cells.

Amongst the corals dredged by the 'Challenger' is a *Distichopora* which I had not seen until after the present paper was written, which I have named *D. irregularis*, in which the lines of pores are unusually irregular in their disposition, and traverse the faces of the flabellum all over as well as the edges of the branches as usual.

Further, specimens in spirit, of *Lepidopora cochleata*, and *Pliobothrus tubulatus*, were most kindly sent to me by Count de POURTALES, and I was able to determine some points in the structure of the soft parts of these, though they were not completely

hardened and in best condition, not having been specially prepared with a view to microscopic examination.

Lepidopora cochleata is essentially similar in the structure of the soft parts to *Errina labiata.* The dactylozooids are especially numerous and closely packed. The gastrozooids have four tentacles. The nematophores are like those of *Errina,* as are also the female gonophores. A female specimen only was available for examination. The specimen of *Pliobothrus tubulatus* was not well preserved, but in the gastrozooids there was seen an appearance as of very short tentacles more than four in number. I am uncertain whether tentacles are really present; it seems improbable that such can be the case.

From a study of the specimens of *Stylaster Madeirensis* (JOHNSTON), *Stenohelia Madeirensis* of KENT, in conjunction with some specimens obtained by H.M.S. 'Challenger,' but only lately available for examination, I conclude that the genus *Stenohelia* should be preserved with the following characters :—

Genus *Stenohelia,* SAVILE KENT (Ann. and Mag. Nat. Hist., 1870, vol. v. p. 120).—Corallum delicate; branching flabelliform; pores in regular cyclo-systems only. Cyclo-systems all turned towards one face of the flabellum. Dactylopores without a columella or with a very rudimentary one. Gastropores very deep and curved, so as to tubulate in all but the older branches the entire lengths of the axes of the branches; with small styles, seated at the bottoms of these tubes and directed parallel to the axes of the branches at right angles to those of the mouths of the cyclo-systems.

Species *Stenohelia Madeirensis,* KENT.

Stenohelia profunda, sp. n., H. N. M.—Off St. Thomas, Danish West Indies, 450 fathoms.

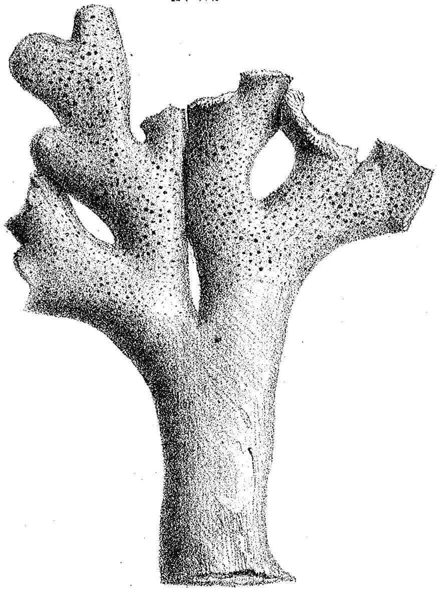
A further specimen, also dredged by H.M.S. 'Challenger,' seems to require the formation of an additional genus which I call *Conopora,* of which the following are the characters :—

Genus *Conopora,* gen. nov., H. N. M.—Corallum delicate; with pores in regular cyclo-systems; branching irregularly, the cyclo-systems having their mouths turned in all directions. Cyclo-system masses conical in form. Both kinds of pores devoid of a style. Gastropore with two chambers, the upper opening into the lower by a circular aperture. Differs from *Cryptohelia* and *Astylus* in having no lid or tongue-like process and in not forming a regular flabellum.

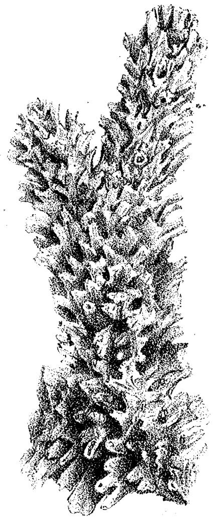
Species *Conopora tenuis,* sp. n., H. N. M.—Dredged off the Kermadec Islands, in 650 fathoms.

Possibly this species should be placed in the same genus as VERRILL'S *Cyclopora bella,*=*Stylaster bella* (DANA), see p. 481; but the descriptions in the old terminology are inadequate to determine the point. If so, *Cyclopora* may be revived as a genus with the above characters.

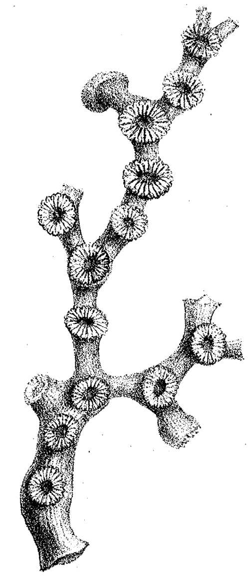
2. x½

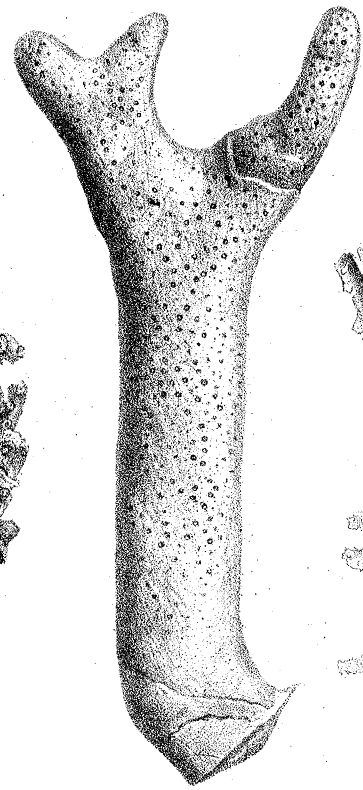


3. x2

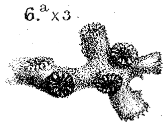


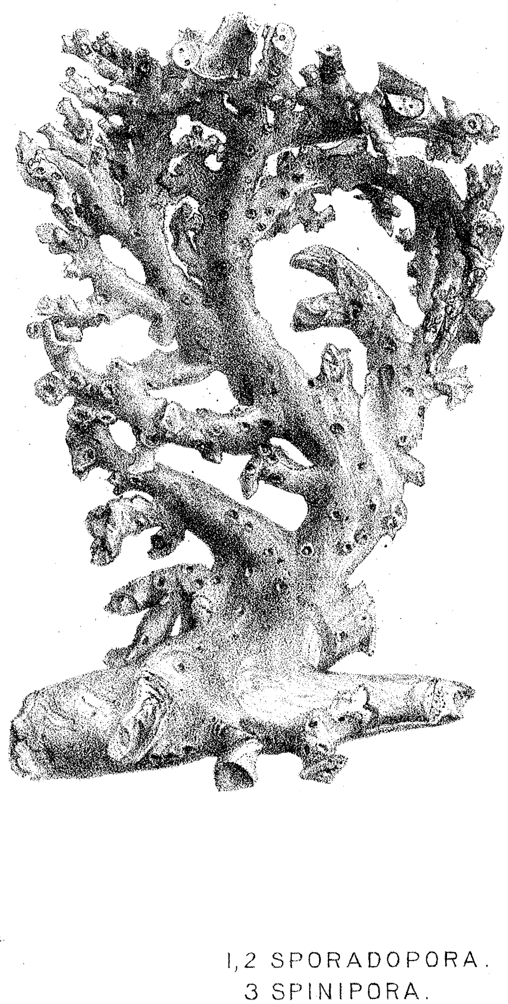
4. x3





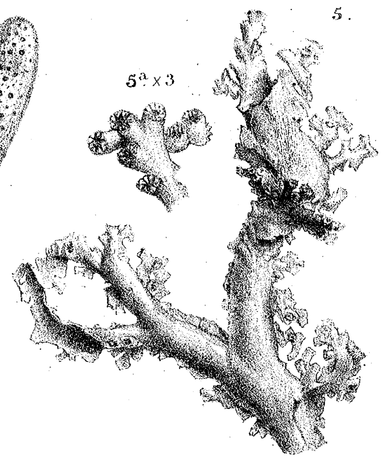
6.a x3



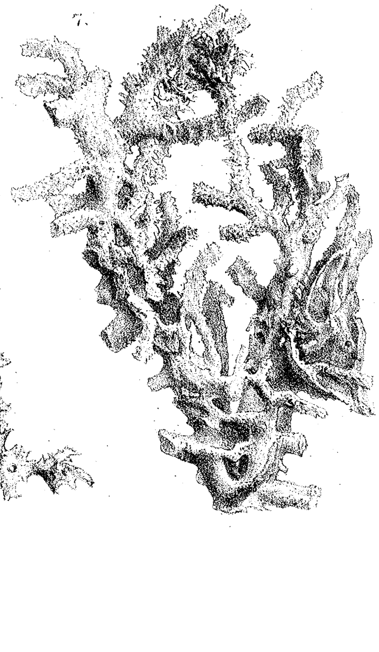


5.

5.a x3



7.



7.a x3

J.Erxleben ad nat. lith. Hanhart imp.

1, 2 SPORADOPORA. 4 ASTYLUS. 6 ALLOPORA.
3 SPINIPORA. 5 STYLASTER. 7 ERRINA.

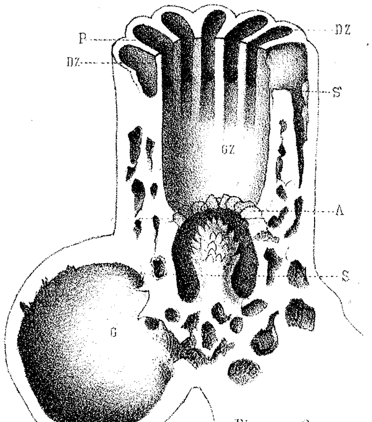


Figure 3.

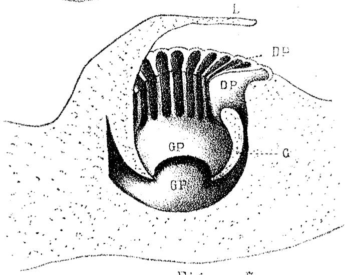


Figure 7.

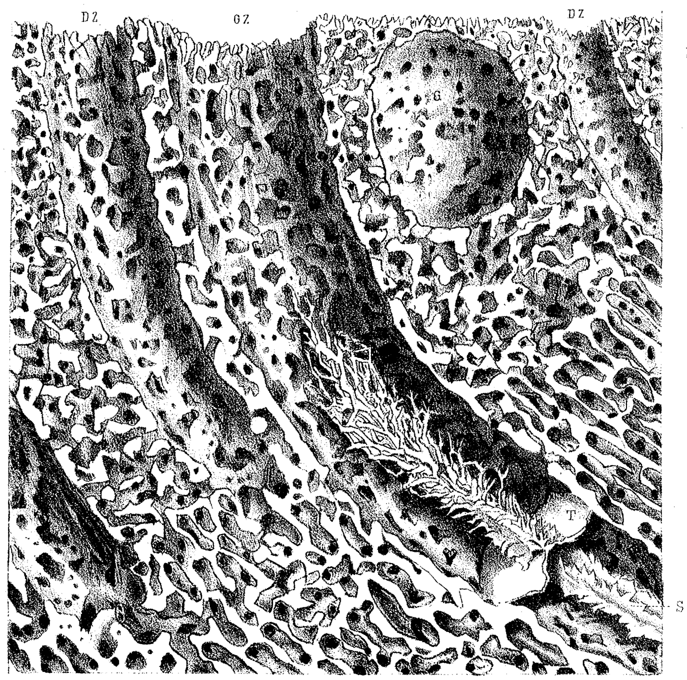


Figure 1. × 40.

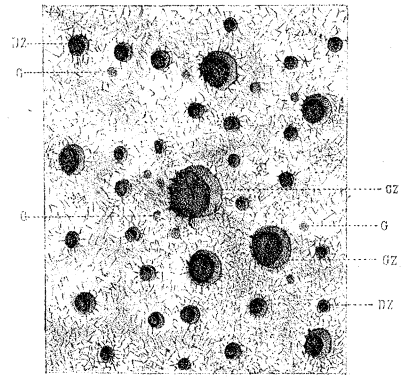


Figure 2. × 10

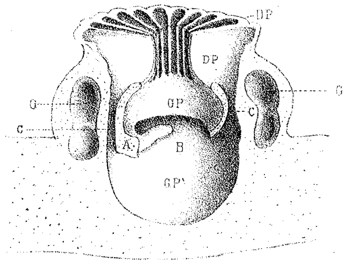


Figure 8.

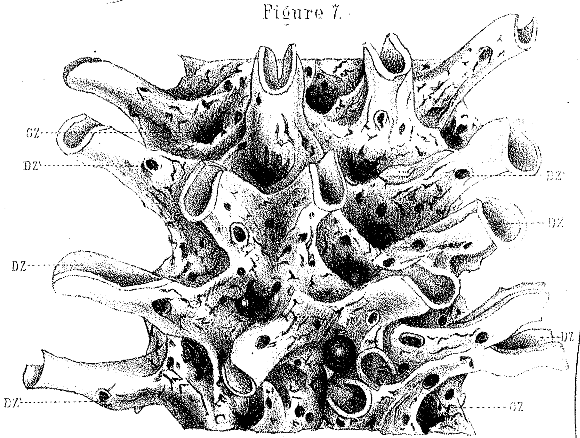


Figure 4 × 7.

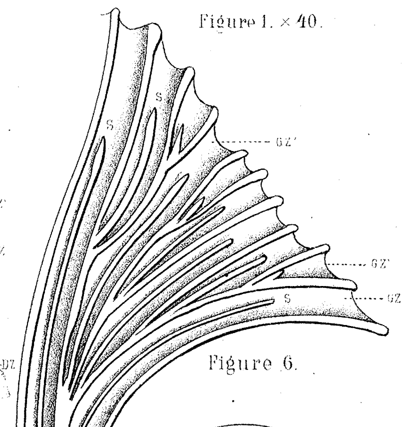


Figure 6.

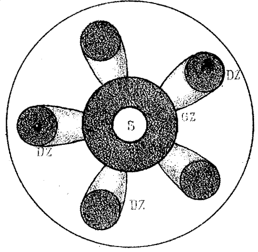


Figure 11.

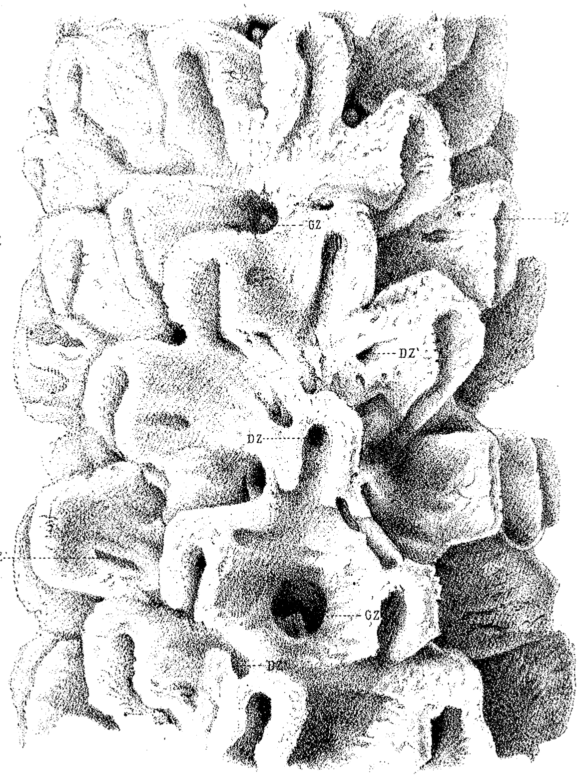


Figure 5. × 16.

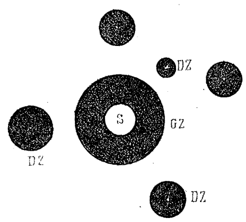


Figure 9.

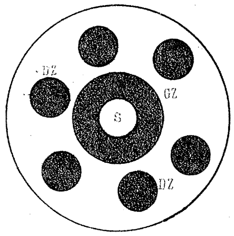


Figure 10.

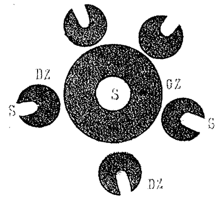


Figure 12.

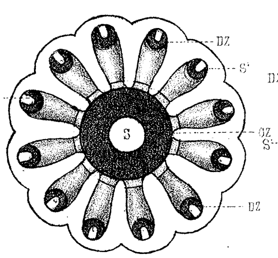
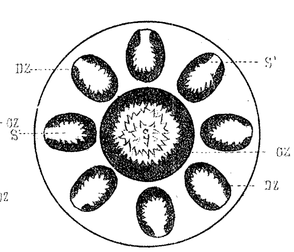


Figure 13.



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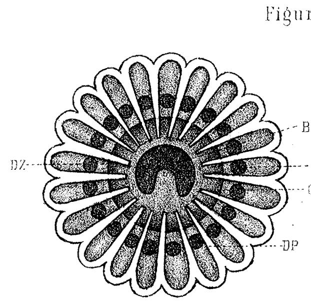

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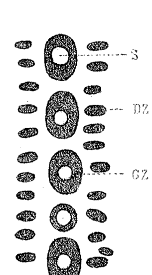
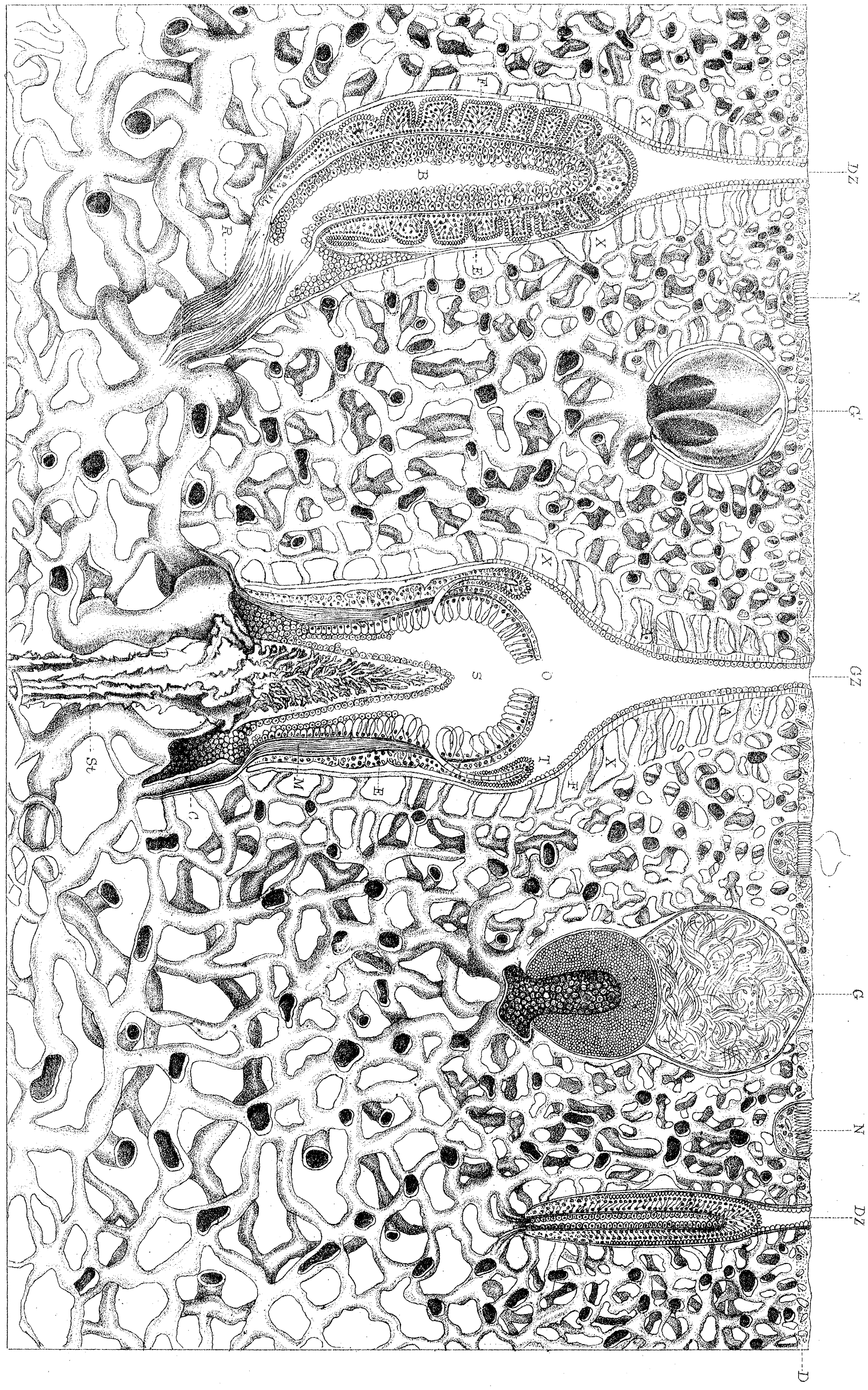


Figure 16

H. N. Moseley & Stewart del. Lith. Anst. v. J. G. Bach, Leipzig.

1, 2, 9, SPORADOPORA. 3, 13, 14, STYLASTER. 7, CRYPTOHELIA. 8, 15, ASTYLUS. 4, SPINIPORA.
5, LABIOPORA. 6, 16, DISTICHOPORA 10, 11, 12, ALLOPORA.

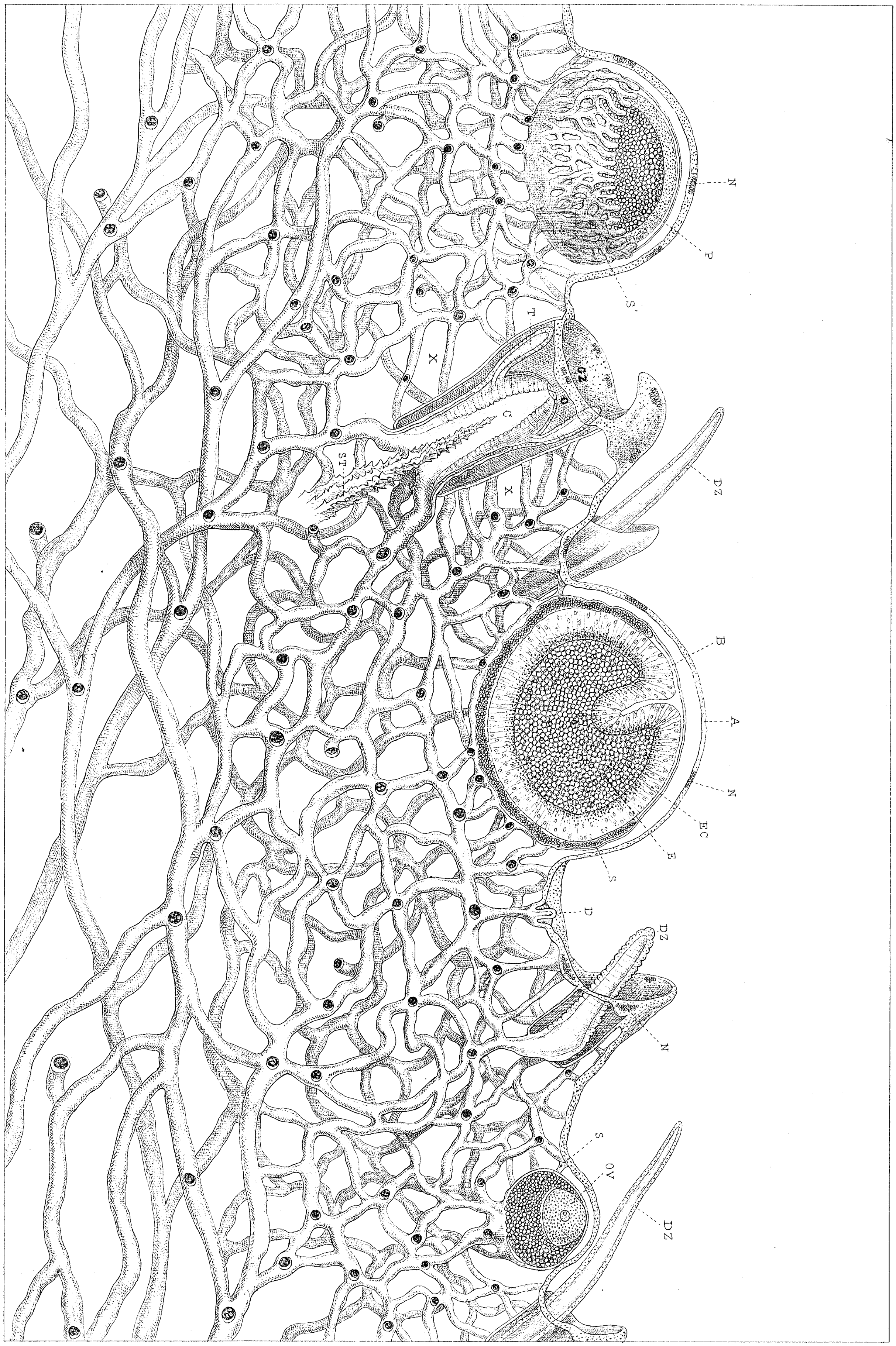


Sporadopora dichtoma, X 60

H.N.Moseley, del. J.Erxleben, lith.

SPORADOPORA.

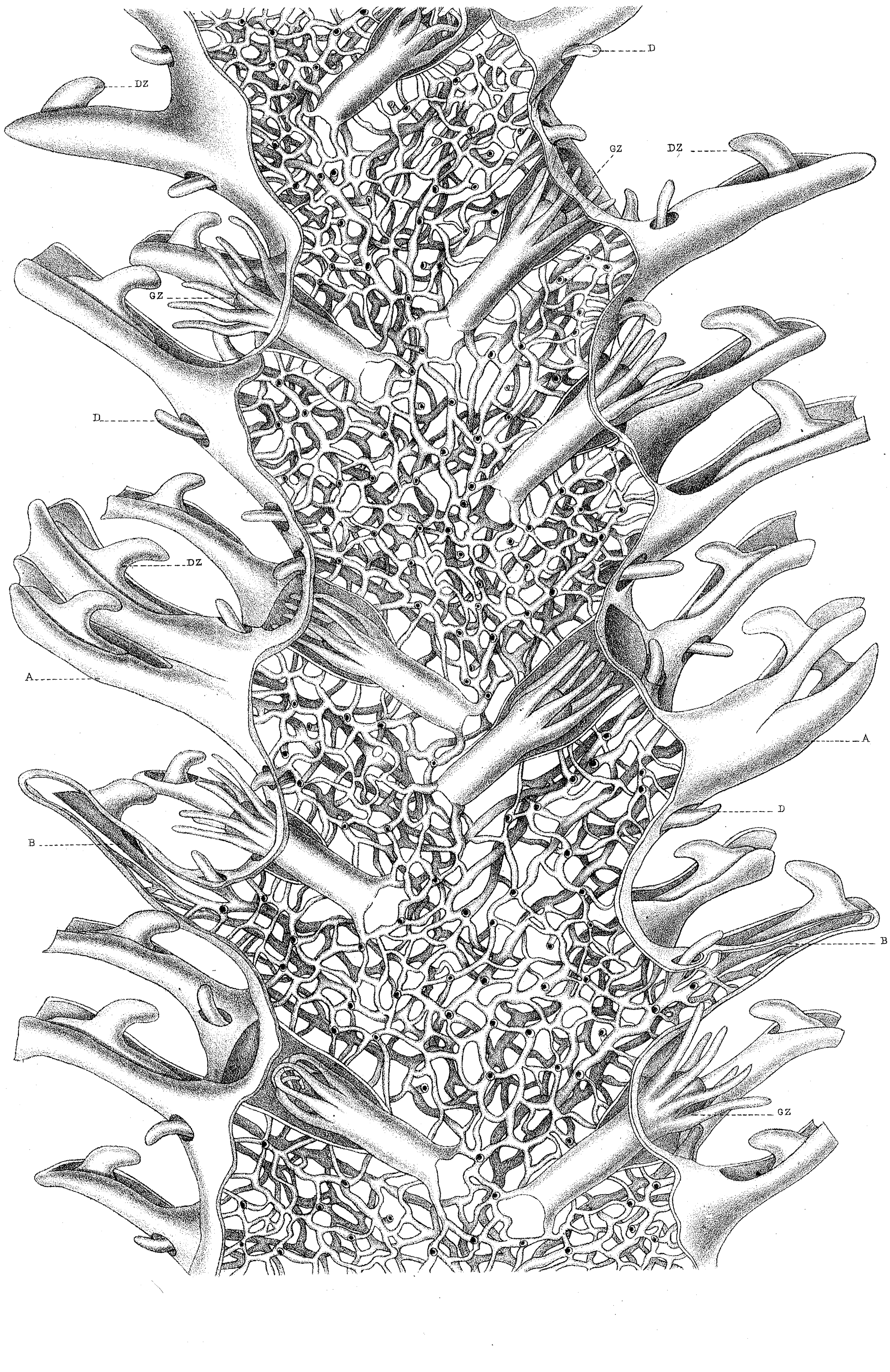
Hanhart imp.



Errina labiata × 40.

H. N. Moseley, del.t F. Huth, Lith.r Edin.r

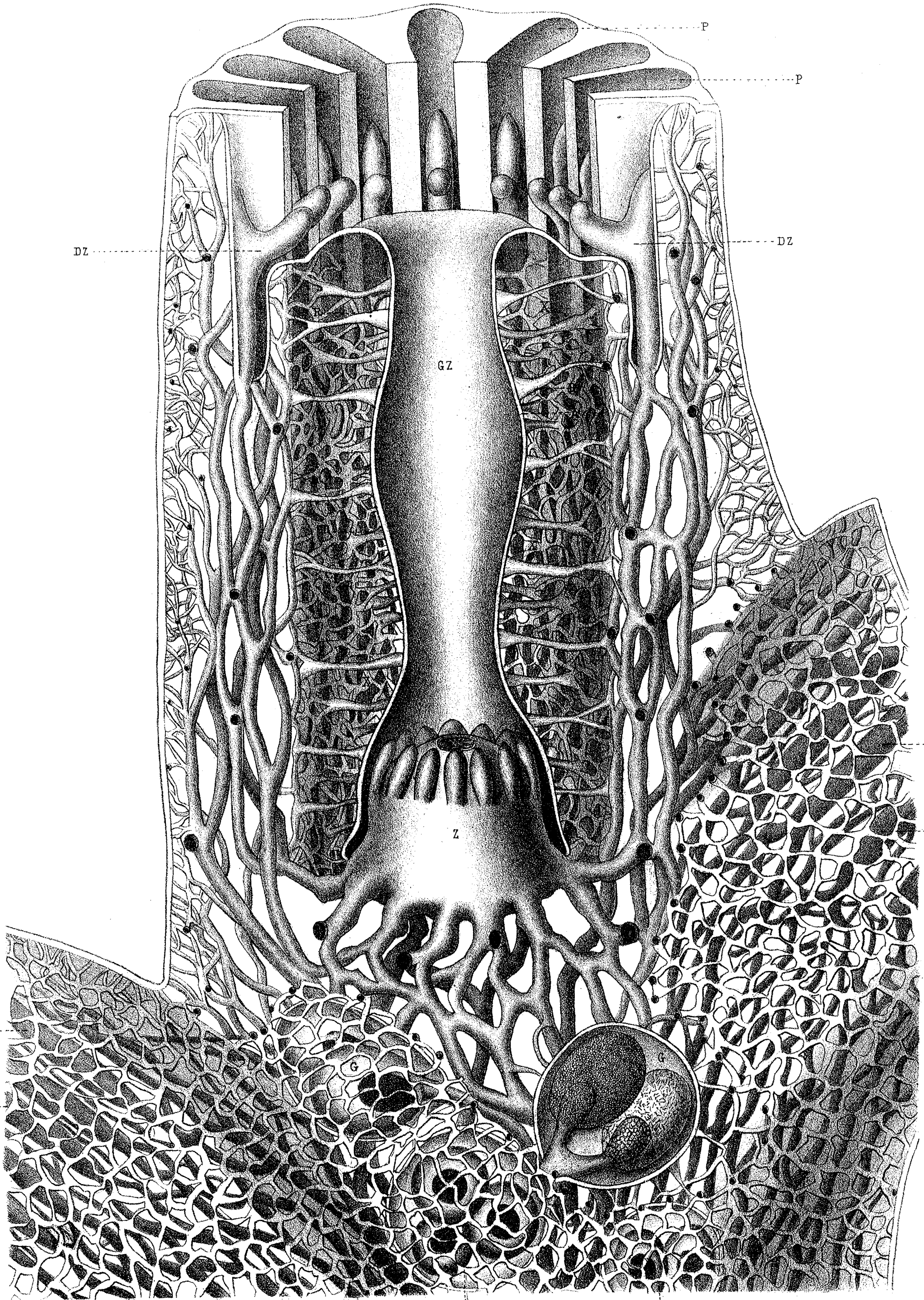
ERRINA.



H N Moseley del.

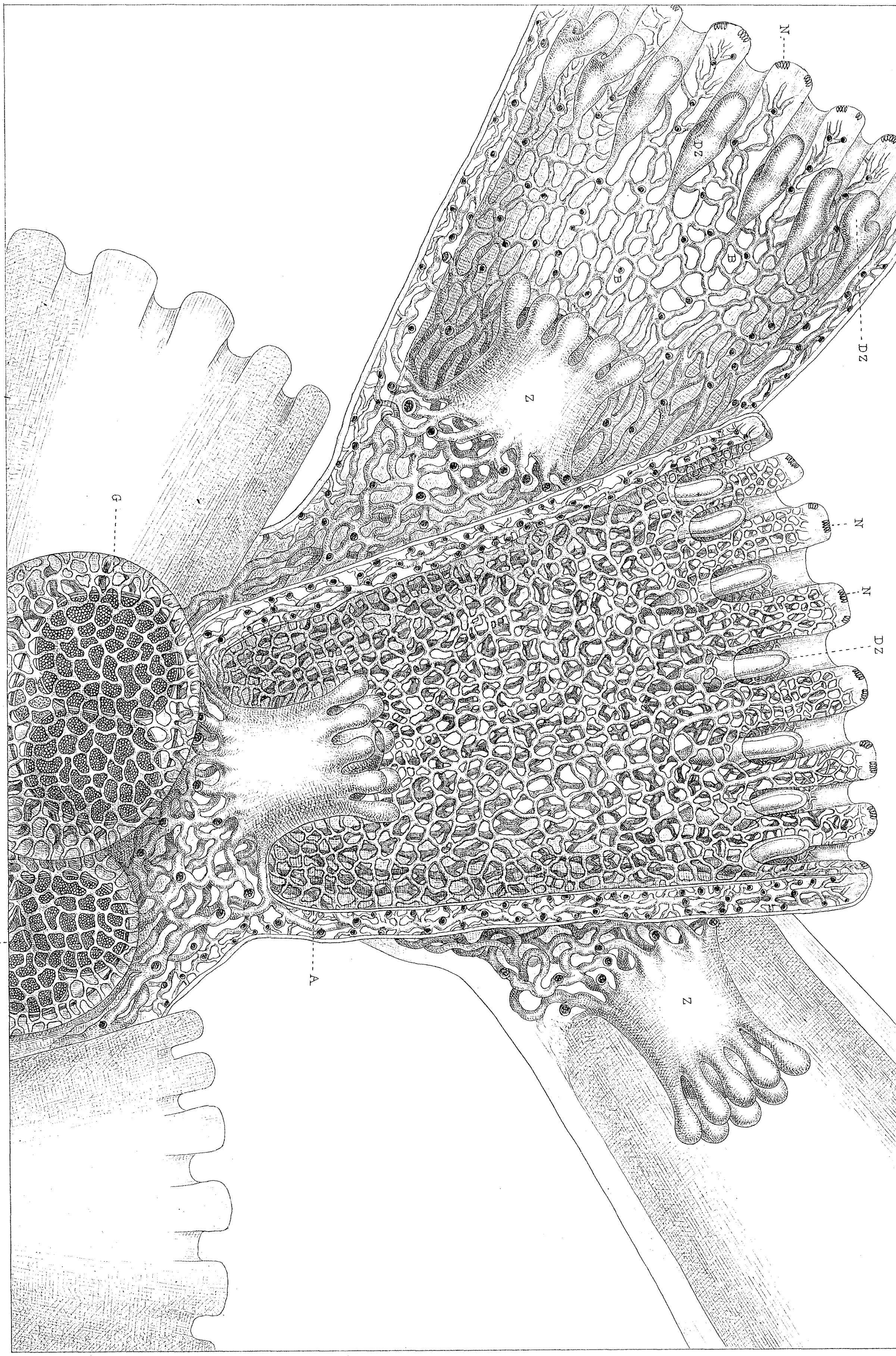
Lith. Anst. v. J. G. Bach, Leipzig

SPINIPORA ECHINATA × 15.



H. N. Moseley del. Lith. Anst. v. J. G. Bach, Leipzig.

ALLOPORA PROFUNDA × 60.



Stylaster densicaulis × 60.

H.N. Moseley, del[t].

F. Huth, Lith[r] Edin[r]

STYLASTER.

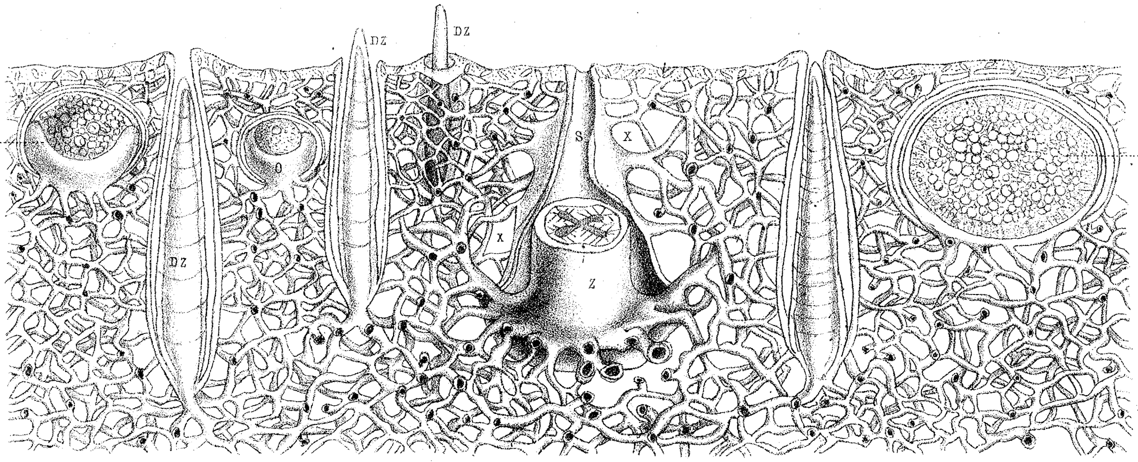


Figure 2 Pliobothrus symmetricus × 50.

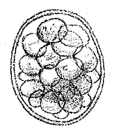


Figure 3. × 50.

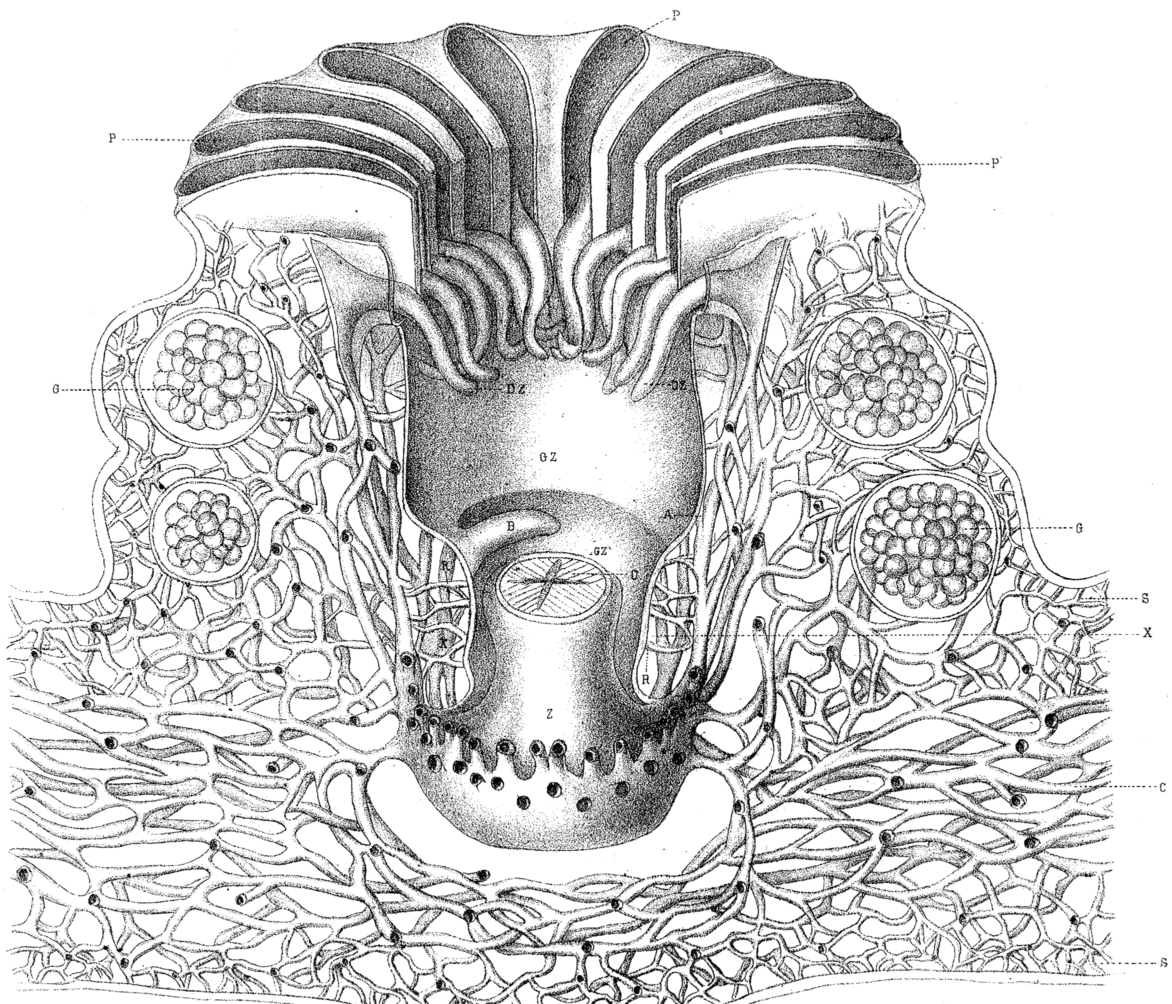
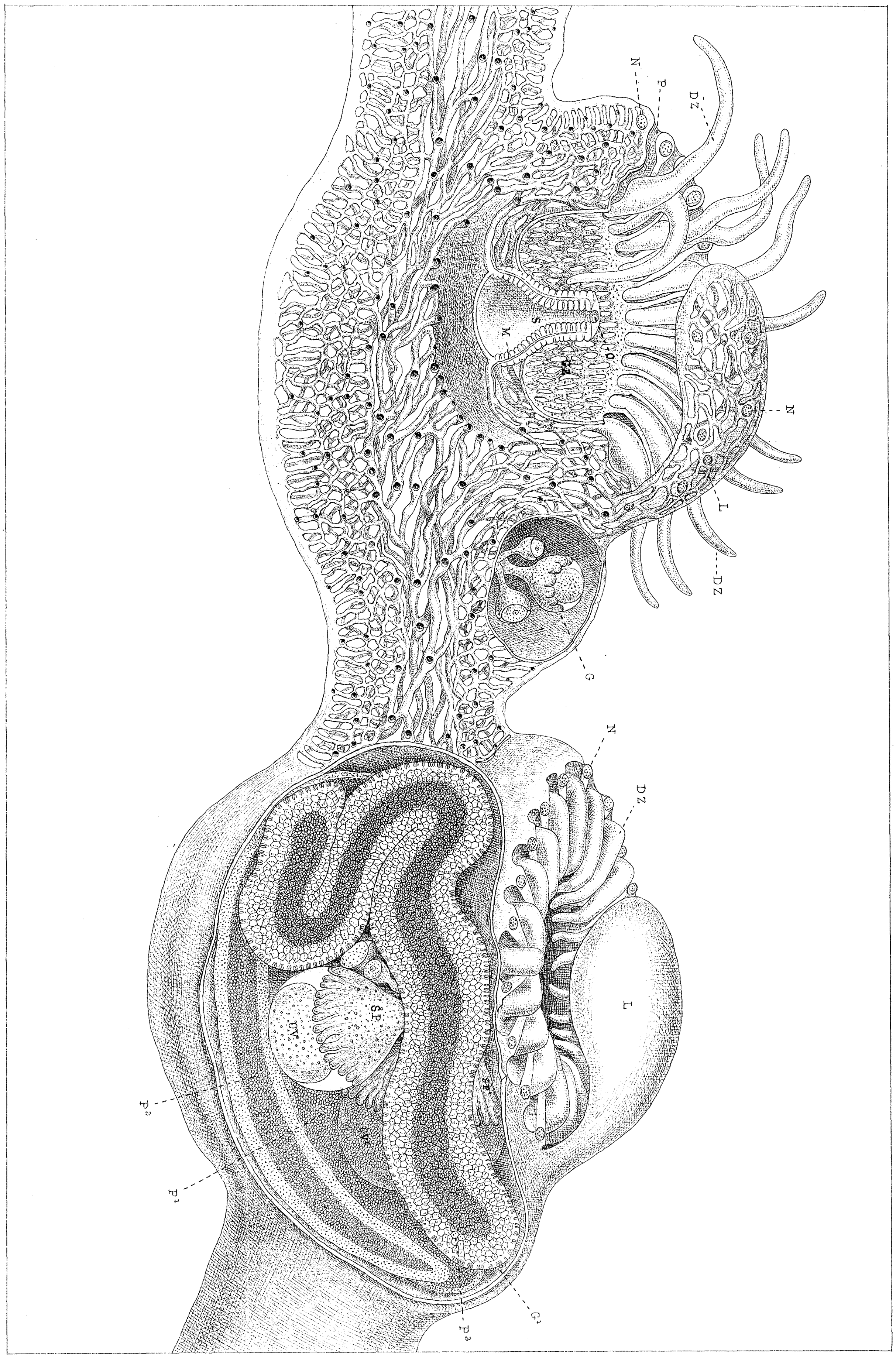


Figure 1. Astylus subviridis × 40

H.N. Moseley del.

Lith.Anst.v.J.G.Bach, Leipzig

1 ASTYLUS. 2 3 PLIOBOTHRUS.



Cryptohelia affinis × 30.

H. N. Moseley, del.t F. Huth, Lith.r Edin.r

CRYPTOHELIA.

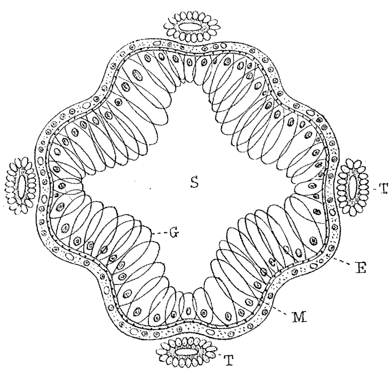


Fig. 1. × 85.

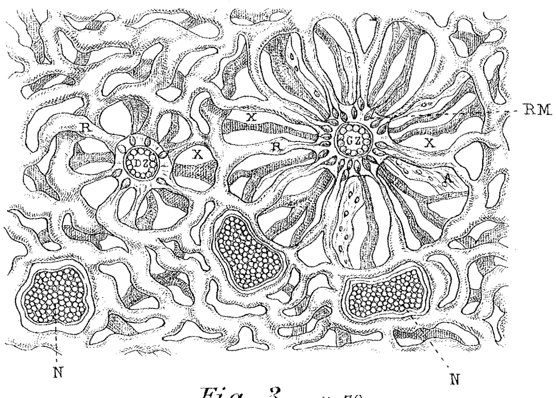


Fig. 3. × 70.

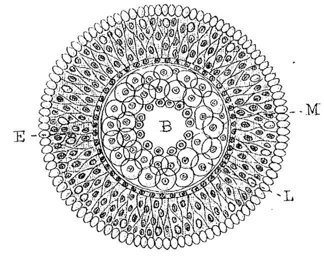
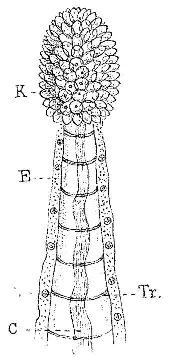
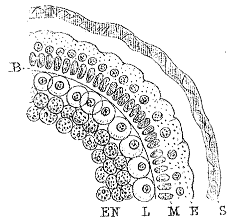


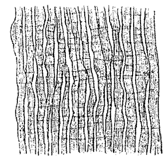
Fig. 2. × 85.

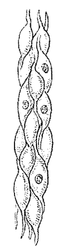


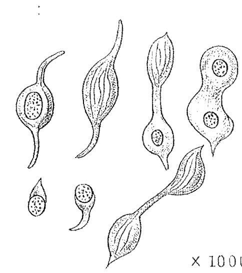
× 100. *Fig. 4.*



× 100. *Fig. 5.*


× 100. *Fig. 6.*


× 100. *Fig. 7.*


× 1000. *Fig. 8.*

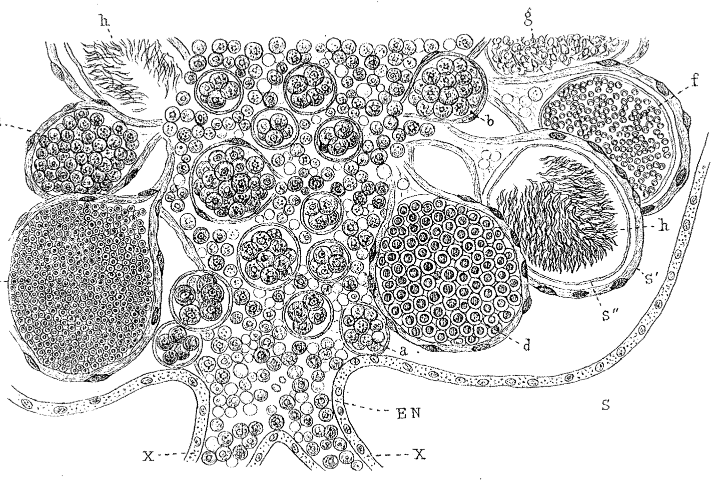
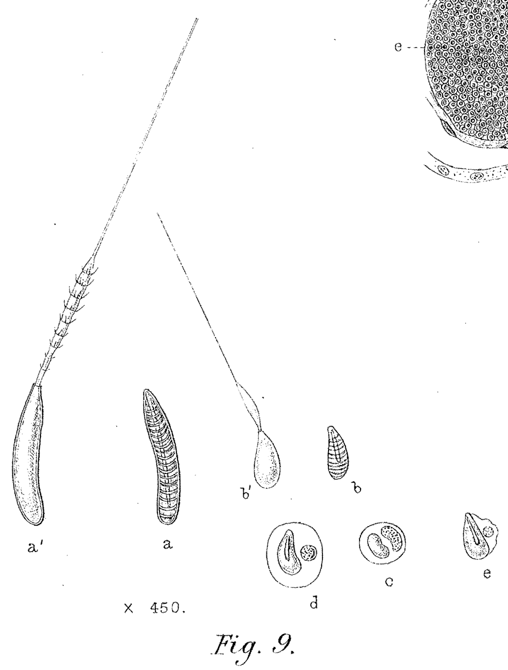


Fig. 10. × 300.



× 450. *Fig. 9.*

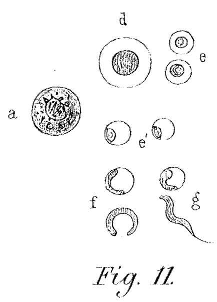
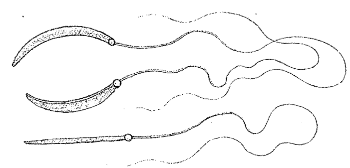


Fig. 11.


× 900. *Fig. 12.*

H. N. Moseley, del^t. F. Huth, Lith^r Edin^r.

1-9, 12. SPORADOPORA. 10. 11. ASTYLUS.

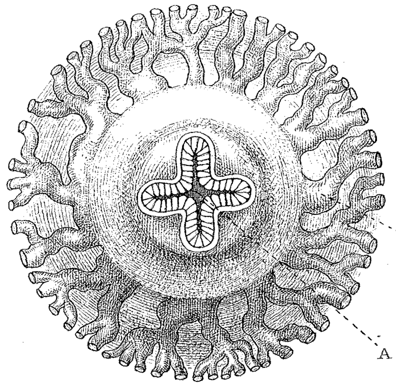


Fig. 1. × 50.

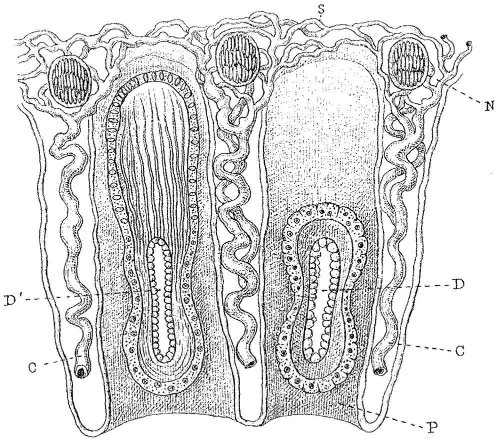


Fig. 2. × 100.

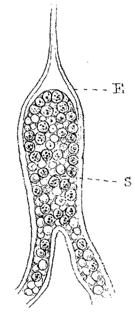


Fig. 3.

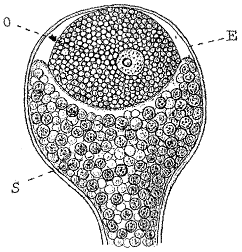


Fig. 4. × 150.

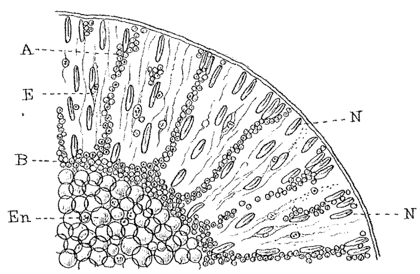


Fig. 7. × 125.

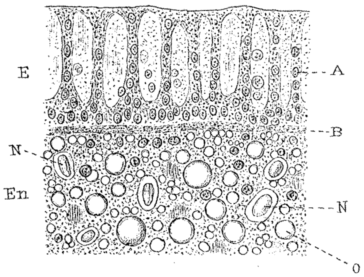


Fig. 9. × 150.

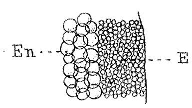


Fig. 5. × 125.

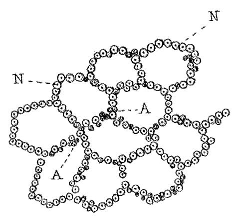


Fig. 8. × 120.

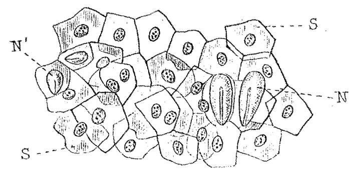


Fig. 10. × 200.

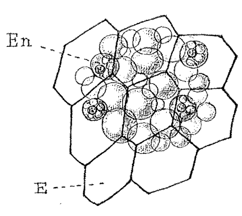


Fig. 6. × 200.

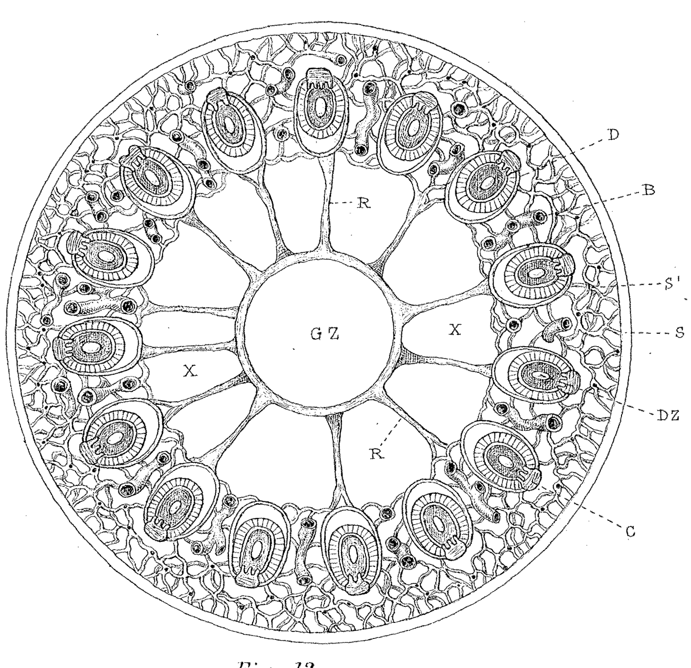


Fig. 12. × 50.

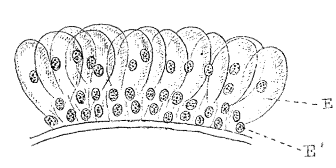


Fig. 11. × 200.

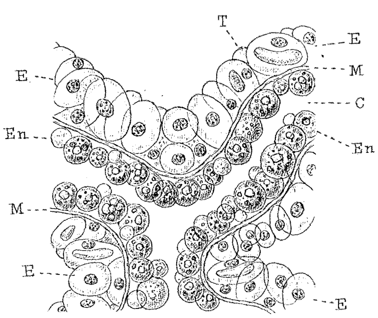


Fig. 13. × 320.

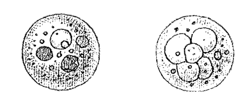


Fig. 14. × 900.

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ASTYLUS. CRYPTOHELIA ALLOPORA ERRINA.