THE

VOYAGE OF H.M.S. CHALLENGER.

ZOOLOGY.

REPORT on the ACTINIARIA dredged by H.M.S. Challenger during the years 1873–1876. By Prof. RICHARD HERTWIG.

SUPPLEMENT.

INTRODUCTION.

AFTER I had concluded my Report on the Actiniaria of the Challenger Expedition, a number of additional specimens were sent to me, on which I now present a short Supplementary Report. Unfortunately the work has been delayed longer than I could have wished, partly on account of a series of experimental investigations upon the fertilisation and segmentation of the ovum, which I had undertaken in concert with my brother, but mainly owing to the claims on my working-time caused by my transference from Königsberg to Bonn, and from Bonn to Munich.

Amongst the material occurred several specimens of species which have been previously described and can therefore be treated in few words; besides these, there are also several new forms, representing new and interesting genera, which require a detailed description, and which are, for the sake of clearness, designated by an asterisk. At the end (p. 54) will be found a list of those Actiniæ of which a systematic study was impossible, either because they were not sufficiently well preserved, or because their appearance was no longer characteristic owing to the absence of sculpturing and colour, the necessary result of the method of preservation.

Since the publication of the earlier part of this Report, the great monograph of Angelo Andres on the Actiniaria has appeared.[1] During the progress of his work this

[1] Fauna und Flora des Golfes von Neapel, Le Attinie, 1884.

author was acquainted only with the short preliminary notice of my researches published in the Jena Proceedings,[1] not with the Report itself; a fact easily understood when one considers how long before the date of publication a monograph constructed on such a plan must be completed. In his comprehensive revision of the Actiniæ, and re-definition of families and genera, he has been prevented from referring to my contemporaneous attempt at revision, since this first appeared in the detailed Report. As it is most desirable that two systems, appearing within a short time of one another, should be brought into such relation as to avoid future discordance and mistake, I accept with pleasure the opportunity of a critical utterance on their mutual relations.

As against the six chief divisions into which I divide the Actiniæ (Hexactiniæ, Paractiniæ, Monauleæ, Edwardsiæ, Cerianthеæ, Zoanthеæ), Andres erects seven, viz. Edwardsinæ, Actininæ, Stichodactylinæ, Thalassianthinæ, Zoanthinæ, Cerianthinæ, Minyadinæ. With regard to three chief groups we are in complete accord (Edwardsiæ, Cerianthеæ, Zoanthеæ), except for the fact that Andres, in my opinion, relies on too inconstant and unimportant external characters; while, as I have shown, these groups, at least, admit of anatomical characterisation by the arrangement of their mesenteries, and thus can be far more clearly and sharply circumscribed. If the reader compare in this connection the definitions of the Zoanthеæ furnished by myself and by Andres, it will be readily admitted that none of the characteristics of the latter author, such as colony-formation or incrustation, are constant within the group; that, on the other hand, all the forms follow one and the same law of mesenterial arrangement, first recognised by G. von Koch.

If we carry the comparison further, we find that Andres places beside the Actininæ, as separate groups, the Thalassianthinæ, the Stichodactylinæ, and the Minyadinæ; though with a certain caution, as having himself studied no representative of them. I believe that he has here exceeded the systematic value which can be safely assigned to the form of the tentacles and their distribution on the mesenterial chambers. I have studied certain Stichodactylinæ (*Corallimorphus rigidus*, *Corallimorphus profundus*, and *Heterodactyla hemprichii*), and of the Thalassianthinæ, *Thalassianthus aster*, and can assert, as the result of a thorough examination of their structure, that in all important points they agree with the hexamerous Actiniæ; nor have I any doubt that these forms, even if united into separate families, must be ranged among the Hexactiniæ. Finally, the group of Minyadinæ has for many reasons, which I entirely recognise, undergone at the hands of Andres so sharp a criticism, that one can hardly see why he retains it, or why at least he does not allow it to rank merely as a subdivision of Hexactiniæ, until the necessity of its removal from that group is rendered apparent by anatomical investigation.

From the point of view explained, I am of opinion that all the forms referred to

[1] *Jenaische Zeitschr.*, Bd. xv. p. 10, 1881.

by Andres must be comprehended in the four divisions, Edwardsiæ, Hexactiniæ, Zoantheæ, and Ceriantheæ, and accordingly hold to the systematic classification which I have published. The groups of Paractiniæ and Monauleæ are in all respects natural, and would also certainly be retained by Andres had representatives of them been known to him.

Even greater discordance than that of which I have hitherto spoken, between the classifications of Actiniæ followed by Andres and myself, presents itself when the determination and nomenclature of families and genera are regarded. Independently of each other, and from different standpoints, we have taken in hand a systematic revision of Actiniæ: Andres starting with the advantage of a richer material, and studying species with which earlier publications are especially concerned, and which he could command in a living condition; while my qualification for a systematic classification was that afforded by close anatomical investigation, namely, that I relied for systematic characteristics upon such weighty differences as the structure of the sphincter, the arrangement of the mesenteries, the structure of the musculature and of the oral disc, etc., points which Andres has, hitherto at any rate, entirely left out of consideration. Thus it has resulted that in the determination of families and genera, and also in the value assigned to existing names, we have in many cases taken up a totally different attitude; and as, in consequence of this, no inconsiderable confusion has arisen in the method of diagnosis, I hold it advisable to inquire critically what must be retained of the system of the Italian observer.

Of least importance are our differences of opinion relating to those Actiniæ which possess acontia. Andres has here adopted the separation, instituted by Verrill, into Sagartidæ and Phellidæ. Having regard to his wider acquaintance with the species, I agree with him in accepting as a distinctive character the chitinous covering extending over two-thirds of the body-wall; and for clearer characterisation of both families, the following marks not mentioned by Andres should be included in the diagnosis, — a mesodermal sphincter, and a differentiation of the mesenteries into sterile complete primary mesenteries, and incomplete secondary mesenteries provided with generative organs. Of the Challenger Actiniæ, there would belong to the Phellidæ only *Phellia pectinata;* to the Sagartidæ, *Sagartia sp.*, *Cereus spinosus*, *Calliactis polypus*, *Bunodes minuta.* Of these, the two latter require an alteration of name; *Calliactis polypus* must be termed *Adamsia polypus*,[1] and *Bunodes minuta* be known as *Cylista minuta*, since it has been shown by Andres that the typical *Bunodes* possesses no acontia, and therefore cannot belong to the Sagartidæ.

Andres has incorrectly allowed the generic name *Cereus* (Oken) to drop, and has

[1] The specific name *Rondeletii* has been wantonly substituted by Andres for the older *polypus*, the former being used for the first time by delle Chiaje in 1825, while the latter was already instituted by Forskål in 1775. Milne-Edwards is therefore correct in calling the animal *Adamsia polypus*.

introduced in its place the more recent name *Heliactis*, for Sagartidæ with numerous large papillæ; although Oken adduces *Cereus bellis* as the type form, which stands in the same relation to the genus *Heliactis*. The papillate Sagartidæ are of two kinds, the one having a soft surface, while in the other the body-wall is covered as far as its upper edge with a bark-like cuticle which recalls the Phellidæ; it is therefore advantageous to confine to the former the name *Heliactis*, applied, though unjustifiably, by Andres, and for the latter to restore *Cereus*, the old designation of Oken, a representative of the newly characterised genus being *Cereus spinosus*.

In discussing the families instituted by Andres, we next come to the Paractidæ. As I understand the diagnosis given for this family,—"margine tentaculato, non rilevato e privo d' acroragi,"—the tentacles spring at the edge where body-wall and oral disc pass into one another, just as is the case both in the Corallimorphidæ and Antheomorphidæ, which I have described in more detail, and, generally speaking, in such Actiniæ as are devoid of a circular muscle. But this relation also holds good in Actiniæ with a weak sphincter, as, for example, in *Anemonia cereus* (to which Andres, strange to say, ascribes a "margine rilevato"); and, finally, in Actiniæ, in which the sphincter is developed at some distance outwards from the upper edge of the body-wall. The facts adduced are sufficient to prove that this characteristic is systematically useless; and in addition to this I insist that the few forms grouped in the family do not appear to agree with the diagnosis. The tentacles of an *Anemonia* are, according to Andres, formations placed more at the edge than are those of a *Paranthus* or a *Paractinia*. On the contrary, the *Paractis peruviana*, which Andres adduces as the type of the family, seems to me to have no tentacles which would be marginal. Indeed, it agrees so entirely with a Challenger form, *Paractis excavata*, that I long doubted whether it were not right to unite the two. In *Paractis excavata*, I am certain that a strong mesodermal sphincter is present, and, corresponding to this fact, body-wall and oral disc are sharply marked off from each other, whence I conclude that the same holds for *Paractis peruviana*. Since I have thus good ground for holding unsuitable the methods by which Andres has instituted his family Paractidæ, and can, in addition, claim the right of priority, I adhere to the definition which I previously published, leaving only to future investigators to decide upon the advisability of erecting Actiniæ with marginal spherules, sucking-papillæ, and papillæ into a family separate from the Paractidæ (*sensu stricto*) with smooth body-wall.

The next family in the system of the Italian naturalist is formed by the Actinidæ, and corresponds to the Antheadæ and Actinidæ of Gosse. I formerly followed Gosse in separating these two families, but had previously maintained that anatomically they are closely related, and should perhaps on that account be united. I have therefore nothing to adduce against this proceeding of Andres, though the detailed investigation of the Actinidæ, which I recommended, has not yet been carried out. It is also

correct to replace the name *Anthea* by the older *Anemonia*, and to range the genus *Comactis* under it. On the other hand, my *Comactis flagellifera* is not identical with *Anemonia sulcata* (*Anthea cereus*), and should therefore be referred to as *Anemonia flagellifera*.

In the system of Andres the Bunodidæ bear the closest relation to my family Tealidæ. I was unacquainted with any typical *Bunodes*, and had supposed (*cf. supra*) that they possessed acontia. This supposition is, according to Andres, incorrect; and the close relationship to *Tealia* is thus anew proven. Accordingly I withdraw the name Tealidæ in favour of the older designation Bunodidæ; but, now as formerly, the endodermal sphincter must occupy the first place in the diagnosis. I relinquish, however, to future observers, as with the Paractidæ, the decision whether forms with smooth and with papillate body-wall should be separated from one another, or not.

A last point of dispute with Angelo Andres lies in the fact that I reckon the *Halcampæ* among the Ilyanthidæ, while he erects them into a separate family. I will not decide in this place either for the one opinion or the other, but will discuss merely the point of view, which, as it seems to me, must be of importance for a decision.

The more we have learnt in late years of the structure of these forms, the more has it become apparent that Actiniæ, which are rounded posteriorly and devoid of pedal disc, exhibit in most cases a sort of ancestral character; eminently primitive forms are, above all others, the Edwardsiæ. Among such forms is the genus *Halcampa*, from which again the genus *Halcampella* is a transition to the remaining Actiniæ, in virtue of its numerous tentacles, and of its commencing to exhibit accessory mesenteries. I opine that the genus *Ilyanthus* stands in close relation to the *Halcampellæ;* the regular increase of the mesenterial pairs by multiples of six, which is commencing in the one case, is in the other clearly expressed, as may be inferred from the presence of the numerous longitudinal furrows of the body-wall; while the siphonoglyphes (ciliated grooves), the hinder edge of the body, and the sphincter, are obviously of weak development, as among the *Halcampæ*. Possibly a study of the mesenteries may yield further points of agreement, but, unfortunately, nothing is accurately known of these important features in the structure of *Ilyanthus;* and so long as this is the case, no conclusion can be certain. If my expectations be confirmed, a union of the *Halcampæ* with the Ilyanthidæ would be desirable; the latter would form a transitional family placed at the top of the Hexactiniæ, and bridging the gap between them and the Edwardsiæ; while, as a peculiar and aberrant branch of the Actiniæ, would be ranged near them the Siphonactidæ, the forms possessing a conchula.

All the forms of which we have as yet spoken possess the typical digitate or tubular Actinian tentacles, so arranged that one tentacle corresponds to each radial chamber; there are, however, two variations of this arrangement. In the one,

the tentacles are replaced by appendages of a different value, for instance, by stomidia in the Liponemidæ which I have described, or by bushy or arborescent growths in the families Sarcophianthidæ and Thalassianthidæ erected by Andres. On the other hand, there are forms in which more tentacles than one correspond to a mesenterial chamber; accessory tentacles, placed on the oral disc, being present in addition to the primary tentacles. This is conclusively proved only for species of *Corallimorphus*, but Andres has rendered it excessively probable also for species of *Corynactis* (compare the account of *Corynactis*? sp. ? p. 10, *infra*). For such forms I have instituted the family Corallimorphidæ, Andres the family Corynactidæ. I believe that my designation deserves preference, because it is the older, and because my diagnosis of the family alone insists upon the important anatomical characteristic; on the other hand, I concede to the Italian naturalist that the family may be restricted to species with knobbed tentacles, and that all Actiniæ with modified tentacles, of which an accurate investigation is still required, may be brought under a series of further families.

For a comprehension of the above discussion, I give a view of that arrangement of Hexactinian families which I hold the most advantageous, in the form of a synoptic table.

A few changes have been made in the English terminology used in the former part of this Report: "œsophagus" has been replaced by "stomatodæum," "mesoderm" by "mesoglœa," and "œsophageal groove" by "siphonoglyphe."

former possesses but one stomidium, the latter apparently must be provided each with two or three,—an inference confirmed by dissection. Since it is the rule amongst Actiniæ that the development of tentacles precedes that of mesenteries, we can also infer in this instance from the plentiful development of stomidia, an imminent addition to the mesenteries.

Genus *Aulorchis*, n. gen.

Liponemidæ, whose generative organs are modified into a tube perforating the oral lip; gonidial grooves on both sides drawn out into a long ear-like cone.

Aulorchis paradoxa,* sp. n. (Pl. I. figs. 9, 10; Pl. III. figs. 2–6; Pl. IV. figs. 1–6).

Stomidia arranged in two alternating rows, approximately sixty in number.

Habitat.—Station 299, December 14, 1875; lat. 33° 31′ S., long. 74° 43′ W.; depth, 2160 fathoms. One specimen.

Dimensions.—Height, 4 cm.; greatest breadth (measured about half-way up the animal), 3 cm.

Among the accessory Challenger Actiniæ occurs this form, of great interest as enlarging by a new genus and new species the group of forms devoid of tentacles. Unluckily, I have had but the one solitary specimen for study, and even this was badly preserved, and had apparently suffered much from the dredge. It was exceedingly contracted; oral and pedal discs were externally unrecognisable, since both ends of the body-wall were closely drawn together. As a natural result of this condition, I have not been able to clear up many important points of the organisation so well as I could have wished. For investigation, I divided the specimen longitudinally, and dissected a sextant with scalpel and scissors, arriving at the following results.

The strongly contracted, and therefore small, pedal disc exhibits indistinct radial brownish wrinkles and furrows, and is sharply marked off from the body-wall, the surface of which is smooth. The latter is of a whitish tint, and of inconsiderable thickness, only here and there becoming more powerful, but never forming hooks or papillæ. Its consistence is less firm than that of cartilage, but considerably more so than that of Medusan mesoglœa. The tissue is of a fibrous nature, composed of very fine fibrils, which are generally interlacing and reticulate. At many points, however, they are thicker and bound together in more parallel series, so that cords and lamellæ are formed, which, though staining brilliantly with carmine, are not sharply differentiated from their surroundings. These lamellæ are ranged parallel to the two surfaces, and run constantly closer to one another till a firmly united mass of fibres is formed just below the epithelium. At other points, however, the fibres are more loosely plaited, so that spaces remain between them, which are filled up by homogeneous mesoglœa. In some places I detected hollow spaces in the tissue, which were devoid of an epithelial

lining. They occur also in the mesenteries, the stomatodæum, and the oral disc, and may perhaps be caused by inadequate preservation.

In the upper part of the body-wall lies, close under the endoderm, a mesodermal sphincter muscle, its length amounting to about 1 cm., while its greatest breadth reaches 5 mm. at the upper end, from which point it gradually thins out. It is of interest from several points of view; in the first place, the muscle-fibres are abnormally strong; consequently the muscle-bundles are formed of but few elements, and consist in many cases only of two to four. Again, the individual tracts are so far from running parallel to one another, that in a longitudinal section many bundles are cut absolutely transversely, others obliquely, and others for long stretches superficially; thus an appearance of extremely entangled fibres is presented (Pl. III. fig. 3*a*).

Finally, *Aulorchis* affords proof of the endodermal origin of the mesoglœal muscle-bundles, as we find on the endodermal side every transition from the mesoglœal bundles to the endodermal layer of circular fibres; in one place the bundles lie close under the fibrous layer, at another are in communication with it by a broader or narrower band; finally, we find slight infoldings of the endodermal muscle-layer (Pl. III. fig. 3*b*).

The stomidia lie in two alternating rows between the edges of the mouth and of the body-wall, somewhat nearer to the former; they are about sixty-four in number (thirty-two between two pairs of directive mesenteries). The stomidia of the inner row are larger than those of the outer; the smallness of the latter producing the impression, that they have just been formed, and that a further increase of their number is taking place. Radial ridges on the oral disc start at the edge of the body-wall and run up to the individual stomidia.

Transverse sections through the oral disc exhibit a strong mesodermal musculature; this is interrupted along the lines of mesenterial insertion, and falls therefore into marked radial bands which cause the radial ridges of the oral disc. The individual muscle-bundles contain a few strong fibres, and are so separated from one another by mesoglœal sheaths, stout or slight, that the lines of mesoglœa form dendritic figures springing now from the ectodermal, now from the endodermal side (Pl. III. fig. 2).

The mesoglœa sends into the ectoderm arborescent supporting offsets, on which to my surprise I was unable to find muscle-fibres. It seems as if in *Aulorchis* the ectodermal musculature is completely wanting; I would gladly have expressed something definite on this point, had the histological condition of the animal not been so indifferent; but the ectoderm, where present, was unfortunately reduced to a detritus, in which no structure could be detected.

In order to demonstrate how the stomidia penetrate the thickness of the oral disc, I have drawn two figures, in the one of which (Pl. III. fig. 4) are seen the openings of the tube to the exterior and to the cœlenteron; in the other (fig. 5) the section passes through a spot where the stomidial tube is closed at both ends, whence it may be

inferred that its diameter is here considerably greater than that of the two openings. The radial mesodermal muscle-fibres pass into its walls with a longitudinal trend.

On the stomatodæum are placed the two siphonoglyphes, which are of a very characteristic appearance, as being more powerfully developed than in any Actinia which I have as yet seen; each projects over the mouth edge and upwards with two long ear-shaped cones. The groove itself is correspondingly deep and broad, pleated, and of a cartilaginous consistence. Between the two siphonoglyphes run on each side about ten strongly-marked longitudinal ridges, terminating in rounded knobs on the lip.

In investigating the mesenteries, I could at least prove their arrangement in pairs, but could not convince myself that the Hexactinian symmetry was carried out. Neither by microscopic preparations of a sector, nor by dissection of individual mesenteries, could I arrive at a definite law of arrangement; this point therefore requires investigation.

The mesenteries dissected bore no generative organs; these appeared to me to be confined entirely to one mesentery, and to possess a tubular structure unparalleled in the whole class of Anthozoa, a fact which decided me to choose for the genus the name *Aulorchis*. Even before dissection it had struck me that at a spot on the edge of the lip, and by a pore specially present for the purpose, was the opening of a cylindrical organ; this organ had obviously once been longer, as at its end a fracture was clearly recognisable. By splitting up the opening and the adjacent stomatodæum, the organ, which I will term in future, for reasons to be mentioned, the genital tube, could be clearly followed into an inter-mesenterial chamber (Pl. I. fig. 9). It meets one of the complete mesenteries, lies at this point embedded in the tangle of mesenterial coils, and, as appeared later from sections, ends at the mesentery in a horseshoe-shaped curve. The curved portion was firmly united with the mesentery. Transverse sections yielded further conclusions relative to its structure; but, unfortunately, owing to bad preservation, no exhaustive account of this is possible. For instance, I have not been so fortunate as to determine how far the structure of the genital tube can be referred to that of the ordinary Actinian ovary (Pl. IV. figs. 1–6).

The genital tube is superficially clothed by epithelium, which is limited externally by a border resembling a cuticle, but perhaps produced only by mucous secretion; then follows the mesoglœa with the ova embedded in it; internal to these lies a cavity, more or less spacious according to the mass of the ova. The mesoglœa is divided by a narrow granular layer into inner and outer zones, which here and there, by failure of the intermediate layer, join together. The outer zone is narrow, and exhibits what appear to me to be circular muscle-fibres referable to the epithelium, which in longitudinal sections through the organ (fig. 3) resemble narrow laminæ placed close together. The state of preservation was inadequate for the determination of the histological character of the granular median layer; in transverse

section it gave the impression of a disintegrated epithelium, in longitudinal it resembled a loose connective-tissue. This layer is important as containing small, spherical, deeply-staining cells, which I regard as young ova. The masses of ova are in parts so considerable as to present the appearance of mosaic, if part of the wall of the genital tube be cut out, stained, and viewed from the surface (fig. 2). Next comes the second zone of mesoglœa, the layer of most importance, since ova of various sizes are embedded in it. Some of these are certainly connected with the superficial epithelium; this condition, I believe, occurs in all ova, and is effected by the fibre-arrangement characteristic of Actinian ovaries, of which remnants only could here be detected (fig. 1).

The lumen of the tube was mostly filled by a cell-detritus, but at some points was lined by a clearly ciliated epithelium (figs. 4, 6); I reckon therefore the lumen as a ciliated canal, serving for the transit of ripe ova and perhaps also of embryos, and opening to the exterior outside the oral disc. The ripe ova appear to lie on the floor of the tube, since here I found compact masses of a finely granular substance, appearing to me to resemble ova.

As to the distribution of the ova in the genital tube, I have the following facts to add: the smaller ovules are met with in sections through the upper part of the tube, forming a ring, on the one side of which the generative elements are more closely packed than on the other. This lop-sided development of sexual cells is expressed more obviously lower down, where on one side of the section they are entirely wanting, the ripening ova being only present in the other half.

With regard to the connection of the genital tube with the body of the Actinia, I have arrived at no positive results. At the pore, the organ merely perforates the oral lip without being attached to it, as I can assert both from macroscopic dissection and transverse sections; while at the lower end I have discovered no intimate connection with the mesentery; what I saw there was only an epithelial adhesion, not a transition from the mesoglœa of the mesentery into that of the genital tube. Such a connection, however, must certainly occur at this point.

From my description it may be recognised that *Aulorchis* is one of the most interesting Actiniæ, and that it would be very desirable that a richer material of it should be acquired by fresh Deep Sea investigations.

Family 7, Phellidæ.

Genus *Phellia*, Gosse.

Phellia spinifera, n. sp. (Pl. II. figs. 8, 9).

The bark-like part of the body-wall is bedecked with thorn-like pointed knobs, distributed more richly on the upper than on the lower parts.

with isolated complete ones. It is probable that, here and there, the one mesentery of a pair is formed, the other arrested. I was compelled to relinquish the determination of the number of the mesenteries, in order to spare the specimen. I counted, however, the number of tentacular papillæ, amounting to fifty-three; some of these, in the neighbourhood of the single siphonoglyphe, were very small. I infer from this that increase of the number of the tentacles was not yet concluded.

III. Edwardsiæ.

Family 11, Edwardsidæ.

Genus *Edwardsia*.

Edwardsia, sp. (?).*

Habitat.—Station 168, July 8, 1874; 1100 fathoms. One specimen.

The sole example of the genus *Edwardsia* which I met with in the Challenger material, and which came from a depth of 1100 fathoms, was so strongly contracted that the capitulum was concealed within the scapus, and in the posterior section was so completely crushed that it was difficult to detect the rounded hinder pole.

The surface is extraordinarily rough and bark-like, probably in consequence of an incrustation of mud on the cuticular layer; at the anterior end the entrance to the mouth is visible, and round it are eight radial furrows, which, owing to the indifferent preservation, could be followed only for a short distance upon the body-wall. The opening is slit-like; the wedge-shaped regions bounded by the furrows at the anterior pole are dissimilar in size, and are so arranged that the broadest is at one end of the slit, the smallest at the other, while the remaining six are symmetrically arranged right and left. At the posterior end of the animal, only seven of these furrows, which correspond to the mesenterial insertions, can be recognised.

I attempted to investigate the structure further by means of transverse sections, but was reluctantly forced to the conviction that nothing remained of the mesenteries and stomatodæum.

IV. Zoantheæ.

As the result of researches instituted by G. von Koch and myself, I have in my former Report separated from the hexamerous Actiniæ, the sharply marked group of the Zoantheæ, and have described as their representatives the genera *Sphenopus*, *Zoanthus*, and *Epizoanthus*.

I conceived it to be eminently inappropriate that such discordance should exist in the nomenclature of the individual species and genera of Zoantheæ, a discordance

referable chiefly to the fact that the forms described had been quite insufficiently studied, and that consequently the systematic characters had been referred to points of secondary moment only. In this condition of affairs no alteration has been effected by the monograph of Angelo Andres; the great abundance of forms cannot be compressed, as he has attempted to compress them, into the three genera, *Zoanthus*, *Palythoa*, and *Sphenopus* (the genera *Verrillia*, *Bergia*, and *Antinedia* having but a doubtful position, so long as we possess such scanty information about them as at present).

I have therefore requested Dr. Erdmann, one of my students in Bonn, to undertake a revision of the Zoantheæ with reference to the following important anatomical characters :—(1) condition of the cœnenchyme; (2) arrangement of the mesenteries; (3) structure of the sphincter; (4) condition of the integument; (5) colony-formation. His conclusions are as follows :—The Zoantheæ may live solitary (Sphenopidæ), or may form colonies (Zoanthidæ); in the latter case the cœnenchyme may either consist of basal stolons more or less branching, sometimes even anastomosing, or of a connecting lamella, or of a mass which unites the polyps almost for their whole height. The integument either consists merely of an epithelium and cuticle, or else there occur on it foreign bodies, which penetrate the mesoglœa of the body-wall, and more or less fill it. In the arrangement of the mesenteries two points are of importance: (1) that the pairs of mesenteries, with the exception of the directives, consist of a macro- and a micro-mesentery; (2) that a dorsal and a ventral zone of mesenteries must be distinguished. The two zones may approximate either with small (Microtype) or with large mesenteries (Macrotype). Finally, the sphincter exhibits three modes of formation; it may be (1) endodermal; (2) mesoglœal; (3) it may be mesoglœal, but distinguished by a muscle-free region into upper and lower portions.

With reference to the points above mentioned, Erdmann has distinguished five genera in the colonial Zoanthidæ, the characteristics of which may be followed without further comment in the accompanying table :—

Genus.	Mesenterial arrangement.	Sphincter.	Cœnenchyme.	Integument.	Generative organs.
Zoanthus.	Microtypal.	Mesodermal, duplex.	Stolonar.	Soft.	Hermaphrodite.
Mammilifera.	Microtypal.	Mesodermal, simple.	Stolon-like, with a tendency to form lamellæ.	Soft.	(?)
Epizoanthus.	Macrotypal.	Mesodermal, simple.	Connective, lamellar.	Incrusted.	Dicœcious.
Palythoa.	Macrotypal.	Endodermal.	Resembling a ribbon or tongue.	Incrusted.	Dicœcious.
Corticifera.	Microtypal.	Mesodermal, simple.	Polyps sunk in the cœnenchyme to their upper ends.	Incrusted.	(?)

The material which I was able to place at Dr. Erdmann's disposal was derived partly from the Bonn Museum, partly from the Triton expedition, but chiefly from the Challenger collection. For the descriptions of the Challenger Zoantheæ I give here short extracts from his Memoir,[1] for the accuracy of which I can vouch, as the whole investigation was carried out under my direction. I have achieved, what he omitted, in identifying as far as possible the forms obtained with species previously described, and, where that was impossible, have introduced new names, and have reduced the diagnoses of species to shorter and more precise terms.

Family 12, Zoanthidæ.

Genus *Zoanthus*, Cuvier (*pro parte*).

Integument not incrusted; cœnenchyme stolonar, with an occasional tendency to lamellar extension; sphincter differentiated into upper and lower sections; mesenteries arranged on the microtype.

Zoanthus danæ (?), Le Conte (Pl. I. fig. 1).

Polyps with fleshy body-wall, the larger borne on a stalk-like extension, and arranged closely together on reticulately branching stolons; approximately fifty tentacles arranged in two cycles.

Habitat.—Bermuda Islands; shallow water.

Dimensions.—Of the individual polyps—height, 0·5–2·5 cm.; breadth, 0·3–0·5 cm.

This animal, which I refer with considerable reserve to *Zoanthus danæ*, is identical with the *Zoanthus* which I have already described. To that description I can add the following points, based on Erdmann's researches:—

1. The colony grows on a foundation of rock in such a manner that the upper ends of all the polyps lie in the same plane. As the foundation is irregular, the individual polyps must be of unequal lengths, a result of which is that those animals which correspond to hollows in the foundation are produced posteriorly into a kind of stalk, distinguished from the body proper by a constriction, and by the thinner consistence of the body-wall.

2. A peculiar attachment of the cuticle to the body-wall, and one perhaps more widely distributed among the Zoantheæ, is effected by mesogloeal processes which perforate the epithelium and are inserted on the cuticle.

3. The colony investigated by Erdmann was sexually mature; ova and testicular follicles occurred in the same mesentery.

[1] Erdmann, Ueber einige neue Zoantheen. Ein Beitrag zur anatomischen und systematischen Kenntniss der Actinien, *Jenaische Zeitschr.*, Bd. xix. pp. 480–488, pls. iv. v.

Zoanthus confertus,* Verrill (Pl. I. fig. 12).

Polyps with thin transparent body-wall, so closely packed as to be polygonally flattened.

Habitat.—Simon's Bay, Cape of Good Hope ; 10–20 fathoms.

Dimensions.—Of the individual polyps—height, 0·6–0·8 cm. ; breadth, 0·3–0·4 cm.

The species is in general structure very close to the preceding, but differs in the thin consistence of the body-wall, through which may be seen the mesenteries, and in the compact arrangement of the polyps. The latter being consequently compressed polyhedrally, a character of importance is afforded for the species, which is further marked off by the transparence and delicacy of the body-wall.

Genus *Epizoanthus*, Verrill.

Integument incrusted, cœnenchyme (mostly ?) lamellar ; sphincter simple, mesoglœal ; mesenteries arranged on the macrotype ; colonies (mainly ?) parasitic.

Epizoanthus thalamophilus,* n. sp. (Pl. I. fig. 3 ; Pl. IV. figs. 7, 8).

Incrustation scanty, exclusively composed of Foraminiferal shells, which are arranged on the individual polyps into 15–20 longitudinal rows, bifurcating downwards ; body-wall transparent ; tentacles 30–40, very long, and arranged in two rows.

Habitat.—Station 299, December 14, 1875 ; 2160 fathoms ; on Gastropod shells.

Dimensions.—Height of the contracted individuals, 0·2–1·3 cm. ; diameter at the base, 0·9–1·5 cm.

"The colony of seventeen individuals has settled on a deserted *Fusus* shell about 8 cm. long. The polyps are principally situated on the back of the shell, and only the five young individuals at its apex are arranged in a whorl round it. The region round the aperture of the shell is free from polyps ; they rise with elliptical bases from a common cœnenchyme, and arch upwards like a dome. The largest specimens have a base of 10–15 mm. in diameter, and are 13 mm. high ; but we find every transition to the smallest specimens, which appear as flat elongated projections with a base of 5–9 mm., and a height of 1·5–3 mm. The cœnenchyme is a continuous sheet, 0·3–0·5 mm. in thickness, which covers the shell as far as the colony reaches. Towards its termination it becomes constantly thinner and more transparent, till it ends as a very delicate pellicle, which may be easily rubbed off. All the polyps were in a highly contracted condition ; and at the dome-shaped summit lies, on a prominence which is bounded by a circular furrow, the entrance to the interior ; it is hardly recognisable as an opening, and is formed by the indrawn parts of the body-wall. The latter is of slight thickness, so that the

mesenteries may be seen through it as clear stripes. In the external zone of its mesoglœa lie the deposits above mentioned, consisting exclusively of Foraminiferal skeletons. They are evenly distributed over the cœnenchyme; but on the body-wall are ranged in a most regular and elegant manner, the following facts being recognisable with the aid of a lens. From the apex outwards run, in a well-grown individual, fifteen to twenty looping rows of Foraminifera in clear elevated lines. Where the body-wall bends downwards at right angles, each row bifurcates, and each branch so produced runs downwards on the body-wall in a straight line; a single row of Foraminifera is thus situated over each mesentery, the insertion of the latter being externally clearly recognisable, owing to the thinness of the wall. While therefore, from the apex of the polyp outwards, the ridges agree in number with the pairs of mesenteries, in the lower part of the body-wall there are present as many rows of shells as there are individual mesenteries. Towards the base these become less plain, so that at the lowest part of the polyps, as on the cœnenchyme, the Foraminiferal coating is evenly distributed all over" (Erdmann). The rows of shells are continued on to that region of the body-wall which has been drawn inwards; and their arrangement can here be only understood by referring to the point of transition from body-wall into oral disc. This occurs along an undulating curve, since at one point the oral disc with its outer circlet of tentacles, at another the body-wall with its rows of shells, projects the farthest. A horizontal section therefore, through the region under discussion, meets alternately with rows of Foraminifera and the origins of tentacles (Pl. IV. fig. 8). Further, at the point of junction, the body-wall forms a strongly projecting fold in which lies the greater part of the sphincter (Pl. IV. fig. 7). The horizontal section represented in fig. 8 exhibits this fold on the inner side, while on the outer lie the body-wall and oral disc, united by mesenteries.

The fold of the body-wall bears, on both sides, rows of Foraminiferal shells, supported on ridge-like processes of the body-wall, and appearing therefore in transverse section as coronets; they are, as we learn from longitudinal sections, discontinuous at the free edge of the fold, so that the outer and inner rows of shells do not pass into each other.

The sphincter embedded in the fold of the body-wall is mesoglœal and simple, and forms here an evenly distributed complex mass of muscle-bundles, the latter being variously shaped. It also overlaps a small strip of that region of the body-wall which is not drawn inwards.

The tentacles are, as in other cases, in two alternating circlets, and are in part produced into long pointed filaments, in part contracted into short stumps. Their muscles are ectodermal and slightly pleated; the mesoglœal supporting lamina lying at the base of the pleats sends processes into the epithelium.

The stomatodæum is oval, and the siphonoglyphe only slightly expressed.

The number of mesenterics varied in the three speciniens investigated between twenty-eight and thirty-six, according to their size. The dorsal and ventral zones of mesenteries approximate always with macromesenteries.

No channel filled with cells is present at the bases of the mesenteries; the muscle-pennons indistinct; the generative organs so abundantly developed as to fill the greater part of the cœlenteron. These latter occur only on the macromesenteries, and consisted of testicular follicles in the three specimens studied.

The cœnenchyme is extremely thin, and possesses internally smooth connecting-tubes lined by endoderm; on the upper surface Foraminiferal shells are sparsely embedded; while on the other side, which covers the Gastropod shell, these are entirely absent.

The name *thalamophilus* was chosen with reference to Thalamophora and Polythalamia, names which have been applied to the Foraminifera.

Epizoanthus stellaris,* n. sp. (Pl. I. fig. 4).

"Polyps of inconsiderable height, nearly saucer-shaped; body-wall vertical at the sides, but strongly flattened above; on its horizontal upper surface are numerous radial ridges, separated by furrows, 15–20 in the adult animal; colour of the colony dark greyish-brown; deposits very various."

Habitat.—Station 201, off Samboangan, Philippine Islands; 82 fathoms.

Dimensions.—Of the individual polyps—height, 0·05–0·4 cm.; diameter, 0·15–0·7 cm.

"Of this species I possess a colony, covering the rooting spicules of a *Hyalonema* for a distance of about 14 cm., and consisting of about 100 individuals. The cœnenchyme forms a tube open at both ends, and surrounds like a sheath the bundle of spicules, the latter being about 5 mm. thick. The individuals spring from it at longer or shorter intervals by an elliptical base, measuring in the largest polyps (3–4 mm. high) about 5–7 mm. in diameter. From these to the smallest, which hardly project above the cœnenchyme, and are 1·5–3 mm. broad, by 0·5–1 mm. high, every transition is found. All the animals are strongly contracted; on the strongly flattened, discoidal, horizontal surface of the body-wall may be dimly seen the entrance to the interior by a circular pit. From this point outwards radiate over the surface of an adult specimen, about 15–20 ridges separated by furrows.

"The colour of the colony is a dirty dark-grey. The body-wall is of considerable thickness, caused by the strongly developed mesoglœa. The exterior surface of the latter is charged with various deposits, consisting of irregular grains of sand and lime, sponge spicules of very varied origin, and finally of the small dark crystalline bodies which cause the dark tint of the colony. These deposits occur in additional quantity on the radial ridges before mentioned. They are continued inwards as elevated ridges over the edge of the covering fold without a break, and run even further, on the inner

face of the indrawn part of the body-wall. Sections through the upper region of the polyp yield appearances similar to those described under the preceding species, though, owing to the abundant and various deposits enclosed, they are not so regular and elegant.

"In those inner parts of the mesoglœa which are free from adventitious accretions there lie embedded in the homogeneous matrix—1. fine radial fibres, penetrating the whole thickness of the soft mesoglœa, provided here and there with nuclei; 2. round mesoglœa-cells containing a large nucleus; 3. round or oval spaces packed with cells. Hertwig, who has observed similar structures in the *Epizoanthus parasiticus* described by him, conjectures that these oval cell-islets are produced only by indifferent preservation, and result from the breaking down of a system of anastomosing cords, such as the mesoglœa of *Zoanthus* exhibits. I [Erdmann] am inclined to regard these roundish heaps of cells as primary structures, like the canals of *Zoanthus*, since I have been able to recognise them in almost all my species of *Epizoanthus*, which were without exception in a very good state of preservation. As to their origin I have no data; but there is no reason why they should not be referred to an ectodermal origin as well as the cell-canals of *Zoanthus*, the derivation of which from ectoderm is indisputable; besides, many of these cell-islets clearly exhibit an elongate outline, with here and there even a slight tendency to branch, by which an external approximation to *Zoanthus* is effected.

"The mesoglœa of the mesentery is well developed, and on its inner edge is thickened like a club. The micromesenteries project only slightly into the interior, but, like the macromesenteries, clearly present marked muscle-pennons. On these mesenteries there springs on the side opposite to the muscle-pennons a mesoglœal lamella, which is considerably elongated in order to carry the generative organs and to form, centrally to these, the mesenterial filaments. The former are present in considerable numbers; and, being cut more or less superficially owing to the contorted course of the mesentery, may be recognised in transverse section as roundish balls enveloped in a thin mesoglœal lamella, pressed against the body-wall and generally filling the adjacent chamber. All the specimens which I investigated were female, the generative balls consisting of a large number of ova closely appressed together, but separated by a fine mesoglœa lamina.

"The body-wall is deeply drawn inwards, and conceals in this region a strongly built sphincter, which has the shape described for the preceding species, but which is distinguished by a greater complication in the branching of the bundles of fibrillæ.

"The stomatodæum is oval, with a clearly defined siphonoglyphe. The ensheathing cœnenchyme measures 1–1·3 mm. in thickness; in its interior run longitudinally numerous connecting tubes. The mesoglœa carries on its surface foreign deposits of the same character and quantity as those on the body-wall, but the inner face, which lies

on the foundation, is completely free from incrustation. The soft mesoglœa of the cœnenchyme is, with reference to histological differentiation, in the same relation to the body-wall as it is in *Zoanthus*, since here also, in addition to the other points of marked agreement, the nucleated fibres are supplanted by mesoglœal cells.

"With a view to observing the mesenterial arrangement, I studied two examples, one of medium size, and one fully grown; both exhibit the regular macrotype. In the younger specimen occurred a symmetrical arrangement of the pairs of mesenteries; of these there were sixteen, seven being regularly distributed on each side of the directives. The other polyp possessed nineteen pairs, of which nine were situated on the one side, and eight on the other."

Epizoanthus elongatus,* n. sp. (Pl. I. fig. 2).

"The individual polyps form elongated cylindrical tubes, the body-wall is flattened above, with a marked indentation, but terminates without radial furrows; colour of the colony a yellowish-grey."

Habitat.—Station 322, off Monte Video; February 26, 1876; 21 fathoms.

Dimensions.—Height of the polyps, 0·05–1·0 cm.; breadth, 0·15–0·4 cm.

"This species can only be externally distinguished from the preceding. The colony is 10 cm. high, consisting of about 100 individuals, and lives on a bundle of the siliceous threads of a *Hyalonema*, about 3 mm. only in thickness. The largest polyps are long cylindrical tubes, about 8–10 mm. high and 3–4 mm. broad; in their neighbourhood occur gradations to the youngest buds, which are small warts projecting from the cœnenchyme, of 0·5–2 mm. in height, 1·5–2·5 mm. in breadth. All the animals are in a state of the most marked contraction; the horizontal upper surface of the body-wall is more or less flattened, and exhibits a circular indentation. This part of the body-wall is entirely free from radial ridges and furrows. The colour of the colony is a greyish-yellow.

"The body-wall is thinner than in the preceding species, and possesses in its outer zone the same deposits, though in smaller quantity. The remaining anatomical and histological relations agree closely with those of the former species, but it is important to observe that the sphincter is less strongly developed. The body-wall is drawn inwards less deeply; its sphincter is in transverse section correspondingly short, but curved, and pointed at both ends. The generative organs consisted of ova in the five specimens investigated."

Epizoanthus cancrisocius,* Studer (Pl. I. fig. 15).

Colony much incrusted, and consequently so brittle as to break readily in pieces; individual polyps slim, body-wall at the upper end bent outwards in the contracted

condition into a plate-like expansion, from the indented centre of which run 15–20 furrows towards the thickened edge.

Habitat.—Station 49, May 20, 1873; 85 fathoms, upon a Gastropod shell tenanted by a *Pagurus*, the shell entirely dissolved away by the cœnenchyme.

Dimensions.—Length of the polyp, 0·6–1·0 cm.; breadth, 0·3–0·5 cm.; colour, greyish-yellow.

"This species forms a colony of eleven individuals, on a shell some 2·0 cm. high. The calcareous substance of the latter is completely absorbed, and at all points replaced by the cœnenchyme, the latter having obviously taken its place, while preserving its external form. Only the anterior side of this cœnenchymatous structure, *i.e.* the part directed forwards in movement of the Crustacean, possesses polyps; the free posterior side allows the coils of the former Gastropod shell to be clearly recognised. Of the eleven individuals, eight large mature polyps occupy the edge of that side which is directed anteriorly in the movement of the crab. They form long cylindrical tubes, 6–10 mm. high and 3–5 mm. broad. In the median space which they bound, stand three very young polyps, projecting as vertical cylindrical warts from the cœnenchyme, with height and breadth alike of 1·5–2 mm. One may remark that the large polyps bend forwards, *i.e.* their oral discs face upwards, in the direction corresponding to the locomotion of the *Pagurus*, so that they are most favourably placed for the reception of the food matters which stream against them. Owing to the curving just mentioned, the large polyps are above strongly compressed laterally.

"The whole colony has a rough shagreen-like exterior, of a grey colour. The otherwise smooth body-wall forms above a horizontal plate, which not only projects like the capital of a column over the vertical part, but has also a characteristic sculpture, and the appearance of a plate with raised edges and indented centre; in the middle of the latter lies the entrance to the interior, which is slit-like, corresponds to the lateral compression, and is always recognisable as an obvious opening. From this median point outwards radiate over the plate-like surface 15–20 radial furrows, which are continued outwards for a short distance over the marginal thickening, appearing on it as deep notches.

"When a polyp is opened with scissors, one remarks that the mesenteries run down the whole length of the body-wall, but do not pass over on to the horizontal floor of the cœlenteron. In the lowest parts of the polyp, the mesenteries are visible as slightly projecting ridges, striking the eye by their clear colouring; at about one-fourth of the total height, the macromesenteries form filaments; these are yellowish-white contorted coils, which completely obscure the micromesenteries. One can without damage remove the mesenteries from the body-wall, and study them independently. The supporting lamina of the mesenteries is very thin, and runs simply to the base without any excavation; the mesenterial filaments are of the customary

structure. I have been unable to detect generative organs in any specimen investigated.

"Owing to the abundant incrustation, the body-wall becomes as hard and brittle as stone, and does not permit therefore of investigation by means of sections. In this case therefore, and in the remaining forms with similarly strong incrustation, I made use of the method of grinding tested and recommended by G. v. Koch in his researches on *Tubipora*.

"The body-wall is of considerable thickness; its mesoglœa exhibits a structure very different from the remaining species of *Epizoanthus*, as being penetrated by deposits throughout its whole depth. These deposits consist of particles of sand with irregular angles, and are set in a strong circular fence, reducing the mesoglœa to thin lamellæ; but there persists a very narrow internal lamella bounding the endoderm all round. In the homogeneous mesoglœa-lamellæ are situated roundish cells which give off fine radiating processes, and fine fibres provided with nuclei; the presence of the cell-heaps, which are to be met with in the remaining species of *Epizoanthus*, I was unable to demonstrate in this case. A transverse section through the wall of the shell exhibits a similar condition in the cœnenchyme. This latter is also of considerable thickness, and is internally traversed by the large endodermal tubes which connect the various cœlentera together.

"The body-wall is, as has been already mentioned, bent above at a sharp angle, thus forming a plate-like surface. In contrast to the remaining members of the genus, where it turns deeply inwards vertically, it is here only slightly invaginated, a difference resulting from the slighter development of the sphincter. The latter commences to a certain extent on the horizontal part of the body-wall, and then thickens gradually into a truncated muscular mass, which appears fusiform in section, and is only slightly curved inwards. It lies enclosed in the innermost lamella of mesoglœa; the latter is thus much thickened, and is free from adventitious deposits. The sphincter is on both sides bounded by a layer of mesoglœa, which extends inwards to the commencement of the oral disc, is charged with the usual accretions, and is a direct continuation of the outer sandy layer."

So much for the anatomical description given by Erdmann, which sufficiently proves that *Epizoanthus cancrisocius* must be separated systematically from *Epizoanthus parasiticus*, the latter possessing larger and coarser polyps and far less incrustation. I have identified the animal with the *Epizoanthus cancrisocius* of Studer, as he records for his specimens similar dimensions, and a marked incrustation, at least for the basal membrane.[1] In other points his description is not sufficiently exhaustive, and this is still more true of Gray's account.[2] Only the statement of the latter that the large

[1] *Monatsber. d. k. Akad. d. Wiss. Berlin*, 1878, p. 547.
[2] *Proc. Zool. Soc. Lond.* 1867, p. 287.

polyps break up easily, and the reference to a figure of Gosse's which recalls our *Epizoanthus cancrisocius*, make it probable that his *Epizoanthus papillosus* and the *Epizoanthus cancrisocius* are identical.

Erdmann refers it in his Memoir to the expedition of H.M.S. "Triton." I find, however, his specimen in a bottle from the Challenger collection, with the label given above; some mistake must therefore have occurred in his manuscript.

Genus *Corticifera*, Lesueur.

Cœnenchyme extending from the base upwards between the individual polyps, and uniting them together almost as far as the upper edge of the body-wall; integument incrusted; sphincter mesoglœal; mesenteries arranged on the microtype.

On the above diagnosis I may remark that, on the body-wall of each polyp may be distinguished two regions, the one surrounded by cœnenchyme, the other projecting freely above it. When the animal contracts, the latter is drawn inwards to the level of the cœnenchyme as in Madreporaria; it partly serves to close over the anterior end, and partly is invaginated inwards. A colony in contraction consequently forms a crust-like covering, in which the individuals are only indistinctly marked off from each other.

Corticifera lutea,* Quoy and Gaimard (Pl. I. fig. 6).

Individual polyps marked off by fairly obvious stripes on the cœnenchyme, and recognisable as annular ridges on the common surface of the colony; they differ but little from each other in size.

Habitat.—Bermuda, June 1873; shallow water.

Dimensions.—Height, 1 cm.; breadth, 0·4–0·5 cm.; colour, yellowish-white.

"The colony at my disposal consists of a flat, quadrangular, crust-like structure, about 16 cm. long and 7 cm. broad. It does not present a complete whole, but is merely a piece torn off from a larger mass, carrying about 400 individuals; the latter reach a height of 10–15 mm., and are in diameter 4–5 mm. It must be insisted that this external height of the polyps in no way corresponds to the internal, since the cœnenchyme forms on the under side so thick an investment that of the total height only about two-thirds belong to the cœlenteron, the other third to the cœnenchymatous layer beneath. All the individuals are strongly contracted, and the body-wall is drawn deeply inwards. The edge of the body-wall projects above the general surface as an annular depressed ridge, in the centre of which lies, always clearly open, the aperture to the interior. At the unmutilated edge the individuals stand out as slight swellings.

"In that part of the cœnenchyme which borders on the ectoderm, are present numerous accretions, producing a firm pellicle. The main bulk of the incrustation consists of irregularly-shaped calcareous bodies; besides these, occur more sparingly

Foraminiferal and Radiolarian skeletons, and finally, numerous Sponge-spicules of various kinds. In the cœnenchyme between the polyps, the accretions are present only in small quantity, and fill here simple scattered cavities, which may be recognised after decalcification as wide lacunæ. The rest of the cœnenchyme is soft; and in its homogeneous matrix we meet with large canals, lined by pigmented epithelium and traversing the cœnenchyme in every direction; they are especially numerous in the lower cœnenchymatous investment, which consequently presents a reticulate spongy texture. As appears from longitudinal sections, these canals are direct continuations of the cœlenteron from the base of the polyp outwards, and extend from this point upwards through the whole of the cœnenchyme; they may consequently be homologised with the endodermal connecting tubes to be found in all Zoanthidæ. The mesoglœa of the cœnenchyme exhibits also numerous roundish cell-islets lined by epithelium, in which we may perceive the origin of such ectodermal cell-heaps as have been described for *Epizoanthus*. The whole of the endodermal epithelium is pigmented by dark granules, as are also the large endodermal connecting-tubes. On the other hand, the roundish cell-aggregations just mentioned are free from pigment granules; this difference of condition affords an indirect proof that the latter are by no means of endodermal origin, but are purely ectodermal structures. Finally, the soft cœnenchyme exhibits fine nucleated fibres starting from the endoderm, and, as is usual, numerous mesoglœal cells provided with fine processes.

"The main bulk of the whole colony is to be regarded as cœnenchyme; the individual polyps consist merely of a mesoglœal cylinder lined internally by endoderm, of moderate thickness and homogeneous consistence. The supporting lamina of the mesenteries is of similarly weak development. Below, the latter enclose a canal filled with cells, which in the case of the macromesenteries is frequently divided up by cross anastomoses. The muscle-pennons are well developed, and appear, especially in the larger mesenteries, as branching processes, which extend over a wide stretch of the mesentery. Nothing of interest can be said about the mesenterial filaments. In none of the specimens investigated could I find generative organs. The stomatodæum is pear-shaped in section, with a well-marked siphonoglyphe."

The sphincter is mesodermal, simple, and only slightly developed. It begins early, as a narrow strip, in that part of the body-wall which is drawn horizontally inwards, and extends without any thickening to the edge of the invaginated part. The number of the mesenteries, which are arranged on the microtype, varied in five individuals between thirty-four and forty.

Corticifera tuberculosa,* Klunzinger (Pl. I. fig. 5).

Individuals closely appressed together and flattened polygonally, generally separated by a deep furrow, and of very dissimilar sizes, so that the surface of the contracted

colony appears to be irregularly covered with knobs. These knobs exhibit radial furrows which run outwards from the indistinct opening.

Habitat.—Simon's Bay, Cape of Good Hope; 10–20 fathoms.

Dimensions.—0·6–0·8 cm. in height; diameter, 0·2–0·5 cm.

Colour.—Brownish.

The small colony of about forty individuals differs essentially from the above described *Corticifera lutea* in its external appearance. From the small development of cœnenchyme, it results that the individual polyps press closely on one another, and frequently become polyhedrally, generally hexagonally, flattened. They are separated by deep grooves on the surface, which, at few points only, become shallower or disappear altogether. The absence of the groove between two polyps possibly signifies a genetic dependence, the one having arisen by gemmation from the other; and smaller individuals are frequently adjunct to the larger polyps in this fashion.

The individuals of the colony are of most varying size; from the large dome-shaped convex animals with a diameter of 0·6 mm. those of intermediate size lead to the smaller, which measure only 0·1 mm. in the one direction and 0·2 mm. in the other. Since the surface therefore exhibits smaller and larger knobs, I refer the species to the *Palythoa tuberculosa* of Klunzinger, and have therefore retained the well-chosen specific name.

In length there is but little difference between the larger and smaller animals, the former measuring 0·6 cm., the latter 0·4 cm. As they all diminish downwards in a wedge-shape, the lower side of the colony is so much narrower that the polyps on the edge are nearly horizontal.

All the polyps are so strongly contracted that the entrance to the interior is recognisable only as an indistinct indentation, from which radiate outwards numerous shallow furrows.

With reference to the finer anatomy, what has been said for *Corticifera lutea* holds good in this species. In the two specimens investigated there were respectively thirty-four and thirty-six mesenteries, which followed the microtype.

Genus *Palythoa*, Lamouroux.

Integument strongly incrusted; cœnenchyme little developed, ribbon- or tongue-like; mesenterial arrangement on the macrotype; sphincter endodermal.

Palythoa anguicoma,* Norman (Pl. I. fig. 7).

Incrustation superficial, so that a thick layer of mesoglœa remains free of deposit; cœnenchyme tongue-shaped; individuals, when in a contracted condition, long, with a terminal capitular enlargement, on which run 15–20 radial furrows.

Habitat.—Station 135A, off Inaccessible Island; October 16, 1873; 60–90 fathoms; hard ground, shells, and gravel.

Dimensions.—Height of the polyps, 0·4–0·8 cm.; breadth, 0·2–0·4 cm.

Colour.—Brownish-yellow.

"From the material at my disposal, which appears to have been carelessly detached, the general form of the present species cannot with certainty be inferred. The greater part of it consists of single individuals, in which one can recognise the forcible detachment from the colony. One group, which to all appearance represents a complete and intact colony, is composed of four individuals; they are situated, in a row and at short intervals, on a thin cœnenchyme which is extended like a ribbon; their dimensions are 4–8 mm. high by 2·5–4 mm. broad. All the polyps are strongly contracted; the body-wall forms above, in this condition, an obliquely-angled ridge projecting outwards; its upper surface presents an elevation, rendered obvious by a circular furrow, in the centre of which the aperture to the interior is recognisable. From the middle of this upper surface radiate outwards 15–20 furrows, which are continued over the projecting ridge on to the vertical body-wall, where they then flatten out. The colour of the polyps is a dirty yellow.

"The integument is furnished with accretions, and exhibits a rough shagreen-like exterior. On rubbing away the thin sandy layer, there remains the thinner soft part of the mesoglœa, which is excellently fitted for the preparation of longitudinal and transverse sections with a razor.

"The soft mesoglœa is of considerable thickness, and consists of a homogeneous matrix, in which come into view the large number of cavities charged with cells. These may be simple, *i.e.* preserve their roundish or elliptical outline, or, as in most cases, may branch to form a system of anastomosing canals which entirely recall *Zoanthus*. Below the endoderm such a canal runs in an almost unbroken ring through the whole of the body-wall; it lies so close under the epithelium as to be separated from it only by a narrow lamella of homogeneous matrix. Its diameter is not constant throughout its whole circuit, but is frequently constricted, and occasionally such constriction produces an actual discontinuity. It is further of importance that the canal invariably presents a considerable hollow expansion under each mesenterial insertion. At many points can be demonstrated a communication between the smaller branching cell-canals and this large ring-canal, the latter being at such places apparently expanded into a kind of funnel. Further, there are found in the mesoglœa numerous mesoglœal cells, giving off fine processes; and, finally, delicate nucleated fibres, the course of which, however, is here not radial, but in the main circular.

"The structure of the cœnenchyme agrees in all respects with that of the body-wall, except for the fact that it possesses endodermal connecting tubes.

"The mesoglœa of the mesenteries is strongly constructed, and on it can be recognised well-developed muscle-pennons. The generative organs, borne in the supporting lamina, consisted of ova in the individual which I investigated. The mesenterial filaments are of the customary structure.

"The mesenterial arrangement is to be referred to the macrotype. The specimen investigated possessed thirty-six mesenteries, of which five pairs pertained to the dorsal zone, and thirteen pairs to the ventral; in the latter zone were ranged regularly, on each side of the directives, six pairs, consisting of a macro- and a micro-mesentery.

"The body-wall is drawn inwards at a right angle; on the inner side of this region a definite endodermal sphincter may be recognised. The pleatings of the endodermal muscle-lamina are more clearly marked than in *Palythoa axinellæ;* and produce on the mesoglœa prominent antler-like prongs. The accretions are continued on to the indrawn region of the body-wall, but die out at its lower edge, where the oral disc commences."

The identity of this animal with *Palythoa anguicoma* is doubtful, as Norman, who created the species, gave no figure of it. I was influenced by the circumstance that eighteen rough radial furrows are ascribed to this form; besides which the incrustation on it should be only superficial.

Palythoa, sp. (?)*

Habitat.—(*a*) Station 135 A, off Inaccessible Island, October 16, 1873; 60–90 fathoms. (*b*) Station 135 C, off Nightingale Island, October 17, 1873; 100–150 fathoms.

In the same bottle with *Palythoa anguicoma* was another species of *Palythoa*, which recurred in a second tube, the contents of which were dredged a day later than the first, and at a greater depth. The specimens in question could easily be distinguished from individuals of *Palythoa anguicoma* by containing black particles of hornblende. Erdmann attempts to separate the two species, and gives the following description:—

"In this species also the larger part of the material consists of individuals torn away from the colony; one colony, which was undoubtedly not mutilated, was represented by three individuals, ranged behind one another on a ribbon-like cœnenchyme. Externally this species differs from the preceding in colour only, which is in this case a dull grey-brown; besides this, from the greater firmness and unevenness of the body-wall, it may be recognised that the mass of accretions is greater. The body-wall presents, in contrast to the former species in which the relations are reversed, a considerable zone charged with accretions, opposed to a slightly-developed soft zone of mesoglœa. In the latter there passes close under the endoderm a cell-canal, frequently constricted, but rarely interrupted; external to this follow immediately the accessory deposits, so that of the numerous canals and spaces observed in the preceding species only a few roundish cell-islets are preserved."

Palythoa (?) sp. (?)*

Habitat.—Station 299, west of Valparaiso, December 14, 1875; 2160 fathoms.

I found a small Actinia, labelled "Actinia on nodule," which had settled on a piece of pumice near an Ascidian. The animal, being incrusted with sand particles, probably belongs to the *Palythoæ*, but its minuteness and the sandy incrustation forbade a detailed study. The body, not so much as 1 mm. high, was flattened into a disc 5 mm. broad. The number of mesenteries which, as in the Zoantheæ, were very regularly arranged, amounted to thirty-two.

Family 13, Sphenopidæ.

Genus *Sphenopus*, Steenstrup.

Sphenopus pedunculatus,* n. sp. (Pl. I. fig. 11).

Body marked off into an upper swollen trunk, an elongate narrow foot, and a broad sole-like (?) "clasping-disc;" from the apex run, over the upper part of the trunk, about 10–12 indistinct rough furrows.

Habitat.—Station 203, off Panay, Philippine Islands, October 31, 1874; 12–20 fathoms. Three specimens.

Dimensions.—Length, 2·4–3·2 cm.; breadth, 2–2·4 cm.

Colour.—Grey.

"This species differs in many respects from the already known *Sphenopus marsupialis* (Steenstr.) and *Sphenopus arenaceus* (Hertw.). The fully-grown animal permits of an external differentiation into three regions. The most obvious part of such a polyp is formed by the upper bladder-like 'body' (Pl. I. fig. 11), which conceals within itself the organs of nutrition and reproduction. On it is marked off, by a more or less obvious cross-furrow, a hood-shaped anterior region, sculptured by coarse radial furrows. The body passes into a long narrow 'foot,' from which it is sharply defined by a marked furrow, and finally the foot broadens out at its base into a kind of 'clasping-disc.' The three animals of this species which were at my disposal represented stages of different age. In the oldest individual the bladder-like body has been irregularly contracted by preservation in spirit, its exterior is folded, and exhibits besides a lateral compression. The head region, defined by an obvious constriction, is strongly tuberculate, and marked by twelve coarse radial elevations, separated by discontinuous and incomplete furrows. The height of the body amounts to 2·5 cm., its greatest width to 2·4 cm. Sharply marked off from it by a circular furrow is the cylindrical foot, the diameter of which reaches 1·2 cm. Unfortunately this latter has been broken away, so that I can give no accurate information either about the total length, or about the clasping-disc of this animal. The second polyp was of medium

age; its total length amounted to 3·2 cm., of which 2·0 cm. belong to the body, and 1·2 cm. to the foot. The former is on one side crushed inwards about the middle, where it is of the greatest diameter (2 cm.), while on the other it is as strongly swollen out. Above, it diminishes gradually into the head region, which is indistinctly furrowed radially; and below, equally gradually, into the foot. The latter is cylindrical, and has a diameter of 0·5 cm., while the sole-like clasping-disc has at its base a breadth of 0·9 cm. The third and still younger polyp consists mainly of the 'body,' which above is flat and discoidal, without differentiation of a head-region, but is at the periphery pressed into folds; its height is 2·4 cm., its breadth 2·0 cm. Below it passes gradually into the foot, which is rudimentary, round, only a few millimetres high, and ends without a clasping-disc.

"For investigation I made use of the middle specimen, which was completely preserved. A longitudinal section dividing the polyp into two halves yielded the following results. The mesenteries run in the foot as clear narrow ridges on the body-wall, scarcely projecting into the interior; they extend also on to the horizontal pedal disc, and appear in this region as radiating lamellæ, which meet at the centre of the flat base. The filaments first appear on the mesenteries at the point of transition into the broader 'body;' they form a thick investment, which nearly fills the whole cœlenteron and covers the mesenteries completely. The body-wall is fairly thick, and even with the naked eye can be distinguished into two layers; an outer, which appears granular owing to the accretions, and an inner, which is soft, shining, and free from deposits. It is further noticeable, that the quantitative relations between the incrusted and the softer layers vary with the height of the part in question, and in such a manner that, at the upper part of the body, both parts are about equally strongly developed, while with increasing depth the harder constituents become more numerous, till at last, in the foot, a complete obliteration of the softer zone is produced. Above, the body-wall is drawn rather deeply inwards at a sharp angle. On to this infolded region the accretions are uninterruptedly continued as far as the point of origin of the oral disc, the latter being inserted just at the inner edge of the fold. The stomatodæum reaches far downwards, and is characterised by a siphonoglyphe of considerable depth.

"A transverse section in the region of the stomatodæum allows the mesenterial arrangement to be recognised even by the naked eye. The longitudinal section having been carried midway between two mesenteries on both sides, they were completely intact, and the combination of the two sectional halves yielded a complete picture of the mesenterial arrangement, which falls under the microtype. Sixty mesenteries in all are present; of these, after deduction of the regularly formed dorsal pairs, there fall into the ventral zone on each side of the directive macromesenteries, twelve pairs, consisting each of a macro- and a micro-mesentery.

"For a study of the anatomical relations in more detail, I made use of von Koch's

method of grinding. The integument is composed, as was stated above, of an internal softer zone, and an external zone penetrated by accessory deposits. The latter consist mainly of clear angular fragments of sand; but there occur also various indeterminable mineral splinters of different colours, and finally, more sparingly, Sponge-spicules and Foraminiferal shells. All these particles lie confusedly mingled, and so closely together as to form a stout external rind; between them they allow of only thin mesoglœa-lamellæ, in which are embedded fine nucleated fibres, as well as a few stellate mesoglœal cells. The zone of mesoglœa, which is soft and free from deposits, consists of a homogeneous matrix, in which sharply circumscribed lenticular cell-islets are embedded in large numbers and of various sizes. They are especially plentiful in the neighbourhood of the endoderm; but, in passing outwards, every gradation of size, up to fine fusiform structures, is met with. The plane of the long axis of these cell-islets is always circumferential. The nucleated fibres are extremely abundant in the mesoglœa; they extend from the endoderm outwards, their course being sometimes straight, but more generally undulating, with close coils almost like a cork-screw. Besides the contents already mentioned, one observes also the existence of stellate mesoglœal cells, which are sparsely scattered and emit fine processes into the homogeneous matrix.

"The supporting lamina of the mesentery is well developed, and presents an antler-like muscle-pennon. At its base passes a canal, filled with cells, and penetrating the mesenteries for their whole length; in transverse sections through the micromesenteries this appears simple and cylindrical, but forms on the macromesenteries a longer cavity divided up by cross anastomoses. This quite subordinate character accompanies the microtype through all the genera, however different both externally and anatomically; no macrotypal form showing even a trace of this mesenterial canal.

"The sphincter of *Sphenopus* is mesodermal and simple, and is so far characteristic that it commences incomparably deeper than in any other known Zoanthean; it extends so deeply downwards in the outer part of the body-wall, that, even in the contracted animal, its lowest point lies in the same horizontal plane as the lower end of the stomatodæum. In longitudinal section one can see how, at its deepest point, the bundles of fibrillæ, like small circles, are laid so closely together that they appear almost to form a continuous line. Above they are more extended, and place themselves with the long axis perpendicular to the endoderm, from which they are only separated by a narrow lamina of homogeneous mesoglœa. In this condition the sphincter forms a system of bacillate fibrillæ-bundles, which are arranged extremely regularly in the form of a palisade. At the edge of the infolding of the body-wall the bundles begin to bay out irregularly, and finally set themselves, on the indrawn part of the body-wall, to form the sphincter proper, a plait of delicately branching and anastomosing bundles. This circular muscle increases in bulk downwards, and terminates below with a rounded

end. It does not completely traverse the mesoglœa, but leaves free on either side a homogeneous layer, which in its turn is bounded by a stripe reaching to the commencement of the oral disc, and carrying the usual hard deposits."

Sphenopus arenaceus, R. Hertwig.

Habitat.—Station 187, Torres Strait, Australia, September 9, 1874; 6 fathoms. Two specimens.

Sphenopus marsupialis, Steenstrup.

Habitat.—(*a*) Station 188, in the Arafura Sea, September 10, 1874; 28 fathoms. One specimen. (*b*) Station 208, Philippine Islands, January 17, 1875; 18 fathoms. One specimen.

In the Challenger material I have found four further examples of the genus *Sphenopus;* two of these I have determined as *Sphenopus arenaceus* on account of their rusty red tint, and other two as *Sphenopus marsupialis*, in consequence of the earthy-grey colour and the absence of a stalk. It seems to me, however, desirable that, with an opportunity of more abundant and fresh material, a renewed study should be undertaken to decide whether the received specific characters are variable, and whether all three species should not be united in the single *Sphenopus marsupialis*.

APPENDIX TO THE ZOANTHEÆ.

Genus *Stephanidium*, n. gen.

Among the Zoantheæ I include with some reserve a genus which is represented by a single species, and has thus been insufficiently investigated. It differs from the characteristic forms of Zoantheæ in the absence of incrustations, and the non-formation of a colony. Both characteristics, however, may be absent in true Zoantheæ, *e.g.* the soft-skinned *Zoanthus* and the solitary Sphenopidæ. Of more importance is the fact that, in spite of careful study, I have not yet been so fortunate as to demonstrate beyond all doubt the decisive characteristic of Zoantheæ, namely, the regular distribution of micro- and macro-mesenteries. I consequently omit to give separate diagnoses of the species and genus.

Stephanidium schulzii, n. sp. (Pl. I. fig. 14; Pl. III. figs. 1, 7).

Habitat.—Station 209, off Zebu, Philippine Islands, January 22, 1875; 95 fathoms.

Dimensions.—Breadth, 1·5–2·2 mm.; height, about 1·0 mm.

Some Actiniæ were forwarded to me by Prof. F. E. Schulze, found among the Hexactinellidæ entrusted to him for description; they were mainly small, insufficiently characterised forms, which I did not care to investigate; but among them occurred five

specimens of one species, which I will here describe on account of the striking appearance of the body.

The body of Stephanidium is in diameter 1·5–2·2 mm., and about 1 mm. high in the contracted condition. The epithelium had been stripped off at most points, and remained only on the lowest parts of the body-wall, the mesoglœa thus being exposed over a wide extent, and allowing the mesenteries to be seen through it. The resulting appearance is drawn in Pl. I. fig. 14, and was originally interpreted as follows:—I believed that the surface was indented by deep furrows corresponding to the mesenteries; the ridges lying between these furrows become narrower, from a definite part of the body-wall outwards; they are extremely unequal in breadth, a broader and a narrower ridge alternating regularly with one another, and to every broader ridge corresponds, at the upper edge of the body-wall, a special structure of the following nature: the edge of the body-wall is elevated into a kind of battlement (Pl. III. fig. 7), on the outer side of which are situated roundish or oval bodies, which call to mind the marginal spherules of *Actinia mesembryanthemum*. The longitudinal ridge of the body-wall meets the spherule, splits into two forks, and surrounds the structure from below.

Sections through the animal, however, showed that the body-wall is smooth, and that the appearance of furrows was caused by the insertions of the mesenteries. On the other hand, the spherules are really present, and form evaginations of the body-wall, above a spot which is marked by the position of the circular muscle (Pl. III. fig. 1). The latter, in spite of the contracted condition of the Actinian, is of weak development, and is merely a part of that endodermal circular muscle-layer which is at other points hardly recognisable, but is here elevated into small folds. It is most obvious at those places where it traverses the thickness of a mesenterial insertion; here the endodermal muscle-layer is not recognisable, but mesoglœal muscle-rings are embedded in the region of the sphincter, largest at the upper end, and becoming gradually less obvious in a downward direction, till one meets with small groups of only two or three fibres, or even with completely isolated fibres.

Of the tentacles and oral disc it can only be said that the ectodermal muscle-layer is strongly pleated.

The mesenteries, the number of which may be learnt even by superficial observation, amount to twenty-six, and are differentiated, as in the Zoantheæ, into macro- and micro-mesenteries. Of their arrangement, despite much trouble, I have not yet arrived at a completely clear comprehension, but I could demonstrate the probability that the directives of the one side are macro-mesenteries, those of the other micro-mesenteries, that dorsal and ventral mesenterial zones meet with micro-mesenteries, and that one pair is more developed on the one side than on the other.

The mesenteries (probably only macro-mesenteries) bore ripe male generative organs. I was unable to recognise a siphonoglyphe.

of *Diogenes varians*, in having the left chelipede with a tendency towards spinulation on its joints, and the lower border of the propodus curved; the ophthalmic scales also are sparingly dentate.

Diogenes guttatus, n. sp. (Pl. VI. fig. 4).

Characters.—The anterior portion of the carapace is slightly convex from side to side and smooth towards the centre; the front with its median process faintly marked, but a conspicuous projection external to each ophthalmic scale; the antero-lateral border (posterior to the insertion of the antennal peduncle) with an abrupt slope backwards, and armed with a few minute spinules; the lateral margin with about six acute curved spinules. The central portion of the carapace behind the cervical groove has a few granulations.

The rostriform process is entire, narrowing towards the acute apex which scarcely reaches the end of the ophthalmic scales; the latter are subentire, with two or three spinules at the inner and distal margin. The ocular peduncles extend to a point opposite the middle of the terminal joint of the antennal peduncle and the commencement of the same joint in the antennular peduncle. The antennal acicle is short, not reaching beyond the middle of the penultimate joint of the peduncle, and its inner border is quadrispinose; the second joint of the peduncle is broad, and possesses a prominent external spine; the flagellum is not twice the length of the carapace, and its under surface is fringed with long hairs.

The left chelipede has the meral and carpal joints subequal, slightly pubescent, and covered with spinuliform granulations, most strongly marked towards the borders, on which they become distinctly spinulous; the inner surface of the carpus is convex; the propodus is about one and a half times the length of the carpus, its outer surface is covered with perfectly circular, drop-like, and flattened elevations, the upper and lower borders are spinulous and almost straight; on the outer surface and near the carpal articulation are three curved denticles situated near the lower border, the inner surface is faintly granular; the dactylus has a series of dentations on the upper border and numerous granulations on the outer surface, the lower border is minutely toothed; the immobile finger has an obscure median ridge on the upper surface and numerous small teeth on the inner margin. The right chelipede is wanting in the single specimen. The first and second pairs of ambulatory limbs are smooth and sparingly ciliated, with a few spinules on the anterior borders of the meral joints; the dactyli are slightly bent, longitudinally canaliculate on the upper surface, and considerably longer than the propodi. The penultimate joint of the fourth leg has its lower border spinose.

The two terminal segments of the abdomen are smooth and moderately convex, the ultimate is longitudinally channelled.

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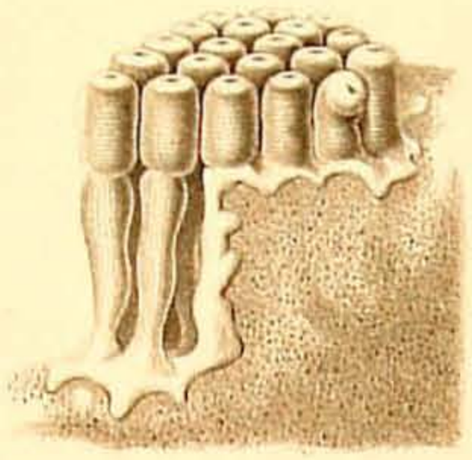

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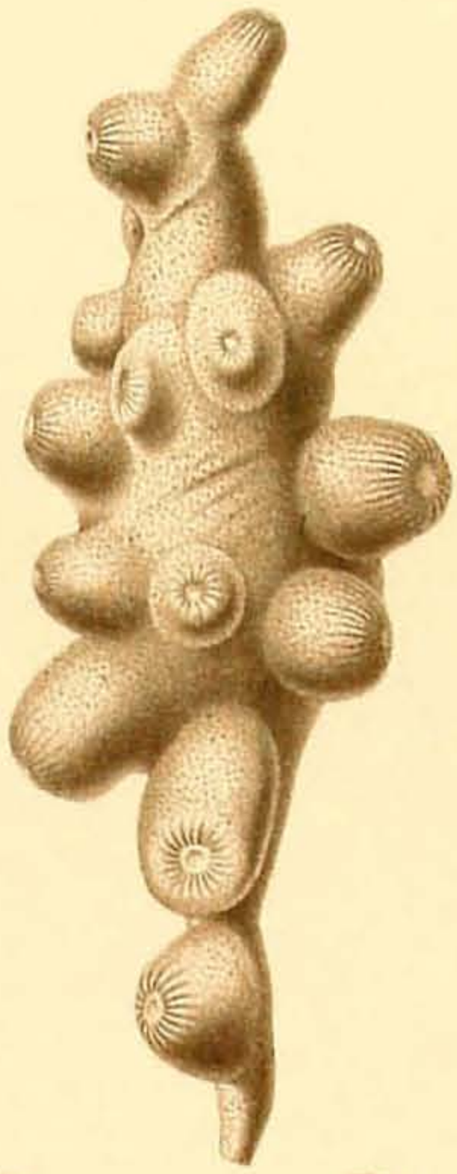

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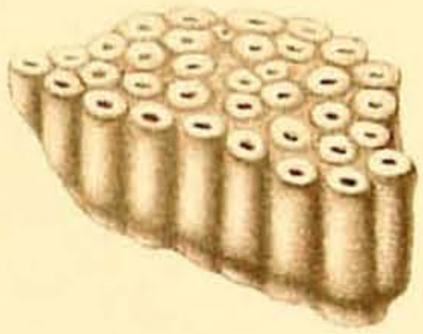

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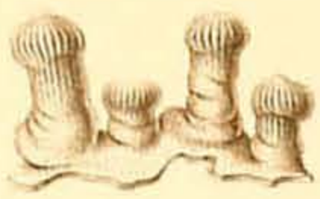

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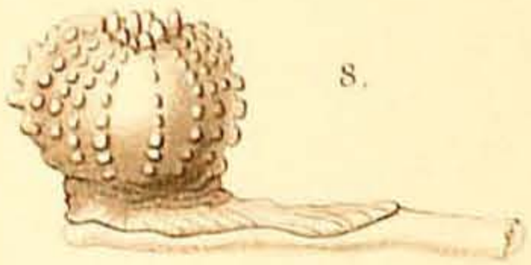

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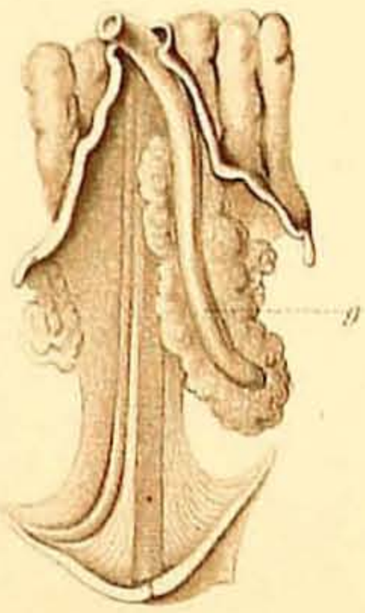

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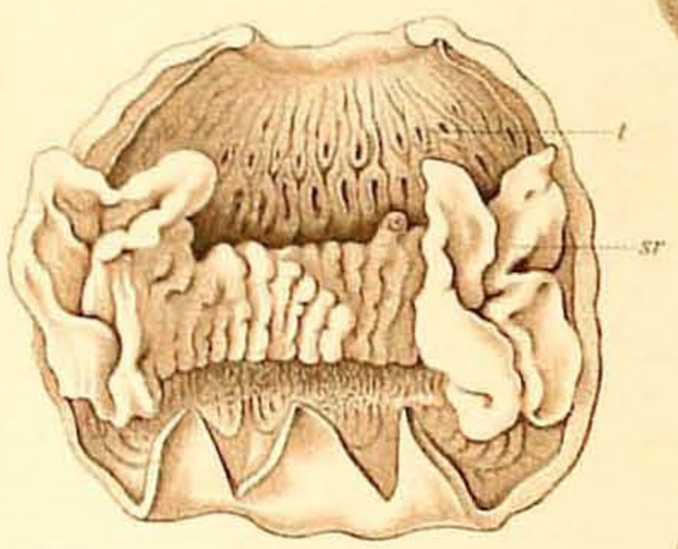

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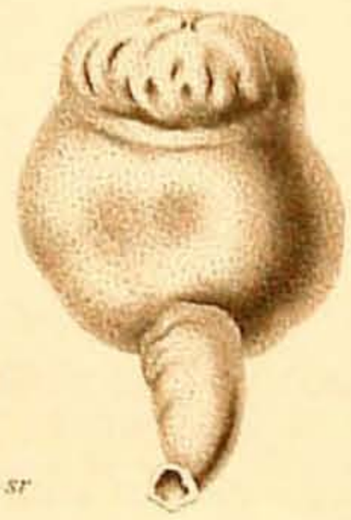

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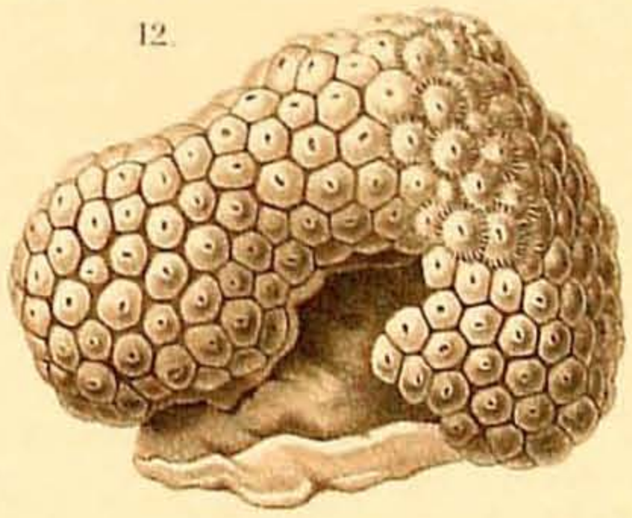

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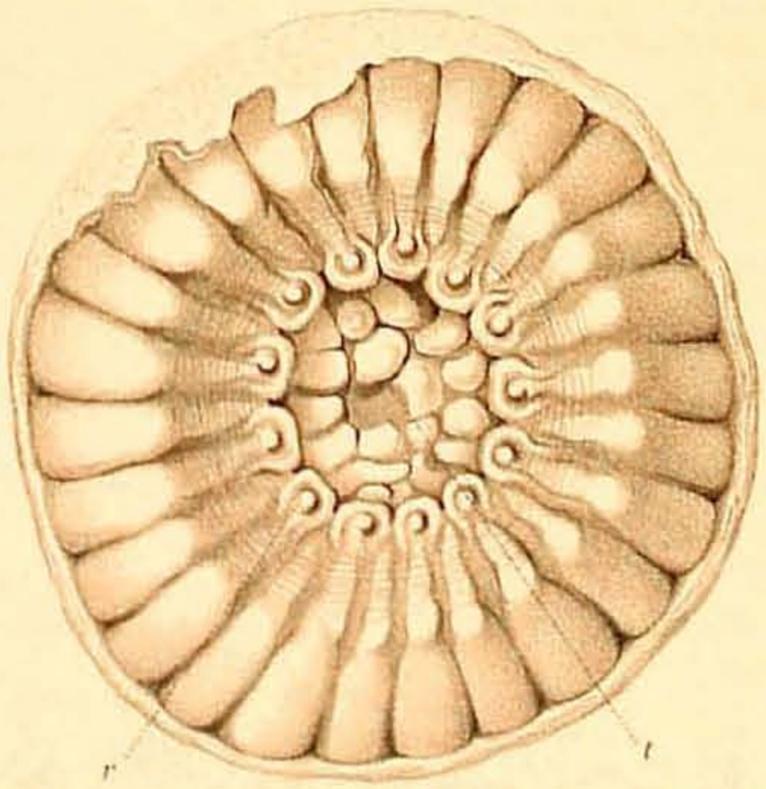

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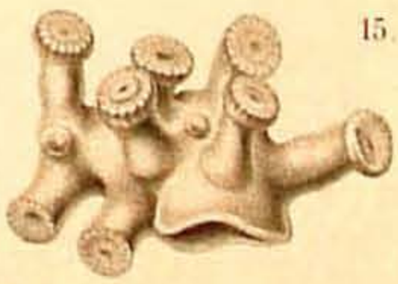

Hartwig et Kohlmann del.

Lith. Anst. v. Werner & Winter, Frankfurt a/M.

PLATE I.

The lettering is the same in all the figures.

cu Cuticula.
ec Ectoderm.
en Endoderm.
g Generative organs.
h Mesenteries.
im Intermediary layer.
m Muscle-fibres.
me Mesoglœa.
ms^1 Upper circular muscle.
ms^2 Lower circular muscle.
o Ova.
r Marginal spherules.
sr Siphonoglyphe (œsophageal groove).
t Tentacles.

All statements given as to magnifying powers have reference to Zeiss's system.

Fig. 1. *Zoanthus danæ.*

Fig. 2. *Epizoanthus elongatus.*

Fig. 3. *Epizoanthus thalamophilus.*

Fig. 4. *Epizoanthus stellaris.*

Fig. 5. *Corticifera tuberculosa.*

Fig. 6. *Corticifera lutea.*

Fig. 7. *Palythoa anguicoma.*

Fig. 8. *Amphianthus ornatum;* × 4.

Fig. 9. *Aulorchis paradoxa;* genital tube exposed by splitting the lip and the stomatodæum.

Fig. 10. *Aulorchis paradoxa;* siphonoglyphe, stomatodæum, oral disc, and mesenteries exposed on removal of about one-third of the animal.

Fig. 11. *Sphenopus pedunculatus.*

Fig. 12. *Zoanthus confertus.*

Fig. 13. *Liponema multiporum;* oral disc and stomatodæum evaginated.

Fig. 14. *Stephanidium schulzii;* × 30.

Fig. 15. *Epizoanthus cancrisocius.*

(Figs. 1–7, 11, 12, 15 are after Erdmann.)

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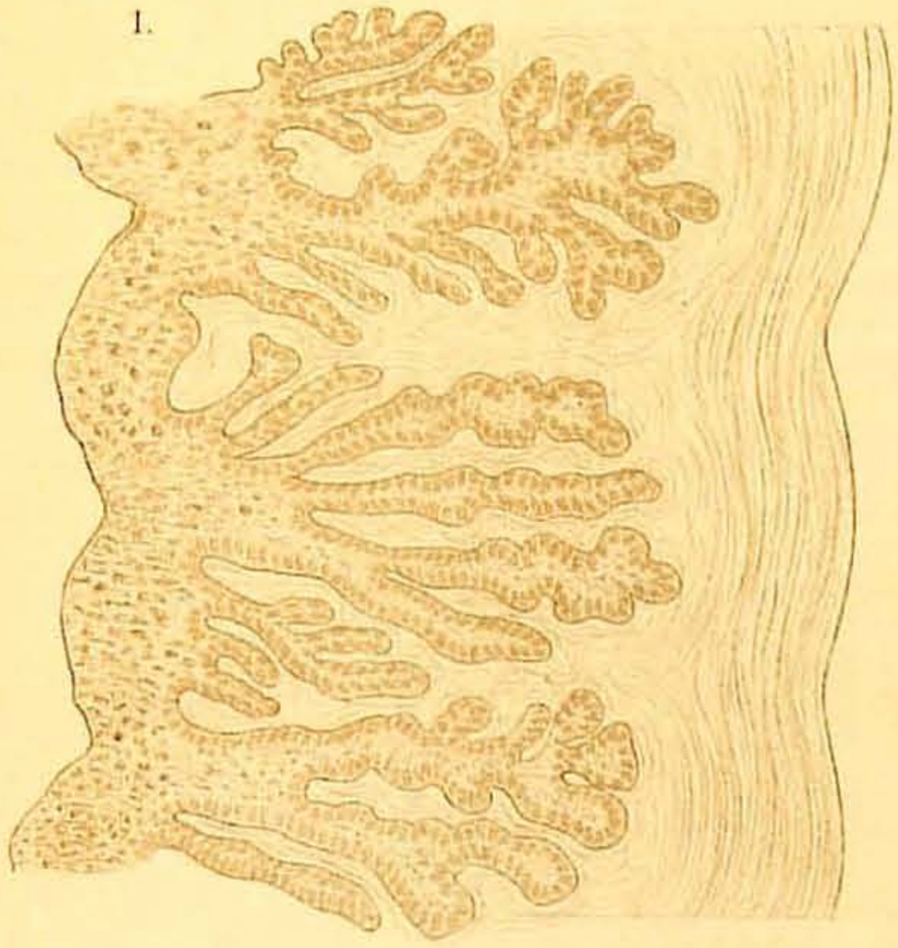

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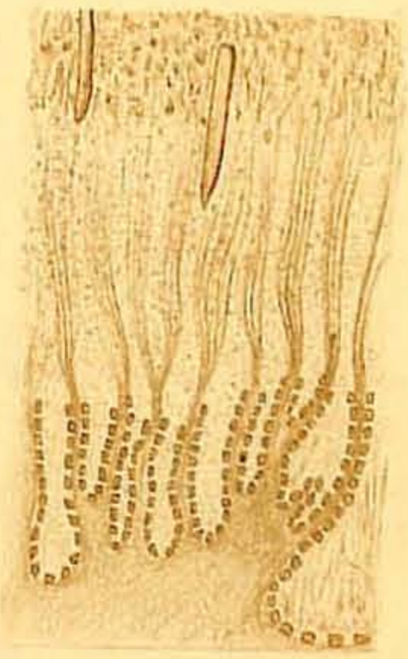

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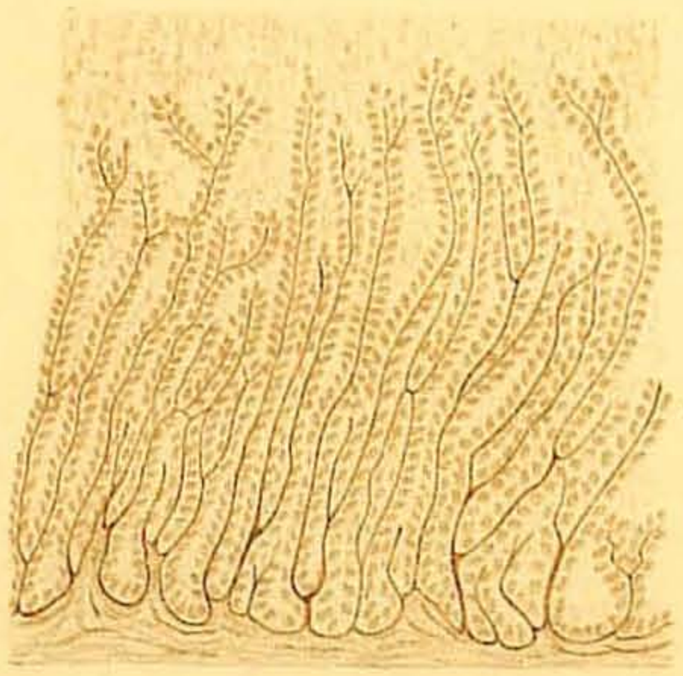

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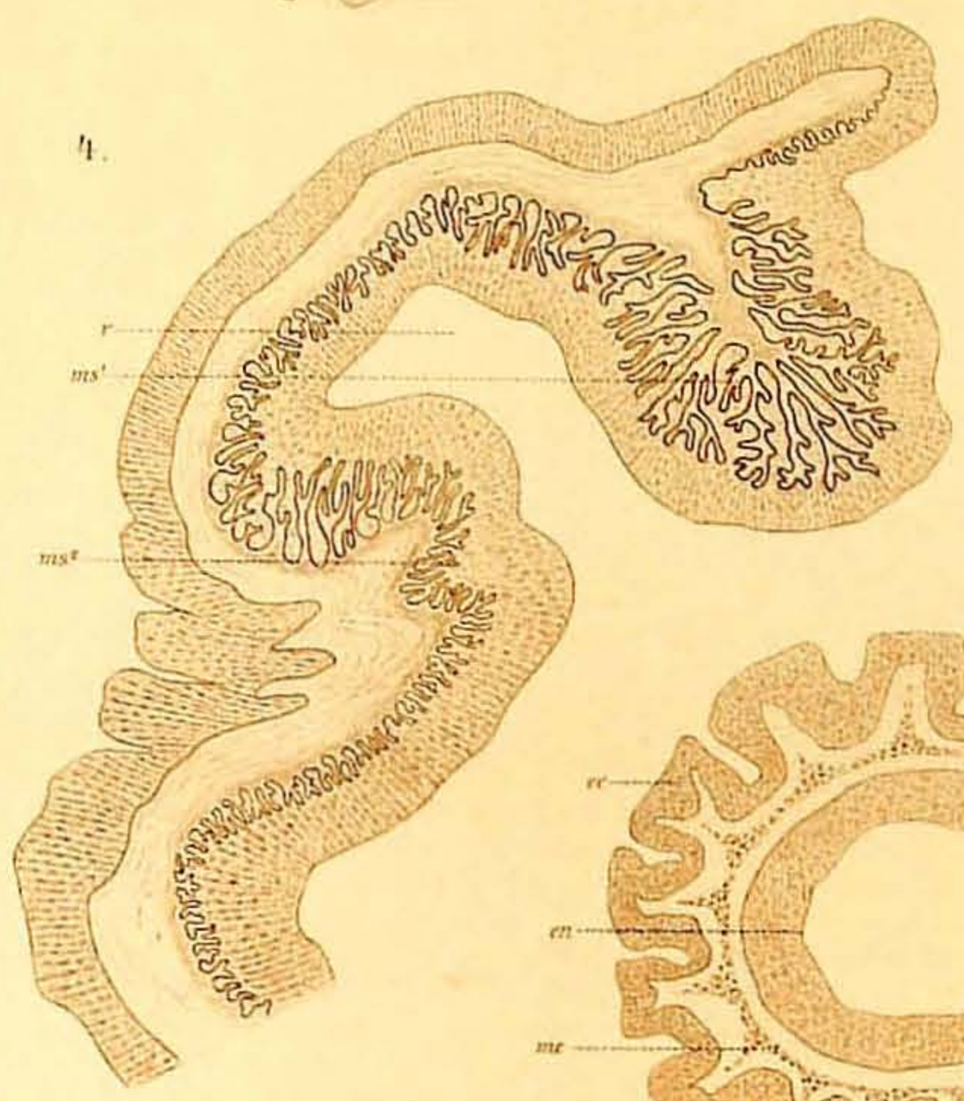

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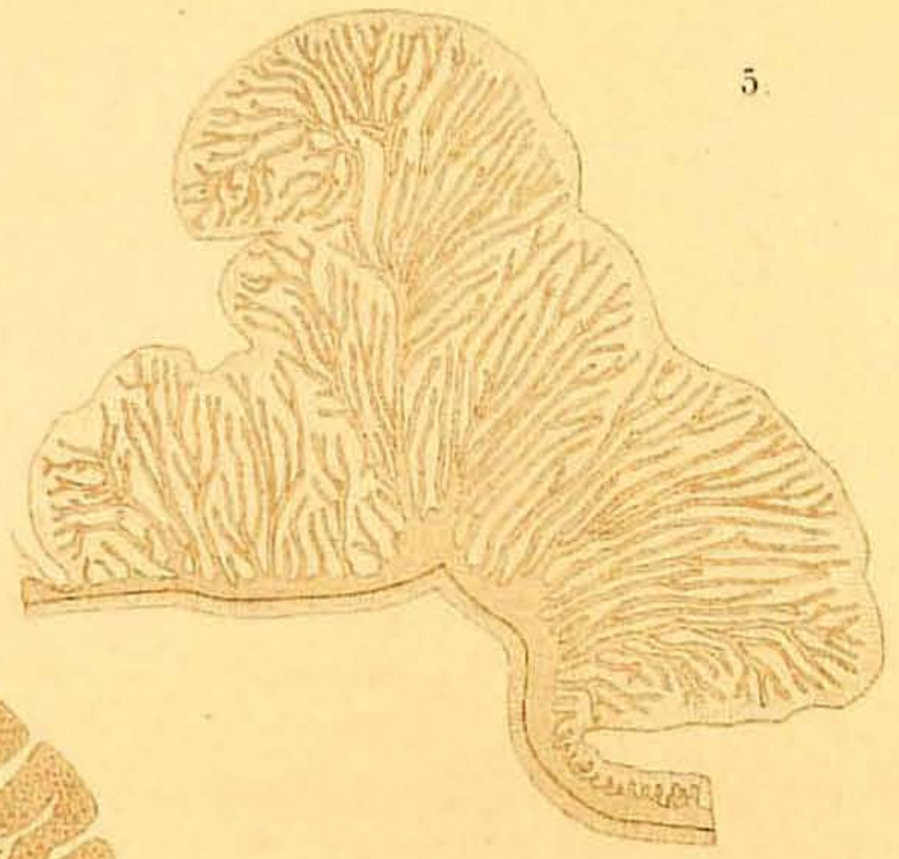

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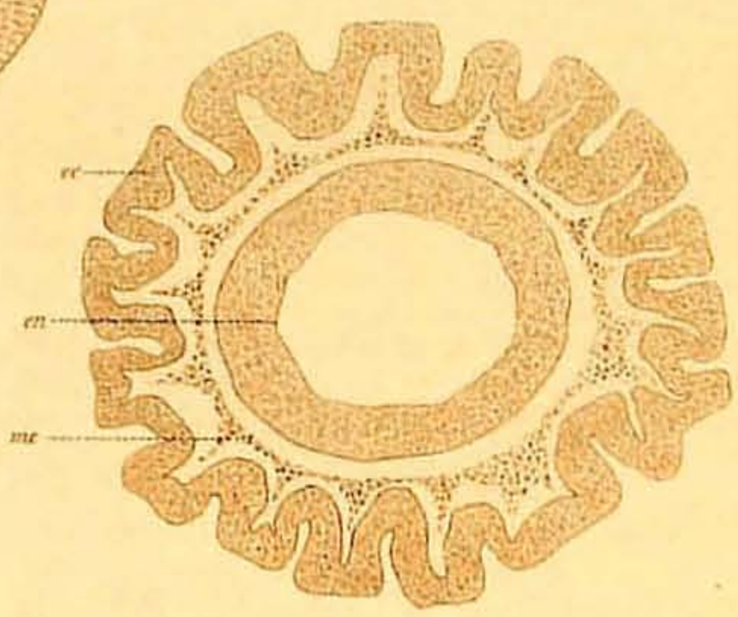

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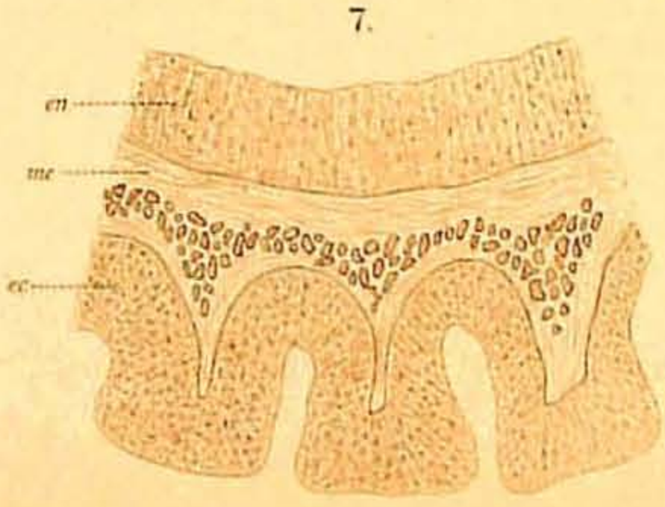

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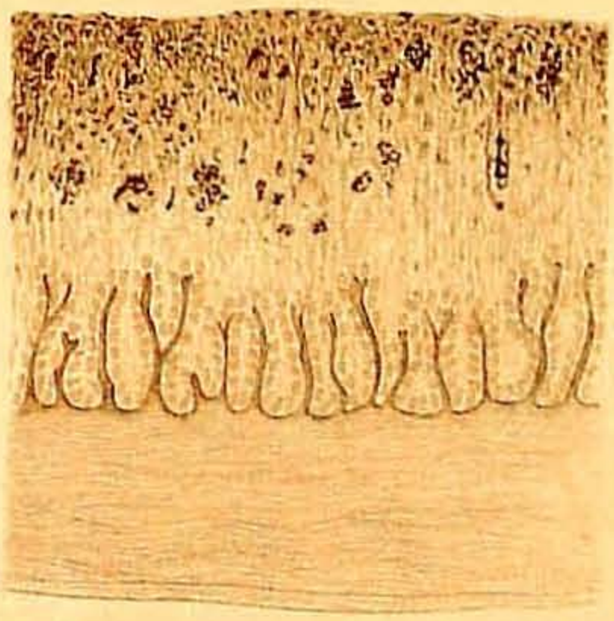

R. Herwig del. Lith. Anst. Werner & Winter, Frankfurt a/M.

PLATE II.

The lettering is the same in all the figures.

cu Cuticula.	*mc* Mesoglœa.
ec Ectoderm.	ms^1 Upper circular muscle.
en Endoderm.	ms^2 Lower circular muscle.
g Generative organs.	*o* Ova.
h Mesenteries.	*r* Marginal spherules.
im Intermediary layer.	*sr* Siphonoglyphe (œsophageal groove).
m Muscle-fibres.	*t* Tentacles.

All statements given as to magnifying powers have reference to Zeiss's system.

Fig. 1. Portion of the circular muscle of *Hormathia delicatula*. D, Oc. 2, somewhat diminished.

Fig. 2. *Ilyanthopsis longifilis;* musculature of the oral disc. $^1/_{18}$, Oc. 1.

Fig. 3. *Hormathia delicatula;* musculature of the oral disc. D, Oc. 2.

Fig. 4. Circular muscle and marginal spherules of *Liponema multiporum*. A, Oc. 1.

Fig. 5. Muscle-pennon of *Halcampa kerguelensis*. A, Oc. 2.

Fig. 6. *Dysactis crassicornis;* transverse section through a tentacle. a^3, Oc. 2.

Fig. 7. Portion of the tentacle represented in fig. 6, more strongly magnified. A, Oc. 1.

Fig. 8. *Phellia spinifera;* transverse section through the musculature of the oral disc. E, Oc. 2.

Fig. 9. The same.

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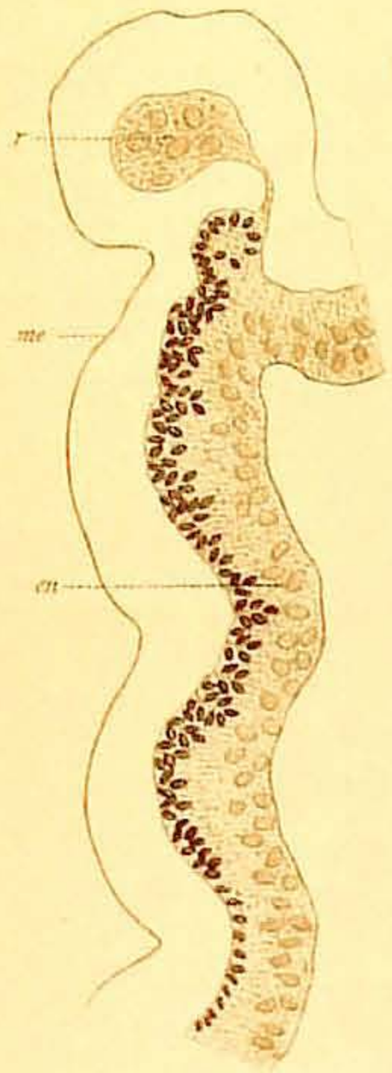

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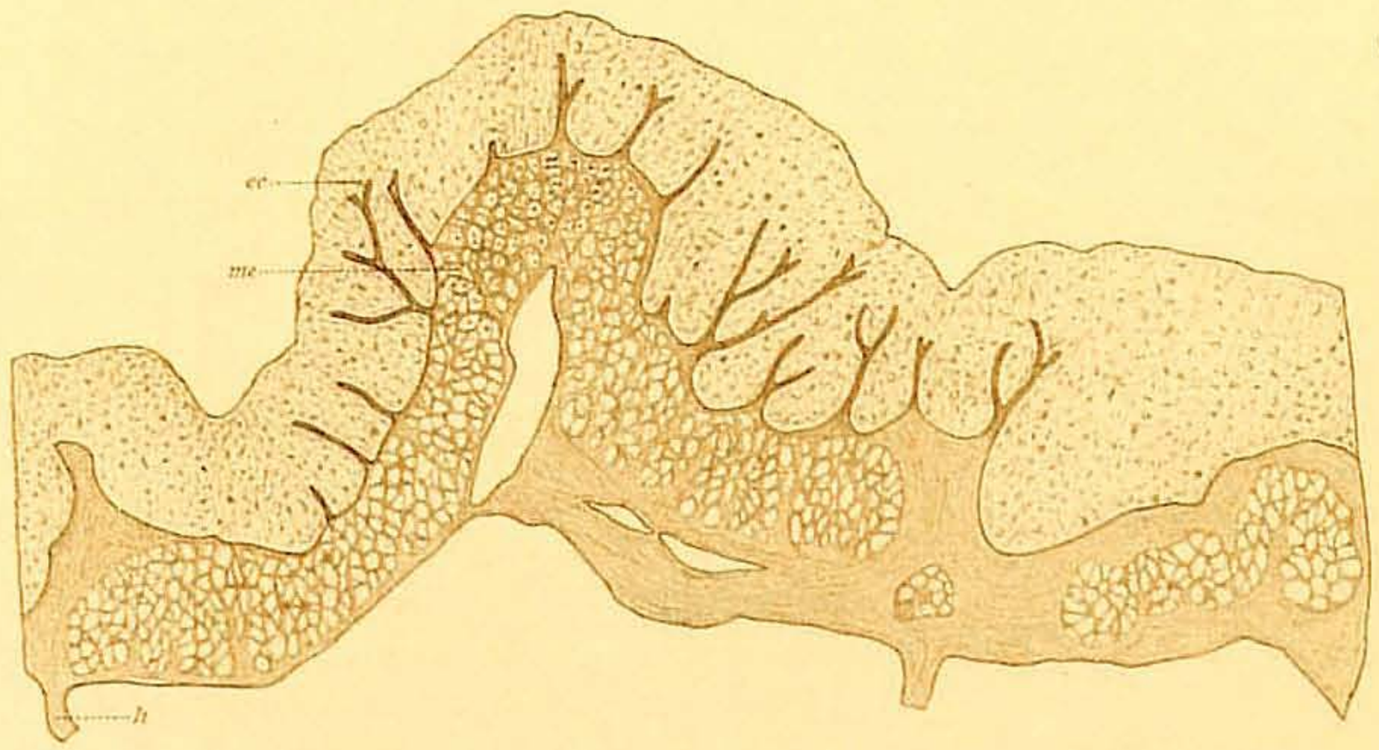

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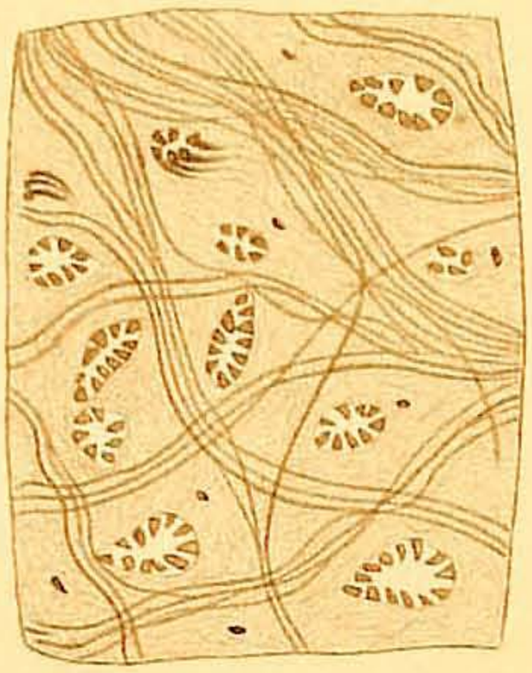

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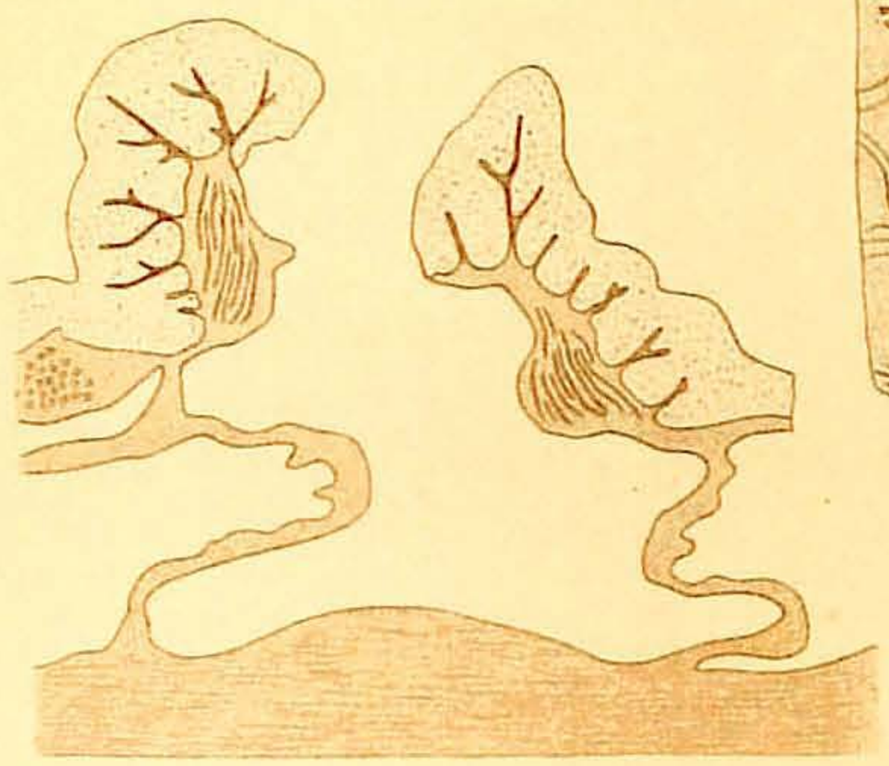

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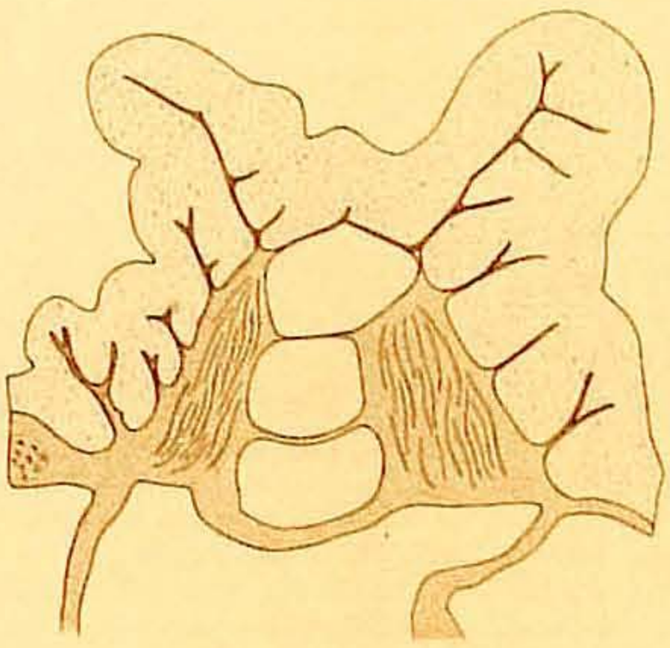

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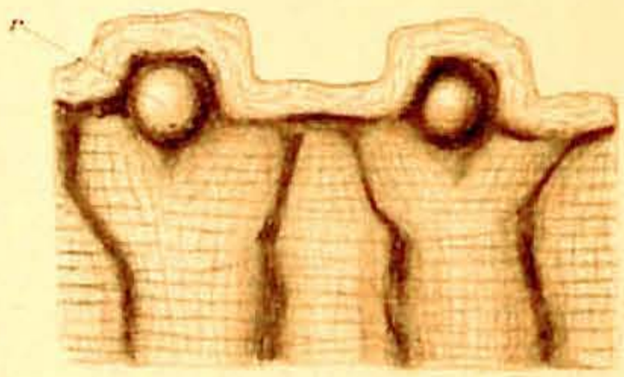

PLATE III.

The lettering is the same in all the figures.

cu Cuticula.	*me* Mesoglœa.
ec Ectoderm.	ms^1 Upper circular muscle.
en Endoderm.	ms^2 Lower circular muscle.
g Generative organs.	*o* Ova.
h Mesenteries.	*r* Marginal spherules.
im Intermediary layer.	*sr* Siphonoglyphe (œsophageal groove).
m Muscle-fibres.	*t* Tentacles.

All statements given as to magnifying powers have reference to Zeiss's system.

Fig. 1. Circular muscle of *Stephanidium schulzii*;—1*a*, in the region of an intermesenterial chamber and of a marginal spherule; 1*b*, in the region of the origin of a mesentery.

Aulorchis paradoxa (figs. 2–6).

Fig. 2. Transverse section through the oral disc. A, Oc. 1, somewhat diminished.

Fig. 3. Parts of a transverse section through the circular muscle, showing the connection of the endodermal and mesoglœal muscle-layers: 3*a*, with D, Oc. 1; 3*b*, with E, Oc. 1.

Figs. 4, 5. Sections through the stomidia. a^3, Oc. 1.

Fig. 6. Transverse section through the mesoglœal musculature of the oral disc. D, Oc. 1.

Fig. 7. *Stephanidium schulzii*; upper edge of the body-wall, × 60.

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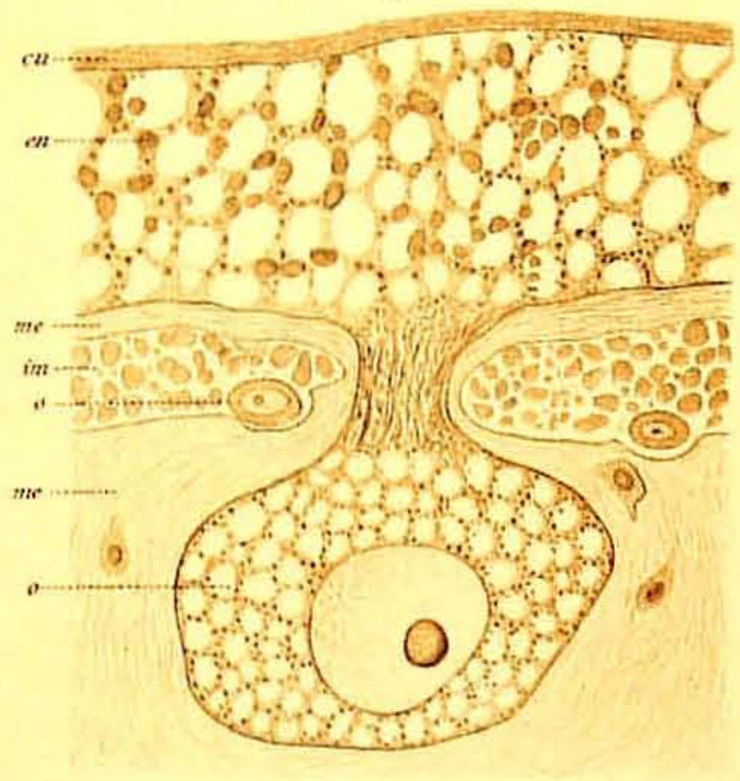
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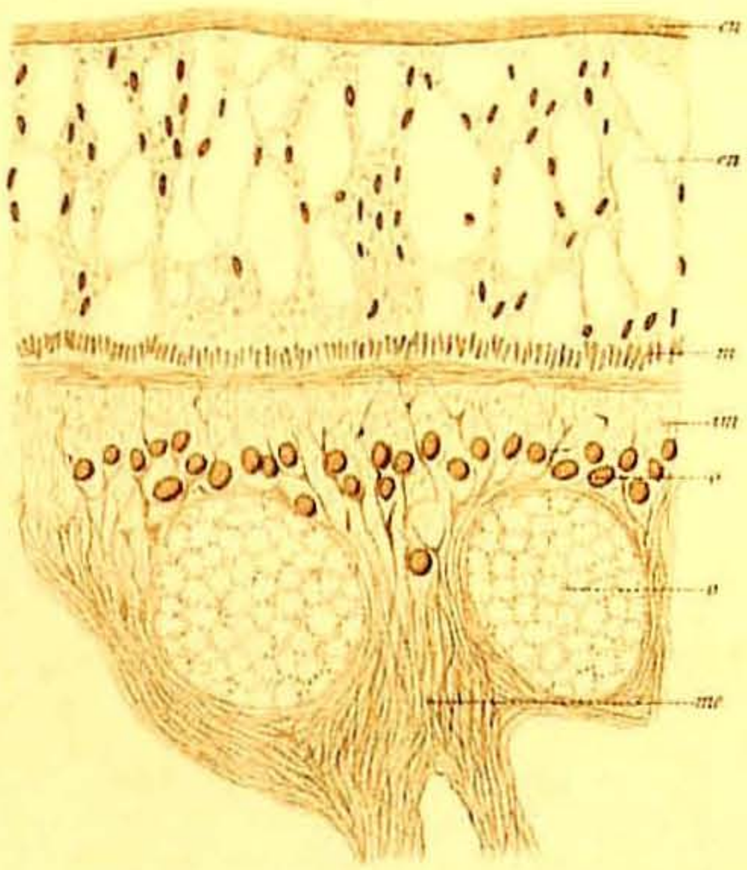
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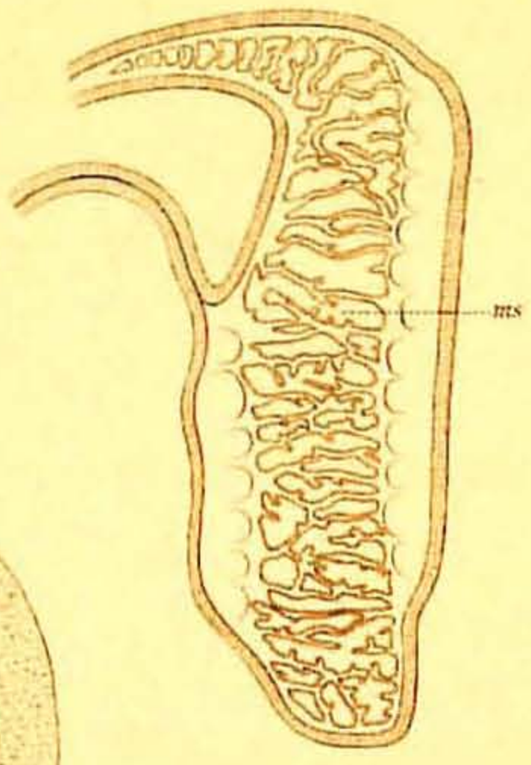
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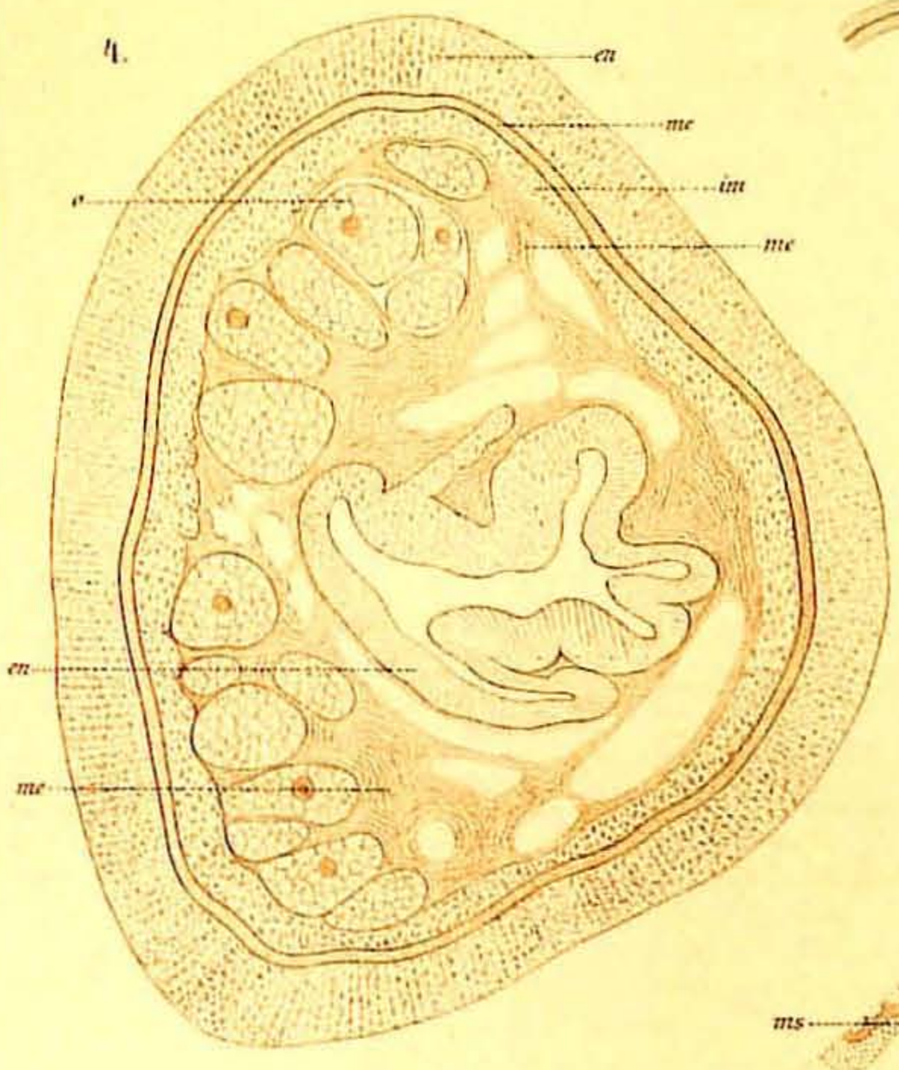
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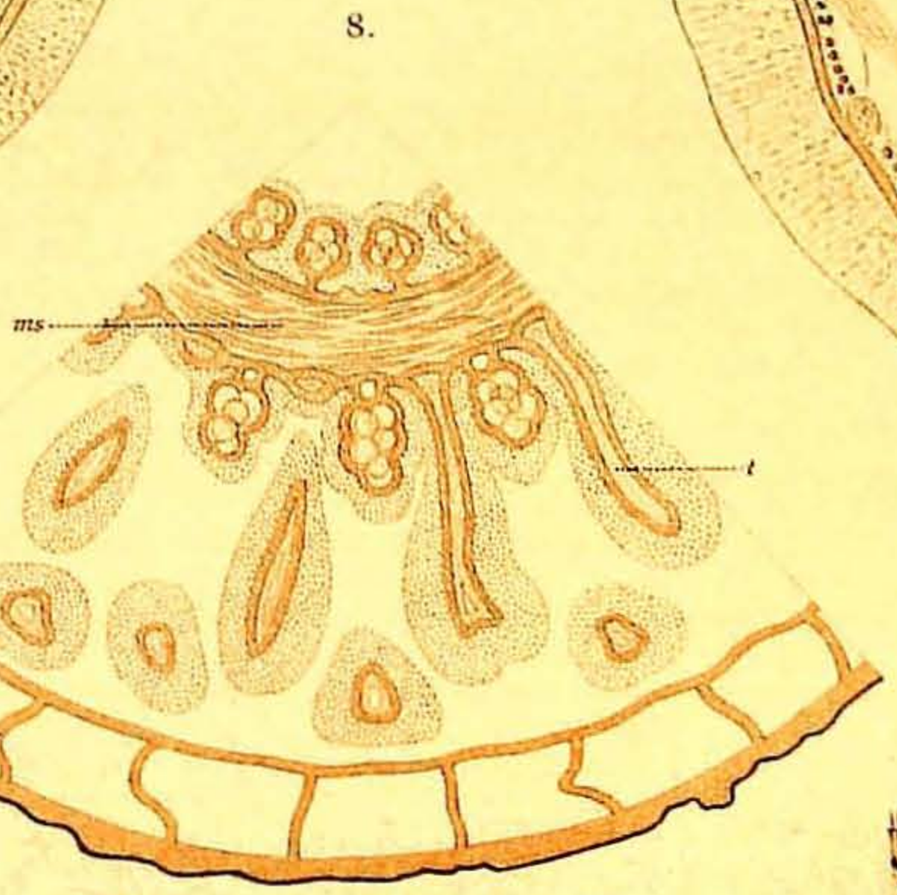
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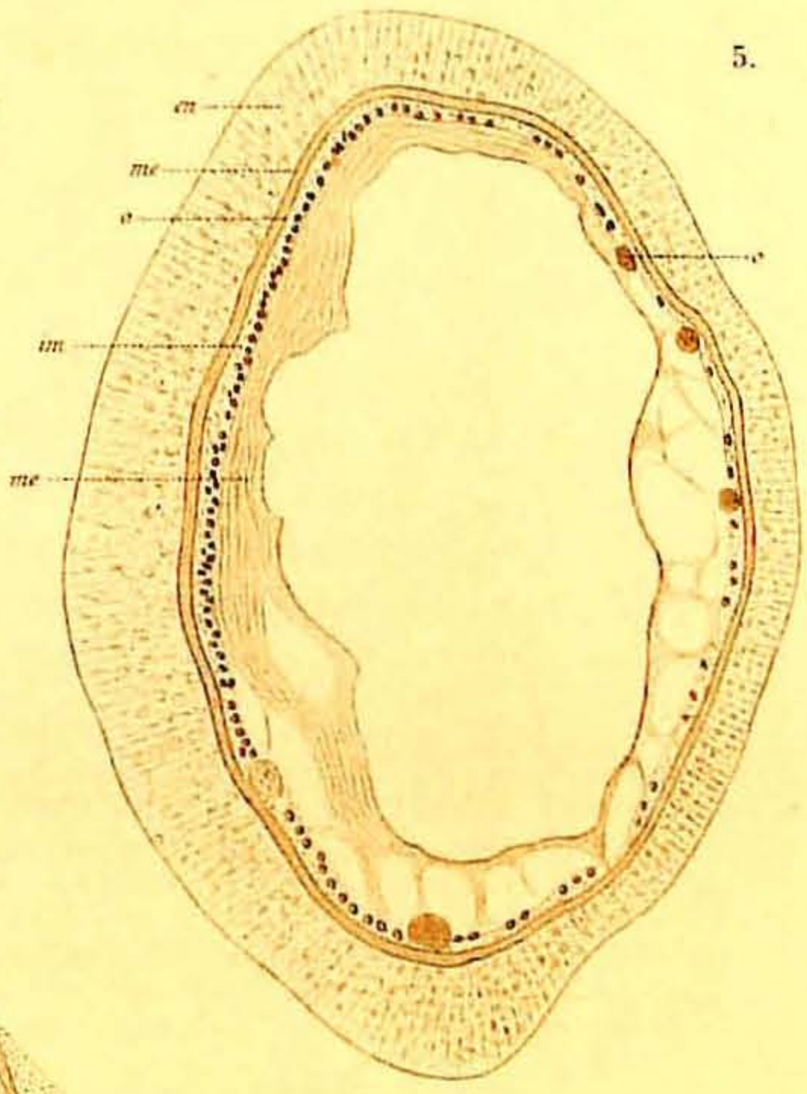
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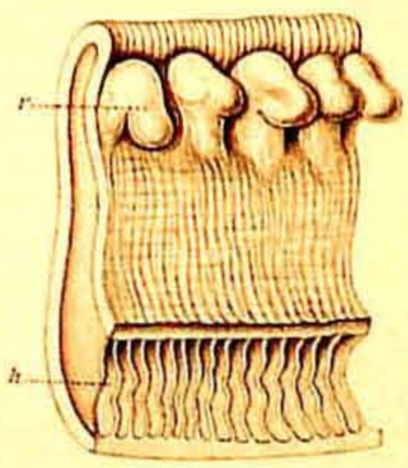
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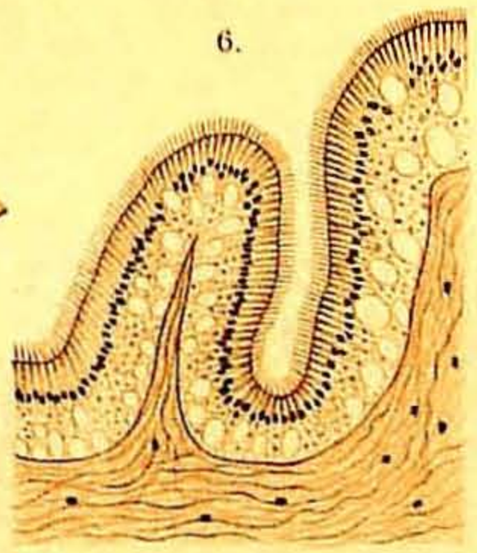

PLATE IV.

The lettering is the same in all the figures.

cu Cuticula.	*me* Mesoglœa.
ec Ectoderm.	me^1 Upper circular muscle.
en Endoderm.	me^2 Lower circular muscle.
g Generative organs.	*o* Ova.
h Mesenteries.	*r* Marginal spherules.
im Intermediary layer.	*sr* Siphonoglyphe (œsophageal groove).
m Muscle-fibres.	*t* Tentacles.

All statements given as to magnifying powers have reference to Zeiss's system.

Aulorchis paradoxa (sections through the genital tube, figs. 1-6).

Fig. 1. Connection of an ovum with the endodermal epithelium, probably by means of a thread apparatus ("Faden-Apparat"). E, Oc. 2.

Fig. 2. Surface view of the germinal layer. I, Oc. 2.

Fig. 3. Longitudinal section through the germinal layer. E, Oc. 2.

Fig. 4. Transverse section through the lower part of the genital tube. A, Oc. 2.

Fig. 5. Transverse section through the upper part of the genital tube, in the region of the oral disc; the central detritus, which is probably produced by degradation of epithelium, is omitted in the drawing. A, Oc. 2.

Fig. 6. Epithelial layer from the interior of the genital tube (cf. fig. 4). E, Oc. 1.

Fig. 7. *Epizoanthus thalamophilus;* section through the circular muscle (after Erdmann).

Fig. 8. Horizontal section through the external and the invaginated portions of the body-wall of *Epizoanthus thalamophilus* (after Erdmann).

Fig. 9. *Hormathia delicatula.* Portion of the partly invaginated body-wall cut out and magnified slightly. The invaginated part bears the parietal spherules.