IV.—On the Genus Porponia and Related Genera, Scottish National Antarctic Expedition.

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[Plate IV.]

In an Appendix to the Actiniæ of the *Challenger* Expedition, R. HERTWIG, 1882, described a peculiar genus, *Porponia*, with two species, *P. elongata* and *P. robusta*, which he characterises in the following manner: "Actiniarien (Hexactinien?) mit 2 Schlundrinnen ohne Ringmuskel, mit dünnwandigen Tentakeln, deren Basen auf der äusseren Seite durch spangenförmige Verlängerungen des Mauerblatts gestützt werden." Partly owing to the badly preserved material, however, he did not venture to indicate definitely its systematic position, though he considered it conceivable that it represented a transitional form between the Zoanthidæ and the true Actiniæ, or Hexactiniæ. HERTWIG expresses the following opinion regarding the systematic position of the genus: "Die doppelreihige Stellung der Tentakel, die Abwesenheit vollständiger Geschlechtsepten (Macrosepten) und unvollständiger, sterilen Septen (Microsepten) sind Merkmale, welche an die Zoantheen erinnern, die Zahlen der Tentakel und der Septen passen ebenfalls am meisten für diese Gruppe, da sie weder von dem Numerus 6 wie bei den Hexactinien noch von dem Numerus 4 wie bei den Paractinien bestimmt sind. Auf der anderen Seite nähert sich die *P. elongata* durch den Besitz von zwei Schlundrinnen wieder mehr den Hexactinien, unter denen sie am meisten mit den Antheomorphiden übereinstimmt. Ich halte es daher für sehr wahrscheinlich, dass *P. elongata* eine Mittelform ist, welche den Übergang von den Hexactinien zu den Zoantheen bildet." *Porponia* possibly, he thinks, belongs to the Antheomorphidæ, a family supposed to be separated from the family Antheadæ chiefly by the absence of a sphincter and by the weak development of the musculature.

Since R. HERTWIG described this genus, it has not been made the subject of any close examination, nor for this reason has its systematic position been discussed in detail. Yet it is only right to mention that M'MURRICH was inclined to refer the genus *Halcurias* (*Endocœlactis*) to the neighbourhood of *Porponia*. "In fact," he writes (p. 226, 1898), "I was inclined at first to associate it (*Halcurias*) with *Porponia*, and was only deterred from doing so by the simplicity of the arrangement of the mesenteries." (That *Halcurias* possesses a peculiar arrangement of the mesenteries, which agrees with what I have described, 1897, for the genus *Endocœlactis*, was not known to M'MURRICH at that time.)

A closer examination of the material which I received for investigation from the

Scotia Expedition has proved, however, that the arrangement of the mesenteries, as also indeed a number of other characters, indicates a close relationship between *Halcurias* (*Endocœlactis*) and *Porponia*, though each genus has its own distinctive characteristics. They must of necessity be referred to the same family, though this cannot be the Antheomorphidæ set up by HERTWIG, with its genera *Antheomorphe* and *Ilyanthopsis*. As the following description will show, I have no hesitation in retaining the family set up by me, Endocœlactidæ, for *Halcurias* and *Porponia*.

After describing in detail the *Porponia* species of the *Scotia* Expedition, I shall discuss the mutual relationship of *Halcurias* and *Porponia*, and the position of the family Endocœlactidæ in the classification. At the same time I shall take the opportunity to discuss the genera *Antheomorphe* and *Ilyanthopsis*, as also the family Antheomorphidæ.

I. THE STRUCTURE OF PORPONIA ANTARCTICA, N. SP.

Place of discovery.—Off Coats Land, 71° 22′ S., 16° 34′ W., 1410 fathoms, 16th March 1904. 17 specimens.

Dimensions of the largest specimens.—Length 6–8 cm., breadth of the foot 3–4 cm., breadth of the disc 8–9 cm., length of the inner tentacles 3–7 cm.

External appearance.—The fresh colour is creamy white, tinged, especially on the tentacles, with pale lavender. The base is expanded and often attached to a round stone, which it more or less encloses; it is arranged in coarse, irregular folds, and secretes a fairly extensive cuticle.

The body-wall is more or less beaker-shaped, arising from the less or greater contraction of the individuals. The distal part of the animal is thus wider than the proximal, and that often to a fairly considerable extent. The thick body-wall is provided with irregular longitudinal and transverse furrows, by means of which it is divided into irregular areas, as a rule very prominent, since the thin ectoderm has fallen off from almost all the specimens. The distal, uneven edge of the body-wall is not marked off by any definite groove or line, but passes irregularly into the bases of the tentacles. In large specimens the tentacles are typically 68 * in number, yet this may be exceeded, as the arrangement of the tentacles and even the grouping of the mesenteries may be somewhat irregular in one quadrant (or several ?), resulting in a somewhat greater development of tentacles here than in the other quadrants. The tentacles have the appearance characteristic for *Porponia*; on the outer side they are greatly thickened and like cartilage; towards the oral disc, on the inner side, they are thin and resemble ordinary tentacles. Owing to the mesoglœa being greatly thickened on the outer sides of the tentacles, it looks as if the tentacles here were provided with bridge-like outshoots from the body-wall. Further, the tentacles are conical, curved

* The normal number of tentacles seems to be developed in the species at a comparatively early stage, as specimens of only half the size of the largest in the collection have already the typical number of tentacles. A small specimen, on the other hand, had considerably fewer tentacles; but as it was much damaged, I have not tried to ascertain exactly the number of tentacles or their arrangement.

like a sabre towards the oral disc, thick in the basal part but gradually narrowing towards the tip, and of moderate length. Their arrangement is irregular, and recalls

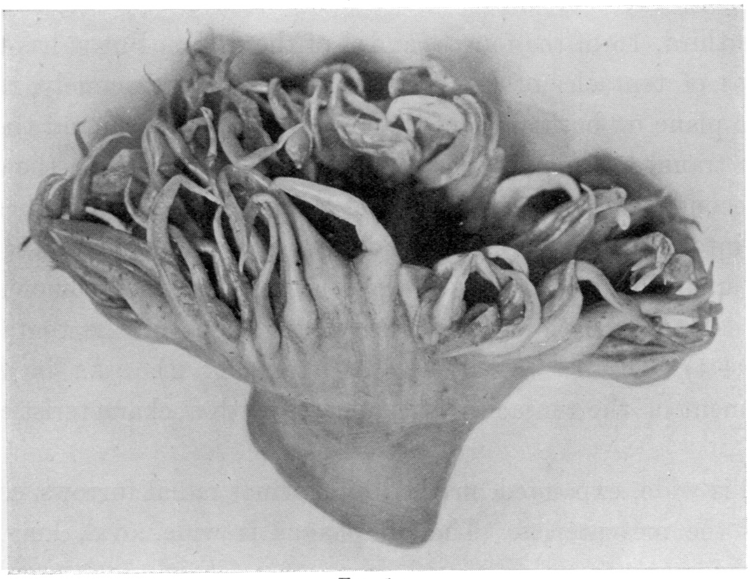

FIG. 1A.

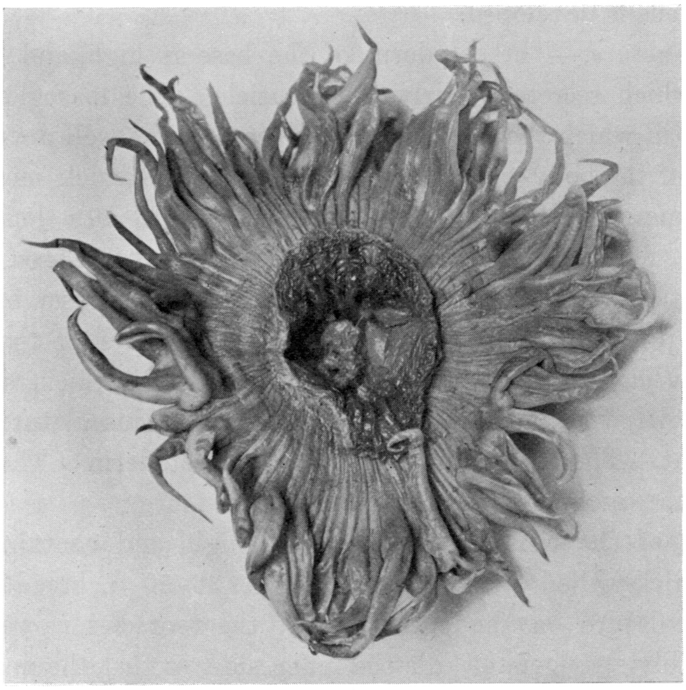

FIG. 1B.

FIG. 1.—*Porponia antarctica*; A from the side, B from the disc.

the condition in *Halcurias* (*Endocœlactis*). In the latter genus the true arrangement is difficult to find, and this is even more the case in *Porponia* owing to the greatly swollen bases of the tentacles. So far as I could find, the arrangement of the tentacles on each side of the sagittal plane is as follows: 1 (dt.), 2, 1, 4, 3, 5, 3, 4, 1, 2, 1, 4, 3, 5, 3, 4, 1, 2, 1, 4, 3, 5, 3, 4, 1, 2, 1, 4, 3, 5, 3, 4, 1, 2 = 34 (dt. = directive tentacle). Altogether, therefore, there should be 18 tentacles of the first order, 10 tentacles of the second, 16 of the third, 16 of the fourth, and 8 of the fifth. But it has to be remarked that some groups of tentacles of the first and second orders, namely, the 5 (1, 2, 1, 2, 1) in the sagittal plane on both sides of the angles of the mouth, and the 3 (1, 2, 1) on both sides in the transverse plane, arise somewhat further in than the other tentacles of the first and second order. The tentacles of the first order should therefore, perhaps, best be divided into 2 circlets (10 + 8), and similarly those of the second order into 2 (6 + 4). The underlined tentacles of the fourth order stand somewhat further out than the others of the fourth order. The arrangement of the tentacles is thus 18 (10 + 8) + 10 (6 + 4) + 16 + 16 (8 + 8) + 8 = 68 (text-fig. 2). As in *Halcurias*, the peculiar arrangement of the tentacles is connected with a characteristic dislocation of the mesenteries.

The oral disc is wide, expanded, marked by distinct radial furrows corresponding to the insertions of the mesenteries. The œsophagus is wide, oval, long, and provided with longitudinal furrows to a number of about 18. There are 2 œsophageal grooves, lying typically in the angles of the mouth, and broader in the aboral than in the oral part. No hyposulcus is developed.

Anatomical structure.—The ectoderm of the base is high, and consists chiefly of supporting cells, which secrete a fairly thick cuticle. The mesoglœa is extensive, as also the entoderm, in which the nervous system seems to be well developed.

The ectoderm of the body-wall by comparison with the thick mesoglœa is thin and provided with numerous spirocysts of varying size up to 60 μ long and 11 μ broad. Further, there are generally thick-walled capsules (length 26–34 μ, breadth 3 μ). In cross-section there seem to be thickenings at the base which resemble transversely cut muscles, but are probably in reality thickened basal parts of the ectodermal cells (see below under *Ilyanthopsis elegans*). The mesoglœa is thick, and provided with numerous small cells with outshoots. The entodermal musculature is weak, and no sphincter is present. The entoderm is thin like the ectoderm. The entoderm of the body-wall and of the œsophagus is pigmented.

The ectoderm of the tentacles is somewhat high, and contains fairly numerous spirocysts and thick-walled nematocysts (length 36–50 μ, breadth 3–(5) μ). The longitudinal musculature on the outer side of the tentacles is weak, but gradually becomes considerably stronger towards the inner side, so that the muscular wall is here about half the height of the supporting cells. The mesoglœa agrees in structure with that of the body-wall. On the inner side, in the lower part of the tentacles, it is, as a rule, just as thick as, or thicker than the ectoderm; on the outer side, however, it is much thickened (fig. 6, Pl. IV.). The thickness decreases towards the tips of the tentacles (fig. 5, Pl. IV.), so that at the ends the mesoglœa is almost equally developed round the tentacles. The entoderm is thin, and the ring-musculature weak. The radial musculature of the disc is in the ridges almost as well developed as the longitudinal musculature on the inner side of the tentacles, but in the furrows it is considerably feebler.

The ectoderm of the œsophagus shows the usual structure, but in addition numerous thick-walled nematocysts (length 43–48 μ, breadth 5 μ), and in fair numbers spirocysts of the same appearance as in the body-wall. The mesoglœa, which is very thick, agrees in structure with that of the body-wall.

The arrangement of the mesenteries is shown by the accompanying schematic fig. 2; 6 pairs of mesenteries of the first order, with 2 pairs of symmetrical, directive mesenteries are present. While all the primary exocœls are reduced, so that no mesenteries could be formed in them, each of the 4 lateral endocœls contains a pair of mesenteries of the second order, in which, however, the longitudinal muscles face outwards, as in the directive mesenteries. The mesenteries of the first and second order, all of which are perfect, are thus 20 altogether; of these 16 are grouped in 8 pairs with longitudinal muscles as the directive mesenteries, owing to the development of the mesenteries of the third order in the secondary endocœls, and the last 4 mesenteries are unpaired at the sides of the directive mesenteries. The arrangement of the 20 oldest mesenteries thus agrees completely with the corresponding condition in *Halcurias.* In the endocœls of the second order we find mesenteries of the third, fourth, and fifth order. The mesenteries of the third order (8 pairs) are perfect, and have longitudinal muscles typical of the Actiniaria (muscles facing inwards). The mesenteries of the fourth order are unequally developed. On one side of the mesenteries of the third order, between these and the mesenteries of the second order, there is an imperfect mesentery of the fourth order, but on the other side a pair, consisting of one imperfect mesentery, lying nearest the mesenteries of the third order, and a perfect mesentery. Between the latter and the mesentery of the first order there is an imperfect mesentery of the fifth order. The arrangement of the mesenteries is thus: $6-4-8-8+8$ unpaired -8 unpaired; thus in all 26 pairs, $+8$ unpaired of the fourth and 8 unpaired of the fifth order, or 68 mesenteries. While this is typical, the development probably proceeds somewhat further in some ways in very old specimens.

The mesenteries are somewhat thick, owing to the thickness of the mesoglœa. The longitudinal musculature is fairly well developed, though not so much as in *Halcurias.* In the distal part the folds are thick, but grade towards the proximal end to a weak, only a little condensed, pennon-like region (figs. 7, 8, Pl. IV.), which approaches the body-wall and fuses with the well-developed parietal parts of the longitudinal musculature. The parietobasilar musculature is narrow but fairly well developed (figs. 7, 8, Pl. IV.), and goes far out towards the distal end. There are no separate basilar muscles, though in the foot end the muscles pass in a transverse direction, also on the longitudinal muscles' side of the mesenteries; but these muscles which run transversely are continuations of the longitudinal musculature, which at the base of the column bend in a transverse direction (*cf.* p. 60, *Ilyanthopsis elegans*).

The filaments are well developed and extremely broad, owing to the strong development of the mesoglœa (fig. 9, Pl. IV.). The vacuolar streak is little differentiated. Both in the intermediate part of the ciliated tract region and in the nematocyst glandular streak there are sparse spirocysts and fairly numerous thick-walled nematocysts, especially in the latter (length 36–41, sometimes even 46 μ, and about 3 μ broad). Of fairly common occurrence further in the glandular streak are nematocysts with distinct basal part to the spiral thread (length 37–41 μ, breadth 7 μ). Even the entoderm of the filament is pigmented, especially on the region of the border-streak.

The sexual organs occur on all well-developed mesenteries, even on the directive mesenteries. The animals are diœcious.

For the *Porponia* obtained by the *Scotia* Expedition I have set up a new species, *P. antarctica.* Of the species of *Porponia* already known it comes nearest to *P. robusta*, R. Hertwig, both in the form of the body and the appearance of the tentacles. To set up good characters between these two species is, however, distinctly difficult, as HERTWIG's description of *P. robusta* is so incomplete, and both, this species as well as the two specimens of *P. elongata*, do not seem to have the number of mesenteries and tentacles typical of *P. antarctica.* It is probable that the mesenteries of the fifth order have not been laid down in HERTWIG's form, to judge from the number of tentacles, which HERTWIG gives to be 54 in *P. elongata.* According to some notes made by me in 1897 on revising the *Challenger* Actiniæ, the distribution and size of the spirocysts and nematocysts in *P. robusta* and *P. elongata* were as follows:—

The spirocysts in the body-wall were in *P. robusta* very numerous and about 40–44 μ long, in the tentacles of *P. elongata* about 56–72 μ; there were also spirocysts in the œsophagus of these two species. The nematocysts in the œsophagus were 48 μ long in both *P. elongata* and *P. robusta*, in the tentacles of *P. elongata* 48 μ long. It is, however, noticeable that there were only fragments of the ectoderm in the *Challenger* species.

II. ON THE SYSTEMATIC POSITION OF THE GENUS PORPONIA.

According to the anatomical account of the genus *Porponia* given above, there should be no doubt remaining that *Porponia* and *Halcurias* (*Endocœlactis*) are very nearly related to each other. Common to both is the structure of the body-wall, and also of the œsophagus, both, among other things, being provided with numerous spirocysts. Even the anatomical structure of the filaments and distribution of the sexual organs show agreement. Most striking, however, is the characteristic and similar arrangement of the tentacles and mesenteries, which differs from that in all other known Actiniaria, as can be seen more clearly from the following scheme for the two genera. In both *Halcurias* and *Porponia* the same displacement of the original mesenteries and tentacles has clearly taken place. After the formation of the first 6 pairs of mesenteries, 1, 1, etc., in the ordinary way, 2 mesenteries (2, 2), with the longitudinal muscles faced outwards, have arisen in the lateral endocœls, and these mesenteries form normal pairs with neighbouring mesenteries of the first order. At this stage, therefore, the genera have 10 pairs of mesenteries, 2 of which, lying medially opposite to each other, are directive mesenteries, whilst the other 8 are formed in pairs with typically arranged longitudinal muscles. In the 8 new endocœls arisen through the growth of the mesenteries of the second order, there is a further development of 8 normal pairs of the third order, so that at this stage we have 10 $(6+4)+8=18$ pairs of mesenteries. Thereafter the development proceeds in a more normal manner, the mesenteries of the fourth and fifth order in *Porponia* not developing in the endocœls of the third order, but on both sides of a pair of the third order; in an exocœl in relation to the mesenteries of the third order, but in an original endocœl of the second order. I have endeavoured previously (1897) to show that the development proceeds in this way in *Endocœlactis*, as with fairly great certainty I considered it possible, partly from the unequal development of the mesenteries at the basis of the column, to distinguish the first 6 pairs of mesenteries (1, 1, etc.) from the 4 pairs of the second order, and thence from the obviously great development of these 10 pairs in comparison with the others to distinguish them clearly from the subsequent orders of mesenteries. In *Porponia* I had admittedly not been able to study the development of the mesenteries so clearly as *Endocœlactis*, as the difference between the mesenteries of the said orders were not so distinct as in this latter form, owing to the fact that in *Porponia* several more complete mesenteries occur than in *Endocœlactis*. The arrangement of tentacles in *Porponia*, as also the whole arrangement of mesenteries, indicates, however, that in this genus the mesenteries arise in the same manner, and that also after reaching a stage with 6 normally placed pairs of mesenteries, a development of mesenteries in the endocœls has taken place. The groups of tentacles of the first and second orders, which arise near the directive mesenteries 1, 2, 1 (dt.), 2, 1, and those which lie in the transverse plane 1, 2, 1, are inside the tentacles of the corresponding order which stand at the other 4 pairs of stronger mesenteries, a condition that is to some extent indicated on the schematic figure, but which in reality is considerably greater than the figure shows. This indicates that we have to arrange the first 6 pairs of mesenteries by this plane. With regard to the arrangement of the tentacles otherwise, this is in the main the same in the two genera, great displacements occurring in the cycles with the development of certain mesenteries in the endocœls, wherewith, so to speak, a doubling of the tentacles in the lateral endocœls of the first and second orders arises. Above all, the arrangement of the 28 innermost tentacles is the same in both genera, as the figure shows. It is characteristic of both genera, therefore, that all the mesenteries of the second and third orders develop in the endocœls, and that in consequence great displacements in the position of the tentacles take place.

Nevertheless, there are a number of differences in the structure of the two genera. In a number of less important characters, such as the form of the body—in *Porponia* beaker-like, in *Halcurias* more cylindric—in the presence of only one œsophageal groove in *Halcurias*, whilst *Porponia* has two, there are certainly differences between

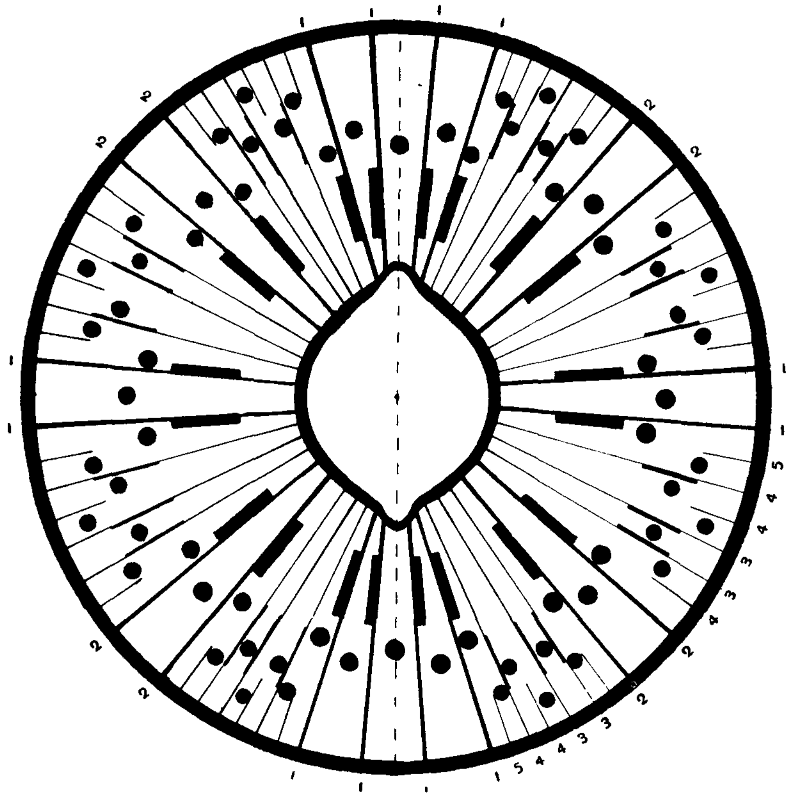

FIG. 2.

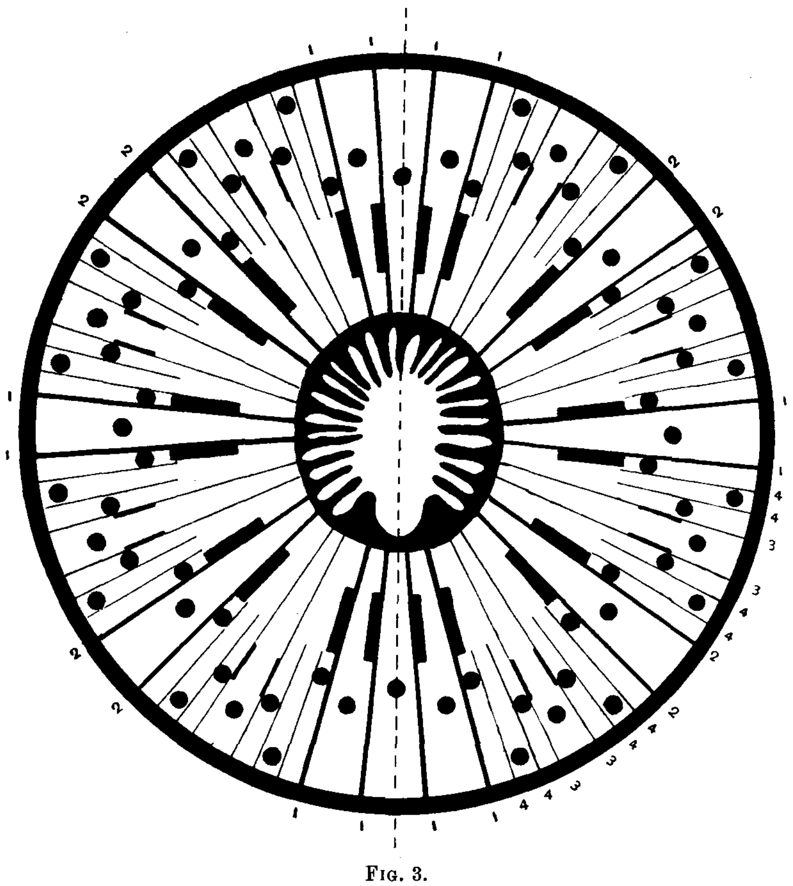

FIG. 3.

FIGS. 2 and 3.—Schematic sections through the œsophagus region of *Porponia antarctica* (fig. 2) and *Halcurias carlgreni* (fig. 3). The position of the tentacles (the dark rings) is drawn in. The rectangular, dark figures on the mesenteries indicate the longitudinal muscles. The shaded lines denote the directive plane. In *Porponia* the ridges of the œsophagus are not drawn in.

the genera, but also others more important exist. In the two genera the tentacles are formed in a different manner, having the usual appearance in *Halcurias*, whilst they are greatly thickened in *Porponia* on the outer side, so that it looks as if the thick mesoglœa of the body-wall extended in the form of bridge-like outshoots into the tentacles. An important distinction between *Porponia* and *Halcurias* is also seen in the development of the mesenteries. Whilst *Halcurias* has only 10 pairs of stronger mesenteries—the mesenteries of the third order being thus but feebly developed, and that only in the most distal end—there is a much larger number of stronger mesenteries in *Porponia*, which are connected with the œsophagus in its whole length or the greater part of this. Very characteristic also is the fact that the development of the mesenteries, which appear after the mesenteries of the third order, is different in the two genera. In *Halcurias* the mesenteries of the fourth order arise normally, so that the two mesenteries in the same pair appear simultaneously; the development then ceases, though it is possible that in some cases mesenteries of a fifth order may be laid down. In *Porponia*, on the other hand, the development has taken a different line, and comes to resemble that of the later mesenteries in *Actinostola* and *Stomphia*. The mesenteries of the fourth order, namely, do not appear at the same time; on the one hand, the one mesentery is developed much earlier than its pair; on the other, the development of the mesenteries of the fourth order is delayed in certain regularly arranged exocœls, so that here only one unpaired mesentery instead of a pair arises. This displacement of the mesenterial appearance has had the result that an unpaired mesentery of the fifth order arises on the side where the strongest and perfect mesentery of the fourth order lies. In fact, the development of the mesenteries of the fourth and following orders in *Porponia* comes under the same law as I have indicated for the development of later mesenteries in Actinostolidæ, and which means that the development of a stronger mesentery in a previous order leads to an earlier development of the mesenteries of the subsequent orders in the area which lies nearest this stronger mesentery. Finally, it has to be noted that irregularities not rarely arise in a quadrant of *Porponia* which shows a somewhat larger number of mesenteries than the normal. If we indicate the mesenteries with numbers, those of the first order with 1, of the second with 2, and so on, the irregularity in the arrangement of the mesenteries on each side of the directive plane can be seen from the following scheme for the two genera (dm. = directive mesenteries):—

Halcurias (*Endocœlactis*).

1 (dm.) 1, 4, 4, 3, 3, 4, 4, 2, 2, 4, 4, 3, 3, 4, 4, 1, 1, 4, 4, 3, 3, 4, 4, 2, 2, 4, 4, 3, 3, 4, 4, 1, 1 (dm.) = 34.

Porponia.

1 (dm.) 1, 5, 4, 4, 3, 3, 4, 2, 2, 4, 3, 3, 4, 4, 5, 1, 1, 5, 4, 4, 3, 3, 4, 2, 2, 4, 3, 3, 4, 4, 5, 1, 1 (dm.) = 34.

The arrangement of the tentacles is also somewhat different in the two genera (see figures). This difference is due entirely to the different arrangement of the mesenteries of the later developmental stages, yet it has to be noted that the position of the tentacles, especially in *Porponia*, is difficult to determine, and it is just possible that the agreement is somewhat greater than is represented in the schematic figures.

While *Halcurias* and *Porponia* are thus closely related to each other, there is still the question whether they have any near relationship to the genus set up by R. HERTWIG, *Antheomorphe*, as M'MURRICH and HERTWIG maintain, the one for *Halcurias*, the other for *Porponia*. In my opinion, such a relationship does not exist, for *Antheomorphe*, according to HERTWIG's poor description of this genus, appears to have normally arranged mesenteries and tentacles. On the other hand, it is not impossible that *Halcurias* and *Porponia* are related to the form which WASSILIEFF (1908) has described as *Ilyanthopsis elegans*. The abnormal development of the mesenteries in *Ilyanthopsis elegans*, according to the obviously imperfect data given by WASSILIEFF, indicates, namely, the possibility of a mesenterial arrangement such as in *Halcurias* and *Porponia*, and even the habitus of the animal resembles that of *Halcurias*. To settle this, I have obtained a specimen of *Ilyanthopsis elegans* for investigation from the Conservator of the Bavarian State's collection in Munich. As WASSILIEFF's description of the animal leaves much to be desired,* and as it is by no means so schematically constructed as this author believed, I give here a description of this species, a description, however, that cannot be considered complete, as the material, which could not be dissected, was insufficient for the purpose.

The body in *Ilyanthopsis elegans* is elongated, cylindrical, the base distinctly flattened, but the boundary between body-wall and base not sharply marked. The body-wall is provided with irregular transverse and longitudinal furrows, so that the parts of the wall between the furrows have the appearance of raised areas, which, however, do not differ in their structure from the remaining part of the body-wall. The tentacles are of moderate length, 2–2·5 cm. (length of body over 6 cm.), and distinctly furrowed longitudinally, not thickened at the base and gradually narrowing towards the distal end. The arrangement of the tentacles was difficult to determine and by no means so simple as WASSILIEFF imagined. There is no arrangement into two circlets only; on the contrary, the arrangement shows distinctly a certain resemblance to that in *Halcurias* and *Porponia*, as some displacement of the tentacles has taken place, here also assuredly connected with an irregular arrangement of the mesenteries. In the first place, we have in each angle of the mouth (in the sagittal plane) quite the same arrangement of the tentacles as in *Porponia* and *Halcurias*. They further agree in this, that at certain points groups of tentacles occur, where two tentacles of the first order stand on each side of one of the second order. Lastly, the other tentacles also show a resemblance in arrangement to the corresponding tentacles in these genera.

* The Actiniaria described by WASSILIEFF, especially some of the species, require revision. Thus, the Actinia described by WASSILIEFF under the name of *Halcampella minuta* is quite certainly no *Halcampella*, but rather a *Haloclava*. The occurrence of warts and the appearance and structure of the tentacles, which are bulb-like and swollen at the tips, speak in favour of this. The arrangement of the mesenteries and the siphonoglyphe agree less definitely, but this may be due to the specimen being a young individual, as is indicated by the small number of tentacles (15). If it cannot be referred to *Haloclava* or *Eloactis*, it may represent the type of a new genus.

The arrangement, however, is difficult to determine in detail in *Ilyanthopsis*, as the grouping of the mesenteries is not known, and only one specimen has been at my disposal, which, moreover, showed an irregular grouping of the tentacles in certain parts. Starting from the one directive tentacle (that where the directive line passes through an œsophageal groove), the arrangement seems to be the following (1, 2, 3, etc., tentacles of the first, second, third, etc., order; dt. = the directive tentacle) :—

1 (dt.)–2–1–5, 4–5–4–5–3–4–3–5–4–5–4–5–1–2–1–5–4–5–4–5–4–5–1–2–1–5–4–5–4–5–4–5–1–2–1–5–4–5–4–5–4–5–1–2–1– (dt.)–2–1–5–4–5–4–5–4–5–1–2–1–5–4–5–4–5–4–5–4–5–1–2–1–5–4–5–4–5–4–5–1–2–1–5–4–5–4–5–4–5–1–2.

It is to be noted here, that among the last mesenteries of the first order, nearest to the last mesentery of the first order, there may be a few tentacles more. A small part of the edge of the body, namely, had been torn away, and it is possible that some tentacles, at most 4 probably, have gone with it. In this specimen, therefore, the number of tentacles is somewhat higher, yet not so high as 100. The group 3, 4, 3, is also somewhat uncertain, in so far as it cannot be determined whether it is a 1, 2, 1 group or not; in any case it seems to stand somewhat inside the other groups of the first and second order. But to clear up the arrangement of the tentacles definitely requires an investigation of more material with the developmental forms.

The oral disc is somewhat broader than the base, with deep, radial furrows corresponding to the insertions of the mesenteries. The mouth was partly projecting, wide. The œsophagus is wide, long, almost half the length of the body, with a siphonoglyphe. WASSILIEFF states that two grooves are present, but I have not been able to find more than one; the other supposed to be present by WASSILIEFF does not differ—at least in the specimen examined by me, which has also been investigated by WASSILIEFF—from the deep longitudinal furrows with which the œsophagus is also provided. Including the siphonoglyphe, the number of these furrows amounts to about 16. No well-marked prolongation of the groove downwards below the œsophagus is present.

The anatomical structure resembles that of the Endocœlactidæ. The ectoderm of the body-wall is not extensive, especially by comparison with the thick mesoglœa. It contains very numerous spirocysts of varying size, and fairly numerous thick-walled nematocysts (length 34–43 μ, breadth 5 μ). In transverse sections at the base of the ectoderm we find structures packed close together, which greatly resemble cross-sections of ectodermal, longitudinal muscles. In the beginning also I was inclined to take them as such, but a closer examination showed that this was hardly the case. In longitudinal sections (fig. 2, Pl. IV.) I found similar structures, which should not have been there if it was a question of longitudinal muscles. The muscle-like parts are, indeed, so far as I could determine, no other than the greatly thickened bases of ectoderm cells, which can also be clearly seen when the section cuts through a wall of the ectoderm and passes through the ectoderm cells a little way from the base. In these it can be seen that the ectoderm cells are fixed in the mesoglœa by greatly thickened bases. I lay stress on this, as M'MURRICH was of the opinion that in

Halcurias pilatus he had found longitudinal muscles in the ectoderm of the body-wall. Though I have not examined this species, I consider it possible that the same condition prevails there as in *Ilyanthopsis*—in other words, that the longitudinal muscles are no other than thickened, basal parts of the ectoderm cells. The mesoglœa of the body-wall is very thick, and provided with extremely numerous cells with bipolar, irregularly prolonged ends. In the inmost part of the mesoglœa there are closely packed fibrillar folds arranged as fig. 1, Pl. IV. shows. The sphincter I have not closely examined, but I think it probable, from an external investigation, that this is completely wanting, as WASSILIEFF states. The entoderm is somewhat broader than the ectoderm, and thicker in the middle between the insertions of the mesenteries than at the sides. WASSILIEFF has described the structure of the tentacles and emphasised the longitudinal muscles of the ectoderm. The ectoderm contains very numerous spirocysts of varying size, and also numerous thick-walled nematocysts (length about 36 μ). The longitudinal musculature of the ectoderm is comparatively weak. How far fine outshoots run out from the mesoglœa into the ectoderm, as is stated by WASSILIEFF, I am unable to determine; it seems to me that these outshoots are nothing else but the thread-like basal parts of the ectoderm cells. The ectodermal nematocysts and spirocysts of the oral disc agree with those in the tentacles, but are not so abundant. The ganglion and nerve layer is also well developed here, as in the tentacles. The ectodermal radial musculature is strong, especially in the ridges, and the muscle folds just as high as, or higher than, the epithelial parts of the ectoderm. The inner parts of the muscle folds show a tendency to be mesoglœal in the ridges (fig. 3, Pl. IV.). The structure of the œsophagus agrees with that of the body-wall. The mesenteries are all complete, corresponding in number to the tentacles.

As WASSILIEFF states, the musculature is very weak, and only somewhat more strongly developed where the mesenteries join the body-wall (fig. 1, Pl. IV.). Here we can distinctly distinguish the muscles, both the longitudinal and the parieto-basilar, which are weak. On the very thin mesenteries there is no trace of protuberance of the longitudinal muscles. In longitudinal sections through the mesenteries and transverse sections through the base it looks as if the basilar muscle occurred as a weak fold of the musculature of the mesenteries. But specially differentiated basilar muscles do not seem to be developed, for the transverse layer of muscles near the base on the side of the mesenteries where the longitudinal muscles are, is formed by the latter muscles, bending almost at a right angle a little way from the base, thus forming what may be called pseudo-basilar muscles (fig. 7, Pl. IV.), the same condition as in *Porponia*, as I was able to determine from preparations of the mesentery. With regard to the arrangement of the mesenteries, it is impossible to determine whether all of them are equally developed. So much can be said, however, that in the specimen I have examined, in addition to the directive mesenteries with longitudinal muscles on the outer side, the other mesenteries seem to be arranged in pairs with the longitudinal muscles on the inner side. The *Halcurias* stage, or rather the *Porponia* stage, which *Ilyanthopsis* probably passes through during development, is thus not apparent in the older individuals. The filaments seem to agree with those in *Halcurias* and *Porponia*, but were so badly preserved that I could not obtain any clear picture of them. In addition to spirocysts there are thick-walled nematocysts like those in the body-wall (length 36 μ), as also numerous thick-walled capsules with distinct base to the spiral thread (length 31–34 μ, greatest breadth 5 μ). Sexual organs are present on all the mesenteries. The animal is hermaphrodite. Well-developed testes occurred distally inside the filament region in each mesentery, while a few grape-like eggs were found in the proximal part.

The investigation of *Ilyanthopsis elegans* has thus led to the result I imagined it would, namely, that this is nearly related to *Halcurias* and *Porponia*. Though the material is too small to permit of a detailed statement of the grouping of the tentacles and mesenteries, there can be no doubt that they should be placed together. The arrangement of the tentacles shows the same characteristics as in these genera, and certain features of the mesenterial arrangement are the same apparently. Even the external appearance agrees well with that of *Halcurias*: spirocysts occur in the body-wall and œsophagus, as in the latter genus and *Porponia*. *Ilyanthopsis* shows most resemblance to *Halcurias*, and it might be a question whether these two genera should not be joined as one. For the time being, however, such a grouping would not be so fortunate, as *Ilyanthopsis* has a much greater number of mesenteries than *Halcurias*; further, in the former all the mesenteries are perfect, while in the latter about half are perfect. Add to this that the longitudinal musculature of the mesenteries is strongly developed in *Halcurias*, very weak in *Ilyanthopsis*, and it is evident that *Ilyanthopsis* has its own developmental characteristics. It seems, moreover, more probable that *Ilyanthopsis* has passed through a *Porponia* stage than a *Halcurias* stage, if the mesenteries are taken into consideration. If we imagine all the mesenteries in *Porponia* to be perfect, it is quite easy from them to derive the arrangement of the mesenteries in *Ilyanthopsis*. In *Halcurias*, on the other hand, the stronger, not-directive mesenteries occur as unpaired mesenteries. How the development has proceeded we can only learn from the younger stages. I consider it advisable, therefore, to set up a new genus, *Synhalcurias*, for the species *Ilyanthopsis elegans*. The genus *Ilyanthopsis* must be abolished, as the type species of this genus, *Ilyanthopsis longifilis*, R. Hertwig, is no other than *Condylactis passiflora*, as stated by Pax (1910); I had also come to this view in 1897 on examination of type specimens of the *Challenger* Actiniæ in London.

We know of one more genus that might possibly be allied to *Porponia*, namely, the genus *Actinernus*, founded by Verrill. From R. Hertwig's description of *Polysiphonia tuberosa* (= *Actinernus tuberosus* M'Murrich) and from M'Murrich's description of *A. plebeius*, however, we can hardly conclude that a close relationship exists between *Porponia* and these forms. According to my observations on a specimen of *Polysiphonia tuberosa* from the *Challenger* Expedition, the arrangement of the tentacles does not seem to show the displacement seen in *Porponia*; in fact, as far as I can see, the tentacles are at no places grouped in such a way that two tentacles of the first order border on a tentacle of the second order, even though certain changes in the size of the tentacles have been observed, so that according to R. HERTWIG the exocœl-tentacles are not the smallest in size. Though *Actinernus plebeius* and *A. tuberosus* do not suggest any close relationship to *Porponia*, it is yet not impossible that the type specimen of the *Actinernus* genus may show greater similarities, a question I may leave unsettled at present, as I have not had the opportunity to examine this specimen.*

For the present, therefore, we must be content with a comparison between *Halcurias*, *Porponia*, and *Synhalcurias*. The question is now, where we are to place these genera, and would it be of advantage to separate them from other forms? M'MURRICH in 1901 dealt with this question with regard to the genus *Halcurias*. "There are, apparently, three courses open for the disposal of the genus. It may be referred to a family already existent, the definition of the family being changed, if necessary, to accommodate it, or it may be taken as the type of a distinct family, as CARLGREN has done, or, finally, it may be separated altogether from the Hexactiniæ and regarded as the type of a separate tribe. It seems to me that this last procedure is quite unnecessary and would probably be entirely out of harmony with the phylogenetic relationship of the genus. We have learned within recent years how extensively nearly allied forms may differ, and how great all the modification which the hexactinian type may undergo. The entire facies of *Halcurias* is that of an hexactinian." I am entirely in agreement with the above citation from M'MURRICH, and, like this author, I am of opinion that it is unnecessary to set up a separate tribe for this genus and *Porponia*, as the whole development indicates that the initial stage is a typical hexactinian with six pairs of mesenteries. M'MURRICH comes further to the conclusion that *Halcurias* need not be placed either in a separate family, as I had done in 1897, but considers it preferable to refer the genus to the family Actinidæ (Antheadæ). "The peculiar mode of development of the secondary and tertiary mesenteries is of minor importance, and I see no more reason for separating *Halcurias* as the type of a new family than I do for separating an octamerous sagartian or one with a multiplicity of mouths and many siphonoglyphs from the rest of the members of that family." He supports this view because "occasional endocœlous development of mesenteries have been already recorded, as in *Bunodes thallia*, in *Actinioides dixoniana* and *papuensis*"—a condition already pointed out by me in 1897.

But is this view of M'MURRICH justifiable? So far as I can understand, this is not the case, as variations irregularly arisen through asexual propagation, or through regeneration and regulation in the symmetry of certain species—in the case of the phylogeny—cannot directly be compared with similar variations from the normal type arising during the ontogeny—a condition not hitherto taken into consideration, but

* Compare Appendix!

which I must strongly emphasise. A species, for example, that normally, through unequal development of mesenteries, through stopping of the growth of certain parts and more rapid growth of others during the ontogenic development, *e.g.* from being a 6-rayed becomes an 8- or 10-rayed type, which is constant or nearly so for the species, cannot in phylogenetic respects be compared with another species where the same stages are obtained through accidental, asexual propagation or by regeneration. In the first case, the 8- or 10-rayed type is constant for the species, and occurs ontogenetically and phylogenetically; in the latter case, on the other hand, it is a mode of adaptation in a less or greater part of the individual, and is dependent on the course of the asexual propagation, and the greater or less reduction of the old mesenteries in the separated or damaged fragments, a condition which has been further dealt with in my studies on the regeneration and regulation stages in the Actiniæ, 1904, 1909. In so far as it has arisen ontogenetically, an 8- or 10-mesentery stage is thus of direct use for the phylogeny, but not in other cases. What applies to the occurrence of an 8- or 10-rayed type of Actiniaria also applies to the varieties that arise through the development of the mesenteries in the endocœls. In such cases the conditions are in full agreement with those found in 8- or 10-rayed forms. *Porponia* and *Halcurias* leave no doubt that the regular development of mesenteries in the endocœls has taken place ontogenetically, whereas the irregular and chance development of mesenteries in the endocœls in *Bunodes*, *Actinioides*, and others stands in intimate connection with the regeneration or possible early dislocations of tissues during development. In *Porponia* and *Halcurias* the development of mesenteries in the endocœls is of importance for the classification, whereas the abnormal occurrence of mesenteries in the endocœls in *Bunodes*, etc., is of no use for this purpose.

The peculiarity that mesenteries occur regularly in the endocœls during the course of development is thus quite specific for *Porponia* and *Halcurias*, and probably also for *Synhalcurias*, and has not been observed in other Actiniaria. The question is still left open, if this peculiarity is of such great importance that it necessitates the setting up of a separate family. As mentioned above, M'MURRICH connects the development of mesenteries in the endocœls with the occurrence of an 8-rayed type, with the development of several mouths and several siphonoglyphs. Just as little as we separate the forms showing such variations from the normal Actiniaria type ought we, in his opinion, to separate *Halcurias* from allied forms on account of the development of mesenteries in the endocœls. That the multiplication of mouths in a genus of Actiniaria does not involve a separation of the genus in question from other closely related species is evident from the above, as this multiplication has not arisen ontogenetically, but by asexual propagation. The same is certainly also the case with the multiplication of the siphonoglyphs. It is now left to take into consideration the abnormal development of the mesenteries. An 8- or 10-rayed type derived ontogenetically from a 6-rayed one is, as already known, by no means a seldom occurrence within the Actiniaria group, and may obviously arise within different families and genera that are in no genetic connection with each other. M'MURRICH is therefore quite right in saying that a genus or species need not be separated from other genera or species because it has been transformed into an 8- or 10-rayed type. It must be pointed out, however, that such a type may in certain cases be of great importance for the classification, namely, in cases where 8 or 10 rays are observed in all species of a certain genus, as the variation in the symmetry can naturally be used as a good generic character. We know of no case where a number of the pairs of mesenteries differing from 6 has led to the setting up of a separate family.

As shown above, both *Porponia* and *Halcurias*, from an assumed typical 6-paired mesentery stage, are transformed into one having 10 pairs of mesenteries. Where the transformation takes place in the ordinary manner by the belated appearance of certain mesenteries in certain areas and through the arising of other mesenteries in the exocœls,* it seems unnecessary to separate these genera, but as the 10-rayed condition arises in such a specific way by development of mesenteries in the endocœls, a development that is continued during the following cycle, I consider it absolutely necessary to set up a separate family for these genera, the more so as such an ontogenetic development of mesenteries in the endocœls has not been observed in any other Actiniaria of a higher type. As far as we know, no such displacement of the tentacles has been observed in other forms of Actiniaria than the above mentioned. I place *Porponia* and *Halcurias* together in one family, therefore, to which already in 1897 I gave the appropriate name of Endocœlactidæ.

III. RELATIONSHIP OF THE FAMILY ENDOCŒLACTIDÆ TO OTHER ACTINIARIA—ORIGIN OF THE RUGOSA TYPE.

As already mentioned in the introduction, R. HERTWIG stated the possibility that *Porponia*, owing to the arrangement of the macro- and micro-mesenteries, might form a transitional stage between the Hexactiniaria (Actiniaria) and Zoanthidæ (Zoantharia). This explanation of the position of *Porponia* and the family Endocœlactidæ cannot, of course, be maintained, after we have ascertained the facts on which the relationship between stronger and weaker mesenteries depends. There is nothing in the organisation of the family Endocœlactidæ that might indicate a close relation to the Zoanthidæ, as the development of the mesenteries in this family takes place in quite a different way from that in the latter characteristic group of Anthozoa.

In my paper on *Endocœlactis* (=*Halcurias*) I pointed out that in *Minyas* there is a strong tendency to widen the endocœls at the expense of the exocœls, causing an alteration in the grouping of the mesenteries, which had some resemblance to the alteration in the grouping of the 10 stronger mesenteries in *Endocœlactis*. How this grouping of the mesenteries has taken place in *Minyas* is still unknown, but it may possibly have arisen in connection with the development of mesenteries in the endocœls,

* It is also to be noted that not all 8- or 10-rayed types are homologous with each other, for the 8- or 10-rayed condition is not always obtained in the same way ontogenetically.

though this is not absolutely necessary. The arrangement of mesenteries in *Minyas* may be explained quite simply through an enlargement of the endocœls. In any case I consider the similarity in the *Endocœlactis* and *Minyas* arrangement as due to convergence, a view which I am now able to further confirm, as *Minyas, i.e.* the species described by me in 1895, and a closely related species, probably *M. olivacea*, later examined by me, are stichodactyline Actiniaria, which are nearly allied to the family Aurelianidæ (the genera *Aureliana* and *Actinoporus*).

With regard to the position of the family Endocœlactidæ, I pointed out in 1897 that it must be placed fairly low in the system of Actiniaria, a view that has also been taken up by M'Murrich. This is indicated not only by the absence of the sphincter and the presence of spirocysts (thin-walled nematocysts) in the ectoderm of the body-wall and œsophagus, but also by the absence of true differentiated basilar muscles. Thus, the Endocœlactids must be Actiniaria, though they are not developed in the same way as the elongated genera provided with physa (*e.g.* Edwardsidæ, Halcampidæ). From a theoretical point of view we must assume the occurrence of forms which constitute a link between the Protactininæ and the Athenaria among the Actininæ, *i.e.* we must take for granted the occurrence of original Actiniaria, which by the retention of the original body-shape with flat base (thus without development of a physa) have lost the longitudinal muscles in the body-wall, but, on the other hand, have not yet developed true basilar muscles; in the same way as I pointed out (1900, p. 57) that the family Discosomidæ forms a link between the Protostichodactylinæ and Stichododactylinæ. Among the Actininæ type similar conditions would then prevail with regard to the family Endocœlactis, if my supposition that this family has no longitudinal muscles in the body-wall proves to be correct. Should it be the case, on the other hand, that M'Murrich is right in saying that such longitudinal muscles occur in *Halcurias pilotus*, the family Endocœlactidæ must be referred to the Protactininæ. In this case the thickenings of the basal parts of the ectodermal cells in the body-wall may be considered as rudimentary epithelial muscles, a view, however, I do not hold, and a question that can only be answered by means of good material of maceration. For practical reasons it would possibly be advisable in future to combine the family Endocœlactidæ with the Protactininæ, and the Discosomidæ with the Protostichodactylinæ, a grouping which I already, in 1900, p. 57 (77), pointed out as possible with regard to the Discosomidæ.

In my opinion, the family Endocœlactidæ must thus belong to the lowest Actininæ, or possibly to the more differentiated Protactininæ. Probably an intimate relation to any other Actininæ family does not exist.

Before concluding the account of the relations of the family Endocœlactidæ to other Actiniaria, we might just point out that these variations are of importance for the study of the other Anthozoa. As already known, the skeleton-forming Madreporaria show similar variations from the usual symmetry, as the Actiniaria, as 8- and 10-rayed, radial or more bilateral forms are found even there. As we have seen that such a peculiar symmetry as that in Endocœlactidæ may also be found in the free Actiniaria, it seems reasonable to conclude that among the variously attached Madreporaria, with their varying adaptation to the under-layer, still more complicated and varying arrangement of the mesenteries may be found. In my opinion, the arrangement of the mesenteries in Endocœlactidæ opens up the possibility of a more intimate connection between Rugosa and Madreporaria, and more readily leads to an explanation of the conditions of symmetry in Rugosa, like the one proposed by me in BRONN's *Klassen und Ordnungen*, p. 150. Whilst the development of the mesenteries in the Endocœlactidæ gives a greater possibility of interpreting Rugosa, it makes the question still more complicated, as in Rugosa there might be a development of mesenteries in the endocœls. Though we shall naturally never be able to reach finality with regard to the position of Rugosa as compared with the typical Madreporaria, but have to be satisfied with a hypothetical explanation, so long as we do not know how the mesenterial musculature is arranged, I shall nevertheless give a picture of the way in which we might imagine the origin of the Rugosa type, if the mesenteries after the 6-pair stage have developed in the endocœls. I presuppose that the hypothetical, separating walls, sarcosepta, are taken as mesenteries, the skeletal dissepiments, sclerosepta, as septa.

We start, therefore, from a stage with 6 pairs of mesenteries arranged typically, but with the lateral endocœls larger or at least as large as the exocœls. In each of the 6 endocœls a septum has been formed (text-fig. 4A). In the next stage the development of mesenteries of the second order takes place in the same way as in the Endocœlactidæ, *i.e.* in the lateral endocœls, 4 pairs of the second order with the longitudinal muscles turned outwards. Each of these mesenteries of the second order forms a new pair with neighbouring mesenteries of the first order. In these new endocœls 4 septa are formed (text-fig. 4B).

Owing to this arrangement of the mesenteries and their occurrence only in the lateral endocœls, 4 zones of development have arisen instead of the 6 found in the exocœls of a normal Madreporaria. These zones of development lie one in each quadrant of the animal. This results in an asymmetrical development of the mesenteries, together with an irregular growth of the walls, due to the fact that the animal is generally attached along the one side of the goblet, or at least has been so once. The consequence is now that in each quadrant of the dorsal side of the animal, *i.e.* the side turned away from the siphonoglyphe, a complete suppression of the mesenteries of the next order takes place, while the development in the ventral part is continued. In the ventral endocœls 4 pairs of mesenteries arise with the same arrangement of the musculature as those of the second order. These mesenteries form new pairs with adjacent mesenteries of the first and second order. In the 4 new endocœls 4 septa are formed (text-fig. 4C). The development is continued in this way with the next order, with suppression of the mesenteries and septa in the dorsal endocœls of the third order in each quadrant. At the end of the development, or at least at a late stage, septa develop in the exocœls (text-fig. 4D).

As we see, the development of the Rugosa type may be explained by a similar development of the mesenteries as in *Halcurias* or *Porponia,* though with the

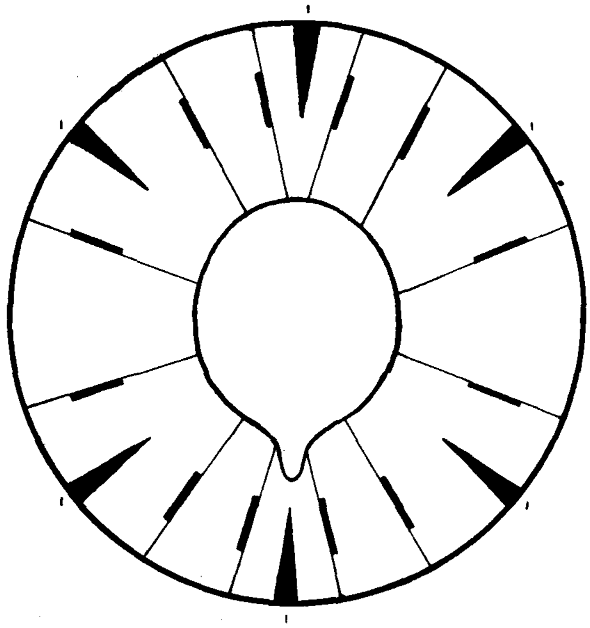

FIG. 4A.

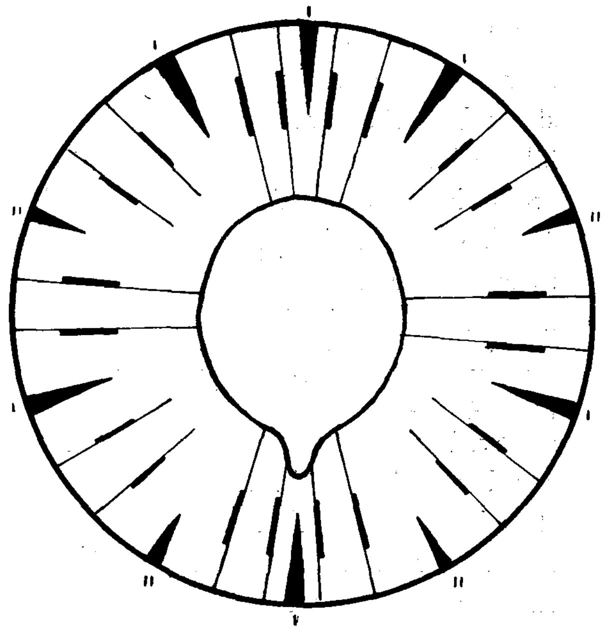

FIG. 4B.

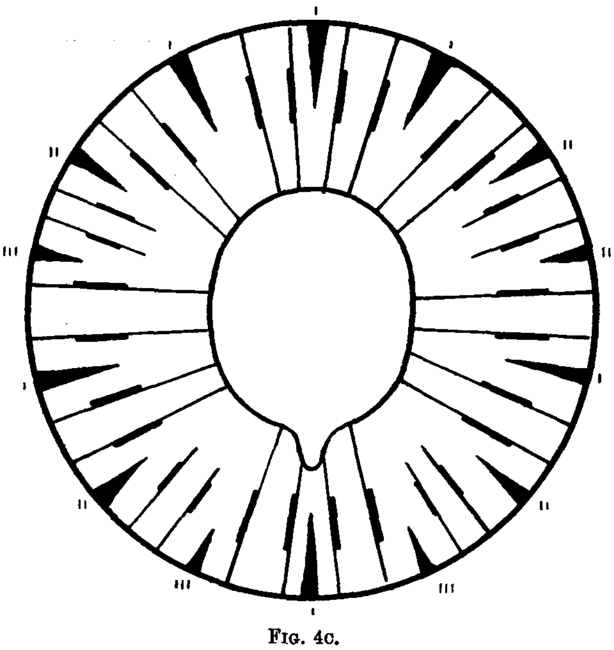

FIG. 4C.

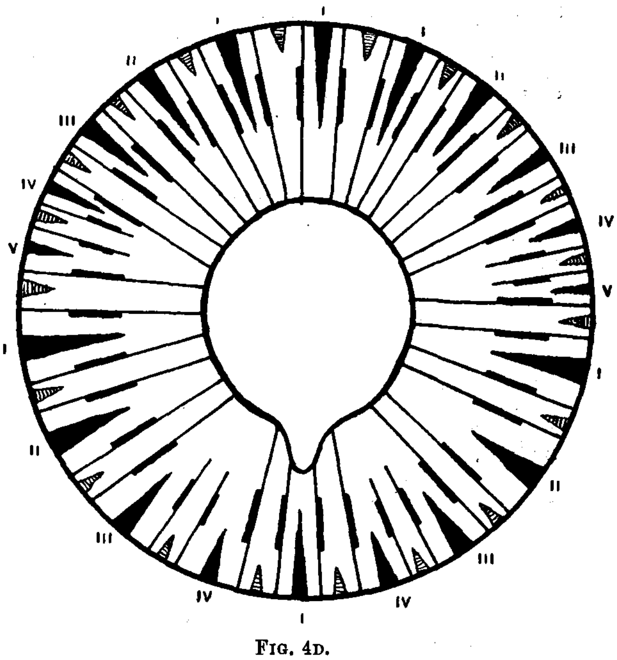

FIG. 4D.

FIGS. 4A–D.—Scheme to illustrate the origin of Rugosa, assuming that the development of the mesenteries to begin with has proceeded as in the Endocœlactidæ. The black tongues are endocœlic septa, the shaded tongues exocœlic septa.

difference that the development of new mesenteries is continued in the endocœls, and that in each quadrant a suppression of mesenteries on the dorsal side takes place in each order from and with the third, a suppression which probably stands in connection with the animal's mode of life.

In this hypothetical explanation of the arrangement of the Rugosa septa, I have mainly intended to direct attention of palæontologists to the fact that the Rugosa type may be explained in various ways; moreover, a closer examination of Rugosa has shown that the development is different in different genera, that some of them retain a bilateral and others a more radial arrangement; the development of septa in this group, however, requires further examination.

The hypothesis put forward by me with regard to the origin of Rugosa seems to me to speak for itself. The presence of the 4 growth-zones after the development of the first 12 mesenteries in Rugosa may be fully explained by supposing a development of certain mesenteries like those in the Endocœlactidæ. The enlargement of the 4 primary lateral endocœls has led to developmental zones for the new mesenteries being removed to these areas instead of to the 6 primary exocœls. The origin of a 4 (8)-rayed type in certain Rugosa may be explained in this way. In any case, I consider the above explanation as good as, if not better than, that put forward by DUERDEN, to the effect that Rugosa must stand in a certain relation to the Zoantharia (Zoanthidæ). In consequence of this view, he also considers the latter group as very old, a view, however, I have some difficulty in accepting, as the Zoanthidæ are obviously rich in species, and presumably form a group which is still in process of differentiation. See also my work in BRONN.

Finally, it seems convenient further to characterise the family Endocœlactidæ with the genera *Halcurias*, *Porponia*, and *Synhalcurias*.

Family *Endocœlactidæ*.

Athenaria (Protactininæ?) with thick, sometimes cartilaginous body-wall, without sphincter and fossa, with spirocysts in the ectoderm of the body-wall and œsophagus. Arrangement of the mesenteries quite different from that of the normal Actiniaria type, owing to the development of the second and third order of mesenteries in the endocœls. In consequence, the arrangement of the tentacles very different from the normal type (among others, 10 tentacles of the first order immediately border on those of the second order). Sexual organs present on all the stronger mesenteries from and with those of the first order, including directive mesenteries.

Genus *Halcurias* M'Murrich = *Endocœlactis* Carlgren.

Endocœlactidæ with *ca.* 68 mesenteries, 36 of which are perfect. Four cycles of mesenteries. The mesenteries of the fourth order regularly arranged on each side of those of the third order, the mesenteries of the same pair equally developed. The perfect mesenteries arranged as follows: 20 (6 + 4 pairs) + 16 (8 pairs), of which the first 20 strong, extending over the whole length of the body; the others only developed in the distal part, and weak. The body cylindrical. The tentacles not bridge-like thickened on the outer side. On the first 20 mesenteries the pennons of the longitudinal muscles well developed. One œsophageal groove.

H. pilatus M'Murrich.
H. carlgreni * M'Murrich (*Endocœlactis* sp. Carlg.).

Genus *Porponia* R. Hertwig.

Endocœlactidæ with (54 ? to) *ca.* 68 mesenteries, of which 44 perfect. Five cycles of mesenteries. The mesenteries of the fourth and fifth order are regularly arranged, but show unequal development, so that the mesenteries of the fourth order on the one side of the mesenteries of the third order consist of a perfect and an imperfect mesentery, on the other side only of an imperfect mesentery; but the mesenteries of the fifth order are not paired, and only developed between the mesenteries of the first order and the perfect mesenteries of the fourth order (as in Actinostola). The arrangement of the perfect mesenteries is 20 (6 + 4 pairs) + 16 (8 pairs) + 8 (these form pairs with imperfect mesenteries). The body goblet-like, sometimes cylindrical. The tentacles on the outer side bridge-like and greatly thickened. The pennons of the longitudinal musculature on the mesenteries hardly indicated. Two œsophageal grooves.

P. elongata R. Hertwig.
P. robusta R. Hertwig.
P. antarctica Carlgren.

Genus *Synhalcurias* Carlgren.

Endocœlactidæ with considerably more than 68 mesenteries (*ca.* 100), all of which are perfect, arranged in pairs, and frequently agreeing in the size and distribution of the sexual organs. The irregular arrangement of the mesenteries probably due to the development of the mesenteries of the second and third order in the endocœls. Origin of the mesenteries of the fourth order and the following (?). The body cylindrical. The tentacles are not thickened on the outer side. The longitudinal muscles of the mesenteries weak, not forming pennons, and almost equally developed on all mesenteries. One œsophageal groove (2 ?).

S. elegans (Wassilieff).

In a coming work I intend to give a description of the other Actiniaria, *ca.* 20 in number, which have been collected by the *Scotia* Expedition.

* As further characterisation of this species, I may give the following information about the nematocysts:—Spirocysts occur in quantities, especially in the tentacles, but are also common in the body-wall, the ectoderm of the œsophagus and in the filaments. They are of greatly varying sizes, generally as large as the corresponding thick-walled nematocyst capsules; but smaller as well as still larger ones occur, the latter especially in the tentacles, where they reach a length of up to 43 μ, breadth 7 μ. In the body-wall the thick-walled nematocysts reach a length of 22–26 μ, in the tentacles 26–34 μ, and in the filament and œsophagus *ca.* 26–29 μ. In the latter places are also found nematocysts with distinct basal part to the spiral thread, of almost the same length as the preceding, but broader at the basal end. The thick-walled nematocysts are most numerous in the tentacles.

APPENDIX.

Now that I have had occasion to examine two highly retracted and badly preserved specimens of the type of *Actinernus*, *A. nobilis* Verr. (place of discovery 43° 18′ N., 60° 24′ W., Gloucester Fisheries, 1879, U.S. Fish. Com.), as far as I can see from the bad material, the tentacles of the first and second order are arranged as in *Porponia*. There are also spirocysts in the ectoderm of the body-wall. Therefore I think that *Actinernus nobilis* (but not *Polysiphonia tuberosa*, and probably not *A. plebeius*—I have not seen this latter species) must be placed in the Endocœlactidæ. Whether *Porponia* and *Actinernus* are synonyms I cannot say for the present, but it is not impossible.

February 4, 1914.

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EXPLANATION OF PLATE IV.

bac., thickenings of the basal part of the ectoderm cells?
cm., circular muscles.
ct., ciliated tract of the filament.
dp., directive plane.
ec., ectoderm.
en., entoderm.
lm., longitudinal muscles.
m. mesoglœa.
mf., fibrillous folds of the mesoglœa.

mp., muscles' pennon.
nd., enido-glandular tract of the filament.
pbm., parieto-basilar muscles.
pm., parietal part of the longitudinal muscles.
psb., pseudo-basilar muscles.
rm., radiated muscles of the disc.
sp., spirocysts.
t., tentacles.

Figs. 1–4, *Synhalcurias elegans*; 5–9, *Porponia antarctica*; 10. *Halcurias carlgreni*.

Fig. 1. Transverse section through the body-wall with a part of two mesenteries. $\frac{4}{0}$.*

Fig. 2. Vertical section through the body-wall. Only a part of the mesoglœa is designed. $\frac{4}{3}$ with out-drawn tube.

Fig. 3. Transverse section of the mesoglœa and muscles of the disc. $\frac{2}{3}$.

Fig. 4. The basal part of a mesenterium with the longitudinal muscles and the pseudo-basilar muscles. Schematic.

Fig. 5. Cross-section through one tentacle above the middle. $\frac{4}{0}$.

Fig. 6. Cross-section through the same on the basis $\frac{2}{0}$.

Fig. 7. Cross-section through a not-directive mesenterium. The same section as in fig. 8. The whole breadth of the mesoglœa is not drawn. $\frac{2}{3}$.

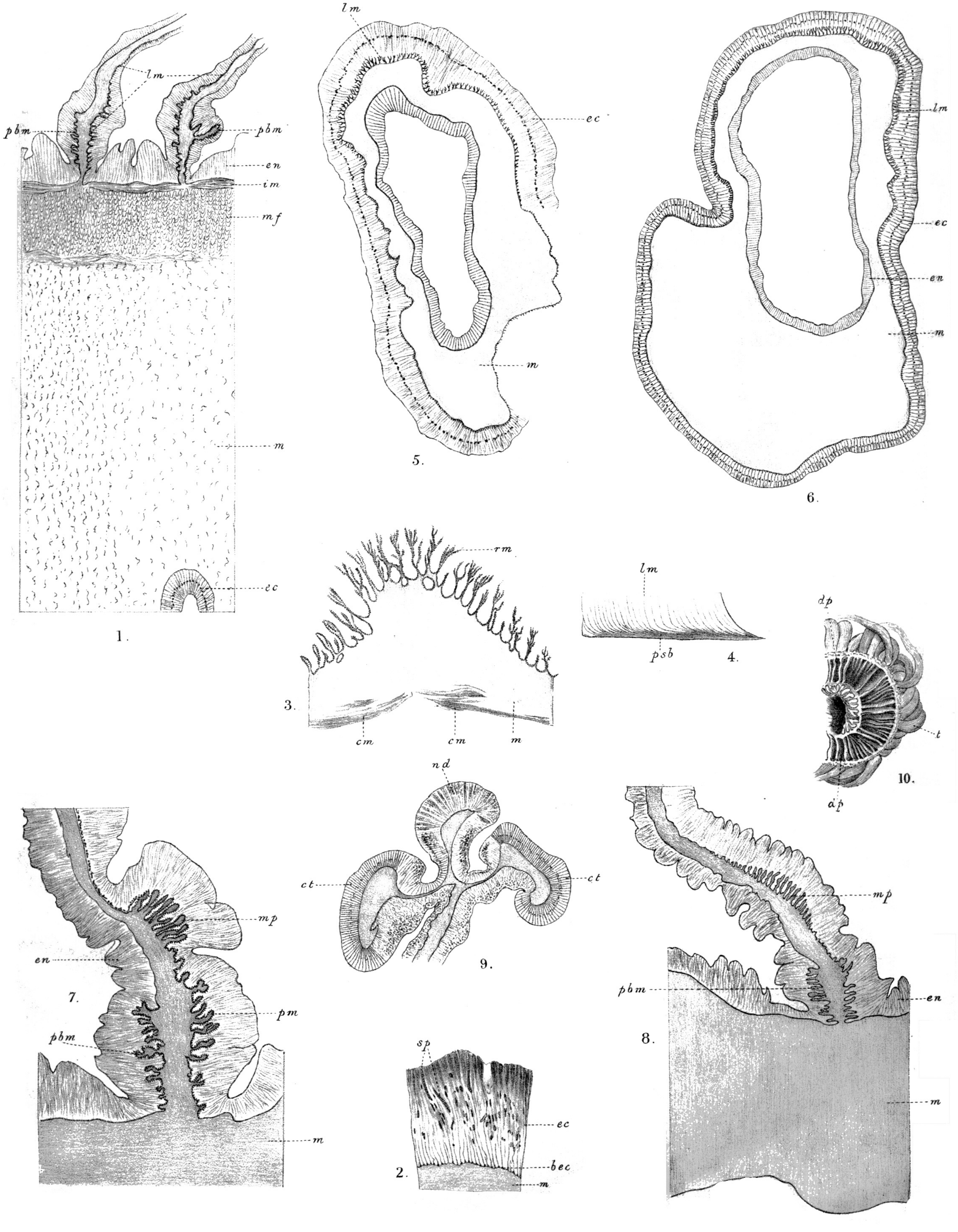
Fig. 8. Cross-section through a part of a directive mesenterium and the body-wall in the region of the aboral end of the stomatodæum. $\frac{4}{0}$.

Fig. 9. Transverse section of the ciliated tract region of the filament. $\frac{4}{0}$.

Fig. 10. Section through the upper part of the body to show the arrangement of the mesenteries. Twice magnified.

* Magnifications refer to Reichert's system, "Austria." Figures drawn in the level of the microscope's foot.

CARLGREN: "SCOTIA" GENUS PORPONIA.



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M'Farlane & Erskine. Lith., Edin.