On a Specimen of a Gigantic Hydroid, Branchiocerianthus imperator (ALLMAN), found in the Sagami Sea.

By

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With Plates XIV & XV.

On the morning of January 1, 1899, quite a commotion was produced in the Marine Biological Station at Misaki by the bringing in of a very beautiful and gigantic Coelenterate (Pl. XIV). It had been caught, on the previous day, by a fishing "long-line," from a depth of about 250 fathoms near Okinose, a submarine bank 18 kilometers south of Misaki. It was an object which was calculated to raise enthusiasm in a naturalist. A large disc surmounted a long stalk which evidently fixed the animal on the sea-bottom. A circle of numerous graceful tentacles hang down from the margin of the disc, while on its upper surface arose an oral tube, surrounded at its base by bushy dendritic appendages and having a second circle of slender tentacles around its upper edge. The total height of the animal was 700 millimeters and the prevailing colour transparent scarlet. It was agreed on all sides that it was a New Year's gift from OTOHIME* and that it should be known in Japanese as *Otohime no Hanagasa.*

The specimen, when brought in, was entirely fresh but was not living. It was placed in 2% formalin to preserve, if possible, something of its beautiful colour. At first the attempt seemed successful, but after a while the colour began to fade gradually, until now the specimen is completely bleached to pale white. For histological examination, pieces of the tentacles and the dendritic appendages were fixed in the sublimate and in Perenyi's fluid.

The specimen was handed over by Prof. MITSUKURI to me to work out its finer structure.

It was evident from the first that the specimen was very similar to the form only a short time before described by MARK ('98) as *Branchiocerianthus urceolus.* I started, therefore, with an idea that I was dealing with an Actinian.

As I proceeded in my investigation, however, it became plain that this idea was not tenable, and the conclusion was finally reached that the animal was very closely allied to *Corymorpha,* and that it belongs probably to the species obtained by the "Challenger" at about the same locality and named by ALLMAN ('85) *Monocaulus imperator,* notwithstanding many discrepancies between his description and the specimen. This conclusion was communicated through Prof. MITSUKURI to Dr. MARK and a request was also sent to him, that during his opportune stay in Europe, he should,

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*Otohime" is a beautiful goddess who is supposed to have her palaces at the bottom of the sea. "Hanagasa" is the flower-sun-shade or ornamental parasol. Thus *Otohime no Hanagasa* means "the ornamental parasol of Otohime."

if possible, examine the original specimen of *Monocaulus imperator* in the British Museum. To the results of his examination of the specimens I shall return in the later part of this paper.

Meanwhile an article was published in the Zoologischer Anzeiger by O. CARLGREN ('99) throwing doubt on MARK's *Branchioceriantbus* being an Actinian, and contending that it more probably is a *Corymorpha* or at least a form standing very close to *Corymorpha*.

In June, 1899, a correction was published by MARK ('99) himself in the Zoologischer Anzeiger. His previous preliminary description had been based on external anatomy, and he now frankly admitted that further researches had convinced him of the fact that the animal in question must be more nearly related to the Hydroidea than to the Actinia, though its exact affinities he had not yet determined. In a postcript he mentions our conclusions which had been communicated to him, as mentioned, by letter, and thinks that both his and our specimens belong to the same genus and that our specimen is probably identical with the *Monocaulus imperator* of ALLMAN.

Before going further I wish to express my deepest feeling of obligation to Prof. MITSUKURI for the supervision and advice which he has given during the progress of my work.

Description.

This hydroid is a solitary form consisting of a well marked hydranth and a hydrocaulus. Its most striking feature is a strongly expressed bilateral symmetry. The hydranth is disc-shaped and bears two sets of tentacles and a circle of dendritic gonosomes, all showing in their arrangement a well marked bilaterality. The hydrocaulus, which is attached not to the center but to the edge of the hydranth, is nearly cylindrical and increases in diameter from the attachment of the hydranth towards the end which is fixed in the sandy sea-bottom. The total height of the animal attains 700 mm., as measured from the top of the oral tube to the attached base of the hydrocaulus.

In the fresh condition the hydranth was rose pink and its tentacles, both oral and marginal, were deep scarlet in colour, while the gonosomes possessed light rufous colour. The hydrocaulus was light pink in colour, being quite pale in its middle.

The general features and the colours are well shown in Fig. 1, Pl. XIV, which was drawn from the preserved specimen by Mr. NAGASAWA, artist of our Institute, making use also of the rough sketches I made at the time of the fresh object.

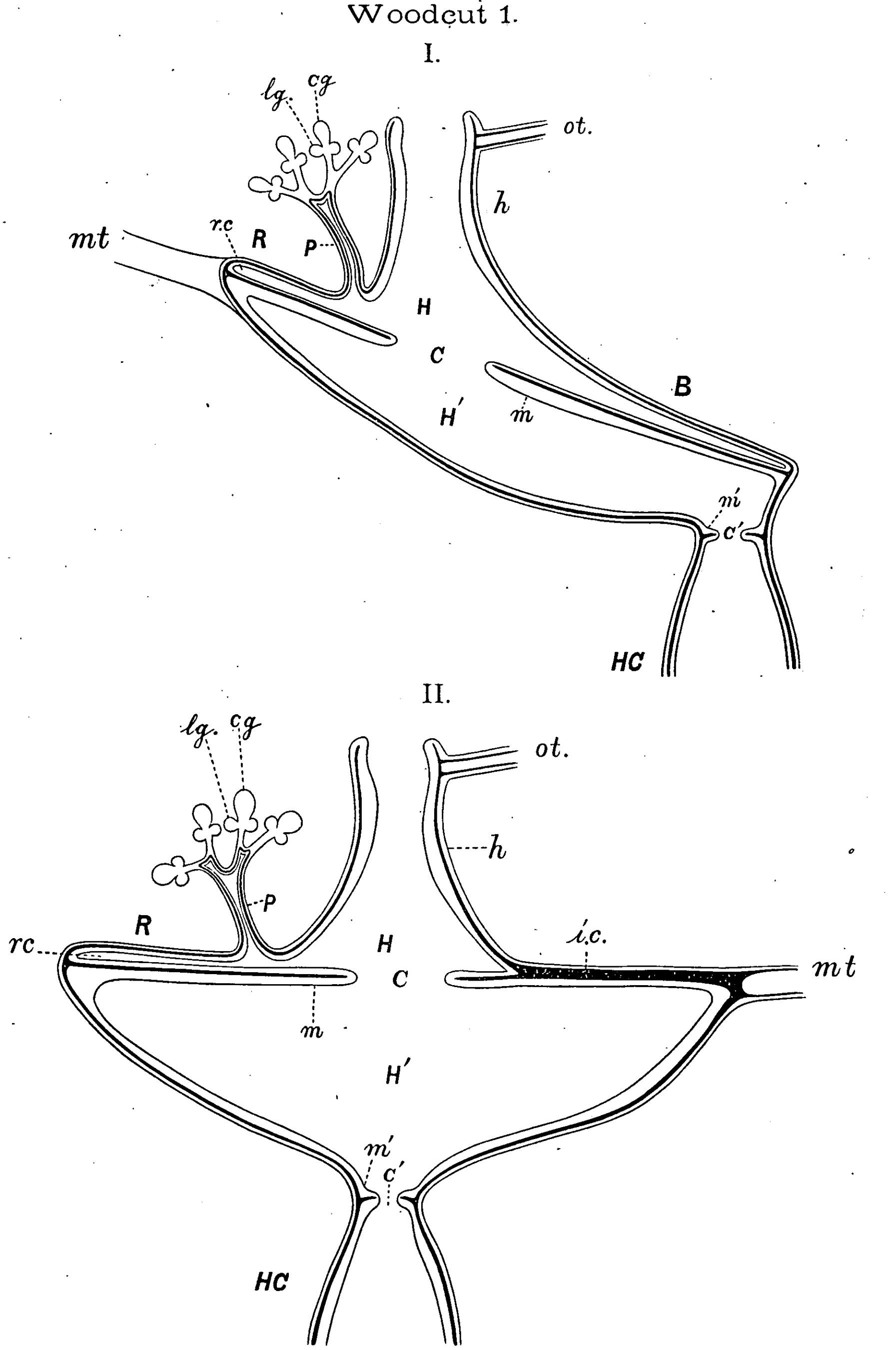
Hydranth.

The upper surface of the hydranth is flattened so that it may be described as an "oral disc." The lower surface, however, assumes a shallow funnel-shape, which passes downwards into the hydrocaulus. This disc has an oval outline, but differs from that of *Branchiocerianthus urceolus, in having its sagittal diameter less than its transverse,* the two diameters being respectively 80 and 90 mm. (Woodcut 2).

At one end of the sagittal diameter is attached the hydrocaulus where the circle of the marginal tentacles is also interrupted. The plane of the disc is oblique to the long axis of the hydrocaulus (Woodcut 1, I), though not to the same degree as in *Branchiocerianthus urceolus* MARK.

The edge where the hydrocaulus is attached I shall designate the lower, and the opposite the higher, edge.

Woodcut 1.



Diagrams showing sagittal (I.) and transverse (II.) sections of the hydranth.

B. hypostomal region of the disc; *C.* orifice of the diaphragm (*m*) in the hydranth; *C'* orifice of the diaphragm (*m'*) in the hydrocaulus; *cg.* central, *lg.* lateral, globule of the gonophore; *H.* upper, *H'* lower cavity of the hydranth; *h.* hypostome; *ic.* intercalated cord; *HC* hydrocaulus; *mt.* marginal, *ot.* oral, tentacle; *P.* peduncle of the gonosome; *R.* outer region of the disc, provided with the radial canals (*r.c.*).

The hypostome (Woodcut 1, I, II, *h*), the superior prolongation of the disc, is slightly conical, diminishing gradually in its diameter from the base towards the free end where the mouth opens. A little below the mouth the hypostome bears a brush-like group of about 180 filiform tentacles (*ot.*) which are arranged in three or more closely packed verticils, the outer tentacles being much larger than the inner. The outermost ones attain a length of 50-55 mm., while the innermost are so small and crowded that I could neither measure them well nor count their exact number. Below the oral tentacles the hypostome is slightly constricted, but there is no indication of syphonoglyph which is said to be present in the oral tube of *Branchiocerianthus urceolus*. The side of the hypostome turned towards the lower edge of the disc passes gradually to the disc, while on the opposite side it seems abruptly raised from the disc, so as to make an angle between. The hypostome is thus oblique to the disc proper which again is not perpendicular to the axis of the hydrocaulus. Hence we can show the relation of the three parts, the hypostome, the disc and the hydrocaulus, diagrammatically with three lines, of which two vertical ones, corresponding to the axes of the hypostome and of the hydrocaulus, meet with an oblique one representing the axis of the disc, forming obtuse angles between them (Woodcut 1, I).

The base of the hypostome (Woodcut 2, *B.*) occupies about the middle of the disc, but on the side turned towards the lower edge, its base gradually becoming lower and lower, may be said to stretch as far as the margin of the disc, while laterally and towards the higher edge it is distant from the margin 35 mm. and 22 mm. respectively. It thus assumes an ovoidal outline, the pointed end attaining the lower margin of the disc and passing directly to the

Woodcut 2.

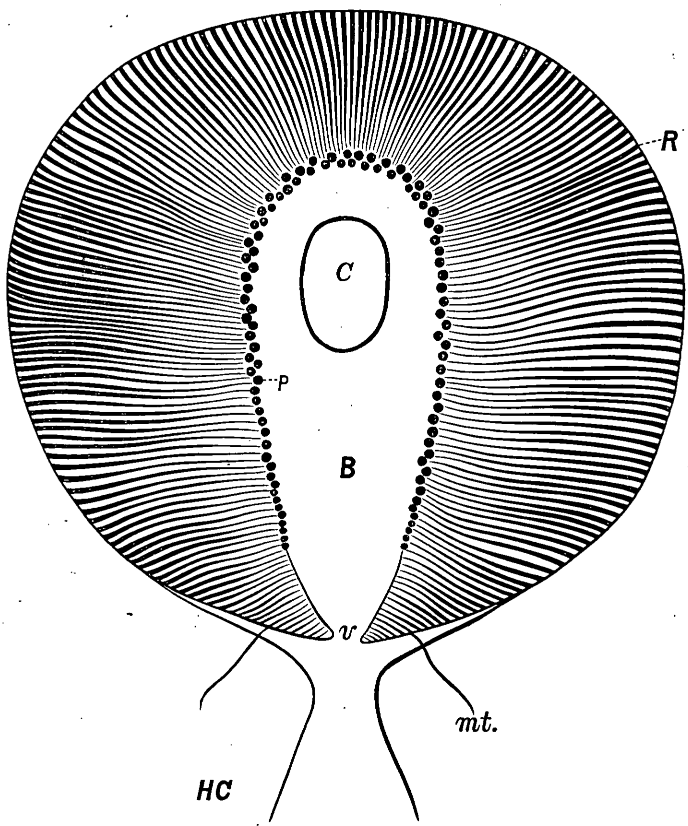


Diagram showing the upper surface of the disc.
v, hiatus at the lower edge of the disc. Other letters as in Woodcut 1.

surface of the hydrocaulus. The longer (*i. e.* up—down) diameter of this ovoidal space measures 60 mm., while the transverse at the widest middle portion is only 25 mm. This space is destitute of the radial canals which are prominently seen in the remaining part of the disc.

Around the margin of this hypostomal region there arises from the surface of the disc a row of dendritic gonosomes (*p*) which in shape strongly remind one of the heads of cauliflowers.

They number in all 96 and are arranged approximately in a single row, which, being interrupted at the lower edge of the disc, assumes the form of a horse-shoe. (Woodcut 2, *P*). At the two ends of the horse-shoe are situated the smallest gonosomes which stand at a distance of 15 mm. across from each other. The length of the stalk of the gonosomes varies from 20 mm. to 60 mm. While the gonosomes nearer the lower edge of the disc are on the whole shorter than those nearer the upper edge, it is to be noticed that the larger and smaller gonosomes are placed alternately, indicating faintly the two circles in their arrangement, the larger gonosomes being placed in the outer, and the smaller in the inner, circle.

The region of the disc outside the gonosomes is marked with numerous radial canals (Woodcut 2, *R*.) which run from the base of the gonosomes to the margin of the disc. This region thus assumes the form of a wide horse-shoe, whose two arms gradually diminish in their breadth towards the lower edge of the disc until they terminate at that edge. Hence this region varies in breadth, measuring 20 mm. on the median line at the higher edge, and 35 mm. on the lateral region, while on the lower side both arms are practically zero.

The radial canals (Pl. XV, Fig. 1, *r.c.*) slightly swell out the surface of the disc thus giving the latter an undulating appearance. The canals are intercalated by solid cords (Pl. XV, Fig. 1, *i.c.*) which appear on the surface of the disc as opaque lines. The canals and the intercalated cords are longest in the lateral region where they run obliquely across the disc, and are longer than the breadth of this region. The canals situated nearer the lower edge are smaller and shorter than those higher up, until at the both arm-ends they are practically *nil*. On the other hand the canals on the higher side of the disc are not so long as those on the lateral, but run straight from the base of the gonosomes to the outer margin of the disc, the length of the canal being thus the same as the breadth of this region (Woodcut 2).

The radial canals and the intercalated cords increase in their width towards the outer margin of the disc where the both structures are broadest. Inwards, the radial canals open into that part of the hydranth-cavity where the cavities of the gonosomes stand in communication with the latter. Outwards, the canals terminate blindly on the margin of the disc. The intercalated cords enlarge suddenly near the margin of the disc and acquire a cavity which forms a part of that of the marginal tentacle (Pl. XV, Fig. 1).

The name of marginal tentacles (*mt*) is given to the outermost circle of filiform tentacles arranged like a fringe around the margin of the disc. The circle is not complete, there being a hiatus (*v*) at the lower edge of the disc where the surface of the hypostome passes directly into that of the hydrocaulus. The shortest tentacles arising from the 6th or 7th intercalated cord, counting from the lower edge, occupy the two ends of this incomplete ring. Whether there were any smaller tentacles nearer the lower edge, I am not sure. There is no indication, so far as I can see, of any having existed. Towards the higher edge of the disc they increase successively in length until about the 10th (counting from the lower edge) is reached, of which the length on both sides is about 200 mm. After this there seems to be no special arrangement of the tentacles, which vary from 200 mm. to 300 mm. in length. They numbered 198 in all. The tentacles are flattened at their base, and are compressed so closely with one another that the basal portion appears to form a part of the disc. Just above the flattened base the tentacle assumes the form of a tube, 4 mm. in diameter, and tapers gradually towards its free end.

The hydranth (Woodcut 1, I. II.) contains a wide cavity which is separated by a thin membrane (*m*) into two parts, an upper (*H*) and a lower (*H'*). The superior prolongation of the upper cavity is that of the hypostome, which does not show any indication of the septal partition. The lower cavity is more spacious than the upper, and not only occupies the whole lower part of the hydranth but extends also through the entire length of the hydrocaulus.

The membrane (*m*) separating the hydranth-cavity arises diaphragm-like just below the upper wall of the disc. In about the center of this diaphragm, directly below the mouth, is an ovoid orifice (Woodcut 1, II, *C*) which puts the upper and lower cavities in communication with each other. The orifice is 11 mm. and 15 mm. respectively in its transverse and sagittal axes.

That part of this diaphragm which corresponds to the part of the upper surface of the disc marked *B* in Woodcut 2, *i.e.* to the basal part of the hypostome, projects into the cavity of the hydranth like a shelf, with the aforesaid opening near its middle and with no attachment either above or below. Outside this portion, however, the diaphragm forms the floor of the radial canals mentioned above, so that it is suspended, so to speak, by the numerous intercalated cords (*vide supra*) to the upper surface of the disc. At the margin the diaphragm is united to the outer wall of the hydranth (Woodcut 1).

To show the somewhat complicated relations existing between the marginal tentacles, radial canals, intercalated cords, etc., a series of sections (Pl. XV Figs. 4–9) passing through the lines 1–1, 2–2, 3–3, 4–4, 5–5, 6–6 in Fig. 1, Pl. XV is introduced. The first section (Fig. 4) through the outermost margin of the disc, which corresponds to the line 1–1 in Fig. 1, shows that the bases of the marginal tentacles (*t.b.*) and the blind ends of the radial canals (*r.c.*) are arranged alternately, the former projecting out above and below more than the latter. The upper projection corresponds to the enlarged end of the solid cord. The cavity of the tentacle is almost filled up by the spongy endoderm which lines the whole cavity of the animal, so that it remains as a narrow canal only in the upper and lower swollen parts of the tentacles. On the other hand the radial canals contain a wide cavity which is clearly separated from that of the tentacle-base by the well developed mesoderm. In the next section (Fig. 5, through the line 2–2, Fig. 1) cut just inside the margin of the disc, the radial canals already assume their characteristic shape in cross-section, while the intercalated cords have already lost their cavity entirely. Bounded by the mesoderm the intercalated cord assumes in cross-section the form of a trapezoid. It is convenient to distinguish here three kinds of the mesoderm-lamellæ, the upper, basal, and the vertical. The upper lamella (*u.l.*) is situated along the surface of the disc, the basal (*b.l.*), in the floor (*i.e.* in the diaphragm), and the vertical (*v.l.*) connects these two lamellæ. When traced inwards, (Pl. XV Figs. 6, 7) the intercalated cord becomes thinner and thinner, until it no longer shows in cross-section the form of a trapezoid, but assumes the shape of a triangle formed by two vertical and one basal lamella. Where the gonosome arises (Fig. 8), the vertical lamella does not reach the upper lamella; hence the radial canals communicate here with one another and form the upper common cavity of the hydranth.

Within the circle of the gonosomes (Fig. 9) the upper lamella stands entirely separated from the basal, on which the vertical lamella shows itself only as a ridge-like line which in cross-section is recognizable as a simple small knob.

Preserved in formalin, the fine tissues of the animal were unfortunately mostly gone. Luckily, however, the pieces of the gonosomes and the marginal tentacles, which were preserved in sublimate, etc., helped us to ascertain something of the histological character of the animal.

The wall of the animal-body, I need hardly say, consists of the three layers, ecto-, endo- and mesoderm as in other Coelenterates.

The ectoderm, the outermost layer, has been entirely shed off from the specimen in formalin, but in the pieces fixed with sublimate was well preserved. This tissue is a single layer of cylindrical cells which in their preserved condition are more or less vacuolised. There are present a few nematocysts which are characteristic of the ectoderm of Coelenterata.

The mesoderm is a very firm, supporting layer which is placed between the ecto- and endo-derm or two portions of the endoderm. This tissue was well enough preserved even in formalin so that the structure of the animal could be largely made out by this layer alone.

The endoderm, the innermost layer, which lines the whole cavity of the animal, remained unfortunately only here and there in the specimen in formalin. From these patches it could be made out that the endoderm lining the hydranth-cavity is several cells thick (Figs. 3 & 10). The cells are irregularly formed and contain but a little cytoplasm which is pressed towards the wall with the nucleus. Consequently the wall of the cavity gives a spongy appearance. I can not think that this appearance of the endoderm is caused by bad preservation, for the tentacles fixed with sublimate show also the same structure. In the preserved state, the endoderm forming the upper ceiling of the lower cavity of the hydranth has a thickness of 3 mm.

In the cross and longitudinal sections (Figs. 11 & 12) of the marginal tentacle, the whole of the space inside the mesoderm is entirely filled up with a tissue which reminds one of the vertebrate notochord. It has the same structure as the spongy endoderm of the hydranth-cavity already mentioned. Only near the base of the tentacle, this spongy tissue leaves in the center a small cavity which is separated by the mesoderm from the hydranth-cavity. Hence the cavity of the tentacle-base is of a limited extent, extending not farther towards the distal end, and communicating nowhere with the general cavity of the hydranth. A longitudinal section (Fig. 2) through the margin of the disc shows plainly the relations of the disc and the base of the tentacle (the mesoderm being drawn darker than other parts in the figures).

The gonosomes (Fig. 1, *p.*) as already mentioned consist of the branched tubular stalks, upon which the gonophores are grouped in a crowded cluster. Each stalk branches dichotomously into about the 10th or 12th order. Each branchlet terminates in a group of small globules, of which we recognize two kinds (Figs. 13 & 14). The one kind of which there is only one in each cluster is situated on the top of the terminal branch, while the others take a more lateral position. The former is larger than the latter, consisting of the irregularly shaped cells mostly vacuolised (Fig. 14, *c.g.*). In this kind of globule the mesoderm of the branch is no longer recognisable and the ecto- and endo-derm can not here be clearly distinguished. It seems, however, reasonable to suppose that the centrally placed smaller cells which are continuous with the endoderm of the branchlet belong to that layer. The cells which presumably belong to the ectoderm and form the main part of this globule seem to be mostly distended. In this globule the nematocysts (Fig. 15, *n.*) are found in a large number ; hence the central globule may be regarded as the battery.

The lateral globules (Fig. 14, *l.g.*) are mostly spherical and consist of compactly packed cells rich in cytoplasm. The mesoderm prolonged from the branchlet distinctly separates the ectoderm from the central cell-mass. After examining many sections I was able to find a few globules which enable us to see that the clusters are true gonophores. In such globules (Fig. 16), one is able to see that the ectoderm cells at the tip are grouped into a mass forming the "bell-nucleus" which pushes the endoderm in as a cup. This part of the endoderm is arranged into a regular layer one cell deep and is easily distinguishable from the remaining part. Owing to the section (Fig. 16) having been cut slightly obliquely, the cavity in the endoderm seems irregular and very limited. In reality, there is a wide cavity occupying the whole interior of the globule, which communicates with that of the branchlet. I could not detect gonophores developed any further than this in our specimen. January is probably not the season in which the ripening of the sexual products takes place.

The terminal branch thus bears two sorts of globules, the one being a nematocyst-battery and the other a true sexual organ. Hence the dendritic gonosome of this animal is a peculiar organ which bears on a common stalk the sexual and defensive elements.

In other hydroids these two elements are borne on separate stalks, as for example in *Pennalia*.

Hydrocaulus.

The under part of the hydranth is prolonged to a shallow funnel whose neck corresponds to the hydrocaulus. At about the point where the hydranth joins the hydrocaulus, there is a circular constriction (Woodcuts 1 & 2). Here the diameter of the hydrocaulus is only 9 mm. and from this part down to the base it increases in its diameter. Within the constriction is a diaphragm (Woodcut 1, I, II, *m'*) separating incompletely the cavity of the hydranth from that of the hydrocaulus. In other words the circular constriction is the surface expression of the insertion of the diaphragm. In the midst of this partition there is an opening (Woodcut 1, I, II, *C'*) which puts the two cavities above and below in communication. It is about 4 mm. in diameter and is almost circular. The plane of the diaphragm is not visibly oblique to the long axis of the hydrocaulus. In the specimens of *Monocaulus imperator* in the British Museum, this diaphragm is, according to Dr. MARK, distinctly oblique and the central opening is much elongated.

The hydrocaulus is a hollow tube which has a total length of 650 mm. including the proximal end with hair-like appendages. The hydrocaulus, even when fresh, was collapsed and more or less longitudinally folded, so that the exact measurement of its diameter was almost impossible. Approximately, it was 15 mm. just below the constriction, 25 mm. at the middle, and 42 mm. at the terminal root.

The outer surface of the hydrocaulus is smooth. In the upper half of it there are visible from outside 15–20 longitudinal wavy bands (Fig. 17). They stand about 2-3 mm. distant from one another and run down to about the middle part of the hydrocaulus where they become obscure. From the surface they look remarkably like the mesenterial filaments of an Anthozoon. These wavy bands anastomose here and there with one another and give to the hydrocaulus of our specimen an appearance much resembling that of *Corymorpha*. Though the bands are in the preserved state still visible, they were more conspicuous when fresh. These longitudinal bands show themselves in cross-section (Fig 18) as dense spots (x) in the mesoderm, which have a great affinity for any staining agents. From the bad state of preservation of the specimen, in which the ectodermal and endodermal cells were mostly lost, I could not ascertain whether the wavy bands were the endoderm canals, a structure peculiar to *Corymorpha*, or not. I think it, however, very probable that they existed, and gave rise to these band-like appearances. In the published accounts of *Monocaulus imperator* of ALLMAN the endoderm canals were plainly described and figured.

The mesoderm is very well developed, especially in the hydrocaulus where it reaches a thickness of about 0.2–0.3 mm. This remarkable layer shows itself in the form of a fibrillated membrane, which, when macerated with caustic potash, is separated into two layers, the outer longitudinal (Fig. 19, *l.l.*) and the inner circular (Fig. 19, *c.l.*). The former is thicker and stains less with any coloring matter than the latter.

In our specimen there is no sudden bulb-like expansion at the lower end of the stalk, such as is described by MARK in *Branchiocerianthus urceolus* or by ALLMAN in *Monocaulus imperator*. The lowest and broadest part of the hydrocaulus is enclosed for about 30 mm. from the base in a chitinous sheath which gives an anchorage to the Hydrozoon. With the exception of the upper edge the sheath (Fig. 20 *s*) bears in most parts very numerous hair-like processes (*ap*) of brown color, which are so entangled that many foreign bodies (*e.g.* Echinus spines, sand gráins, dead shells) are wrapped up within them. The sheath and the root proper are united so closely that they are not to be separated from each other without tearing. In contrast to the pink-colored hydrocaulus the brown color of the sheath with its appendages is very conspicuous.

At the lowest end of the hydrocaulus the wall is very delicate and has an opening, the margin of which is destitute of the hair-like appendages.

Above the root the mesoderm possesses here and there irregular small depressions which are recognized by tolerable magnification from the surface as clear spots. These depressions are also present in the wall of the root enclosed in the sheath.

A portion of the root cut longitudinally (Fig. 21) shows that the sheath with its appendages is separate from the root proper, but has an organic connection with it. The hair-like appendage (*ap.*), which is seen to be a slender hollow process of the sheath, embraces in its interior the thread-like outgrowth (*o.*) of the wall, which perforates the mesoderm and is connected directly with the endoderm of the inner cavity of the hydrocaulus. Hence it seems to me that the above-mentional small depressions in the mesoderm are certainly the indications of the wart-like processes of the wall of the hydrocaulus as in *Corymorpha*.

Summary.

1. The most striking feature in our specimen is its strongly expressed bilateral symmetry as shown by the excentric attachment of the hydranth to the hydrocaulus and by an interruption of the circles of the gonosomes, radial canals, and marginal tentacles at the lower edge of the disc. Those who have read the above account will, I think, agree with me in thinking that this bilateral symmetry is due, not to the primitive state of the body-organization, but rather to its elaboration and specialization. We must therefore regard this remarkable case of bilateral symmetry in a hydriform person as very different from that expressed for instance in the planoblast of *Corymorpha* and *Dicoryne*, which is but temporary and occurs only at a certain period of development, or from the biradial symmetry as expressed in a few genera like *Monobrachium* and *Lar* by a reduction in the number of tentacles.

2. The hydranth-cavity is divided into two parts, of which the upper is in its outer part again divided into many radial canals visible even on the surface of the disc. That remarkable structure is not, however, peculiar to our specimen. For example, the hydranth-cavity of *Tubularia* is divided similarly into two parts by a peculiar ring-shaped formation* observed by several authors. In *Tubularia* the lower cavity is narrower than the upper, so that the former forms a slender canal in the middle of the " Wulst." Gosta Grönberg ('98) described in the hydranth of *Tubularia indivisa* slender endoderm-canals which are the same in number to the proximal (marginal) tentacles and situated between every two tentacle-bases, running obliquely from the com-

*O. Hamann ('82) described that formation as "aboral Wulst," G. Grönberz ('98) as "Mesoderm-wulst."

mon cavity outwards and downwards. These canals, though not visible from the surface, may be regarded as corresponding to the radial canals in our specimen, since they both arise from the upper cavity of the hydranth and are arranged alternately with the marginal tentacles.

3. The tentacles are filiform and arranged in two sets, oral (distal) and marginal (proximal), as is characteristic of the tentacles of *Tubularidæ*, *Corymorphidæ*, and *Monocaulidæ*. The cavity of the tentacle is mostly obliterated, being filled up with a cellular tissue—a condition very frequently met with in the tentacle of the Hydrozoa.

4. The dendritic appendage is a true gonosome which bears in its summit the sexual elements. Our specimen seems to be immature, hence it could not be decided whether the gonophore is a planoblast or a sporosac.

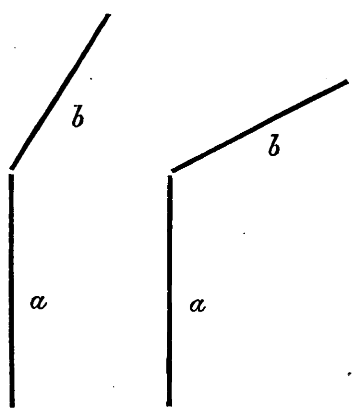
5. The hydrocaulus is marked with many wavy bands visible from the surface, and possesses a thin sheath with filamentous appendages at its lowest end.

Considerations on the Systematic Position of our Specimen.

Those who would compare the account given above of the structure of our specimen with that of *Branchiocerianthus urceolus*, MARK ('98) will not for a moment doubt that we have in these two cases essentially similarly constituted animals. It seems almost superfluous to call attention to the points of likeness: the hydrocaulus with the wavy bands in its upper half and with the sheath and filamentous appendages at its base, the hydranth surmounting the hydrocaulus, with its radial canals, dendritic gonosomes, and two sets of tentacles, all of which show a strongly expressed bilateral symmetry, being interrupted at the lower (or MARK's posterior) edge where the hydrocaulus is attached.

That our specimen and *Brachiocerianthus urceolus* belong at least to the same genus, there can hardly be any doubt. Whether they belong to the same species is another question. It is perhaps premature to decide this point, at present, in as much as MARK has not yet published his full paper. Judging from his preliminary notice which deals exclusively with the external features, the following are the chief points of difference.

a. The general shape. B. urceolus is stated to have an extremely graceful, symmetrical *vase-like figure with flaring lips.* The lateral margins of the hydranth-disc were in the natural state " folded in symmetrically from either side, so as almost to touch at a point, a little below the middle of the oval. This bending in of the margins of the disk produces at the upper end of the animal a sort of eccentric funnel-shaped depression, * * * * The fancied resemblance of the animal to a little pitcher, which this side view presents has suggested the specific name adopted—*urceolus.*" (MARK '98 p. 148). The pitcher or vase shape of the hydranth is thus due to two causes: (1) the folding in of the disc-margin, and (2) the extreme obliquity of the axis of the hydranth to the axis of the hydrocaulus. In the annexed woodcut, *a* represents the axis of the hydrocaulus and *b*



A. B.

that of the hydranth. Thus these two axes make in *B. urceolus* an extremely obtuse angle as in A, and thus help to produce the vase-shape. In our specimen the angle which these two axes make with each other (B) is much less obtuse, and moreover the folding in of the disc margin has not been noticed from the first, either in the fresh or preserved state. The disc lay flat and open as a disc, and never suggested the idea of a pitcher.

b. *The shape of the disc* is oval in *B. urceolus*; in our specimen it is more nearly circular. Moreover in the former, the sagittal or longitudinal diameter is greater than the transverse, while in our specimen it is the *transverse* diameter which is the greater of the two. The following measurements will make this point clear.

	Sagittal (longit.) diam. in mm.	Trans. diam. in mm.	Ratio of trans. diam. to sagittal.
B. urceolus.			
Small specimen	25	15	60%
Large specimen	38	30	nearly 79%
Specimen of Science College	80	90	112.5%

c. The size:—

	Length of the hydrocaulus in mm.	Maximum length of the marginal ternacle in mm.	Maximum length of the oral tentacle in mm.
B. urceolus	105–200	125	30–35
Specimen of Science College	650	300	50–55

d. *The lower end of the hydrocaulus*:—MARK describes a bulb at the lower end of the hydrocaulus. In our specimen, there is no such sudden enlargement as deserves the name of a bulb, although that end is, as has been stated, the largest.

e. *The radial canal*:—MARK mentions that the radial canals of *B. urceolus* run "from the base of the oral tube to the bases of the marginal tentacles, *before reaching which many of them fork, each of the branches communicating with the lumen of a single tentacle*" (MARK '98, p. 150). The case is very different in our specimen in which the radial canals do not fork at all and do not communicate with the lumen of the marginal tentacles. The latter, on the contrary, are the continuations of the intercalated cords.

Whether these differences are to be regarded as only specific or due simply to the differences in size, age, etc., we must leave for the present an open question. I am inclined, however, to think that *B. urceolus* and our specimen are of different species.

References have already been made several times in the course of the foregoing pages to the resemblance of our specimen to *Monocaulus imperator* of ALLMAN, a gigantic hydroid dredged by the Challenger off Yokohama (stat. 327). The description given by ALLMAN of this animal in his report of the Hydroidea of that Expedition ('88) is not as exhaustive as is desirable. He makes no mention of any bilateral symmetry in the animal, but we must remember that the specimens which he had before him were extremely badly preserved, as he is careful to mention, and that the figure of the animal which was made on the spot by the artist of the Expendition must necessarily have been made hurriedly, and as we can testify from our own observation of the fresh object, it is very easy to overlook such a feature as bilateral symmetry when the disc is lying in the midst of a mass of tentacles. Of course the best thing we could do under the circumstances was to appeal to the original specimens. At the request of Prof. MITSUKURI, Prof. MARK, who was opportunely staying in Europe at the time, was kind enough to examine the type specimens of *Monocaulus imperator*, kept in the British Museum. The results of his observation were not entirely conclusive, as the specimens "have so long been in strong alcohol that it was quite impossible to make out anything very satisfactorily." He naturally made special efforts to ascertain the condition of the hydranth—whether it was *radially* or *bilaterally* symmetrical. In one specimen, he felt tolerably confident, though by no means sure, that there *was an interruption narrower than in Branchiocerianthus urceolus in the marginal tentacles.* In another specimen the central opening in the diaphragm which divides the cavity of the hydranth from that of the hydrocaulus was found much elongated—a point which in his opinion pointed to bilateral symmetry.* He also thought that there is much less obliquity of the hypostomal region to the axis of the Hydroid than in *B. urceolus* "for the wall of the hydranth between the constriction and the base of the tentacles can be seen to be nearly the same height all around, or at least not markedly different on opposite sides." This last point is against the view that our specimen is identical with *Monocaulus imperator*, for although the disc is much less oblique in our specimen than in *B. urceolus*, as shown above, the hydrocaulus is attached at one end of the sagittal (longitudinal) diameter of the disc. But Prof. MARK adds, "the specimens were so much wrinkled and folded that I have not much confidence in this conclusion." There is

* In our specimen the opening which puts the hydranth-cavity and that of the hydrocaulus in communication is not elongated, but almost circular as already stated.

one curious point of difference between our specimen and *Monocaulus imperator*. While the hydranth in the Challenger specimen is much smaller than that of our specimen, the stalk is enormously longer, being said to reach the almost incredible length of 7 feet 4 inches. This is, however, stated to be when stretched, and is not the normal length.

While it is not thus possible to establish absolutely the identity of our specimen with *Monocaulus imperator* of ALLMAN, there are on the whole strong probabilities in favor of this assumption. Those who read carefully ALLMAN's description will notice that the points which he brings out distinctly in the structure of his species, such as a wide cavity extending through the entire length of the stalk, the presence of the stalk-mesoderm in the shape of a fibrillated membrane—a point which ALLMAN emphasizes as " the most striking feature in the histology of the Hydroid "—and so forth, are absolutely similar in our specimen. If we remember in addition that both came from practically the same locality, it is, I believe, within the scope of reasonableness *to conclude that our specimen belongs to Monocaulus imperator of Allmann.*

If this is really the case, we must examine other species in *Monocaulus.* The genus includes, besides *Monocaulus imperator*, two other species ; *M. glacialis,* (Sars) (for which ALLMAN established the genus) and *M. pendula,* (AGASSIZ). These two forms show, however, a radial symmetry, and now that *M. imperator* is shown to have a bilateral symmetry, can not possibly be put in the same genus with the latter. *M. imperator* must therefore be separated from the other two species and placed in a new genus. According to the rules of nomenclature, this new genus must take the name *Branchioceriantus** first given by MARK, and our specimen then ought to be known as

Branchiocerianthus imperator (ALLMAN).

P.S. We shall await with interest the full report on the specimen of *Monocaulus* obtained by Prof. CHUN in his recent deep-sea expedition ('99).

December, 1899.

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*MARK ('99) mentions that *Rhizonema carnea* of S. F. CLARKE ('76) may be a form same as, or closely related to, *Branchiocerianthus*. CLARKE's original description is very brief and it is impossible to determine whether MARK's suspicion is correct or not. At any rate, CLARKE makes no mention of any bilateral symmetry in the structure of the animal.

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Explanation of Plate.

Pl. XIV.

The hydranth with the upper half and the lowest part of the hydrocaulus. Nat. size.

Pl. XV.

Reference letters: *B.* hypostomal region of the disc; *Ect.* ectoderm; *End.* endoderm; *H* upper, *H'* lower, cavity of the hydranth; *ic.* intercalated cord; *mes.* mesoderm; *mt.* marginal tentacle; *p.* peduncle of the gonosome; *R.* outer region of the disc, provided with the radial canals; *rc.* radial canals; *t.b.* lumen of the base of the marginal tentacle.

Fig. 1. Surface-view of a portion of the disc with gonosomes (*p*) and marginal tentacles (*mt.*). Nat. size.

a upper wall of the disc, *b* a part of the diaphragm in the hydranth.

Fig. 2. Longitudinal section through the outermost margin of the disc Zeiss a × 4.

Fig. 3. Cross-section of the upper wall of the lower cåvity of the hydranth. Zeiss DD × 2.

Fig. 4–9. Serial sections of the upper part of the disc. Zeiss a × 4.

Fig. 4. Cross-section through the line 1–1 in Fig. 1.

Fig. 5.	„	„	„	2–2	„
Fig. 6.	„	„	„	3–3	„
Fig. 7.	„	„	„	4–4	„
Fig. 8.	„	„	„	5–5	„
Fig. 9.	„	„	„	6–6	„

Fig. 10. Cross-section of the radial canal and intercalated cord. Zeiss BB × 2.

Fig. 11. Cross-section of the marginal tentacle. Zeiss $a_3 \times 2$.

Fig. 12. Longitudinal section of the same. Zeiss $a_3 \times 2$.

Fig. 13. Terminal branches of a gonosome. Zeiss a × 2.

Fig. 14. Longitudinal section of a branchlet of the gonosome. Zeiss F × 2. *c.g.* Central, *l.g.* lateral, globule.

Fig. 15. Central globule with nematocyst (*n*). Zeiss DD × 4.

Fig. 16. Lateral globule in which the bell-nucleus (*b.n.*) and the endoderm-cup (*enc.*) are fairly well recognizable. Zeiss F × 2.

Fig. A part of the wall of the hydrocaulus with the wavy bands Nat. size.

Fig. 18. Cross-section of the mesoderm in the hydrocaulus. Zeiss a × 2. *h.l.* outer, longitudinally, *c.l.* inner, circularly, striated layer. *x.* spot corresponding to the wavy band.

Fig. 19. Mesoderm of the hydrocaulus, macerated with caustic potash. Zeiss a × 2.

Fig. 20. Surface-view of the root and the sheath. Nat. size. *ap.* hair-like appendage; *s.* sheath.

Fig. 21. Longitudinal section of the root figured in Fig 20. Zeiss a × 2. *o.* outgrowth of the endoderm; other letters as in Fig. 20.

Nagasawa del.

Lith. et. imp. Koshiba

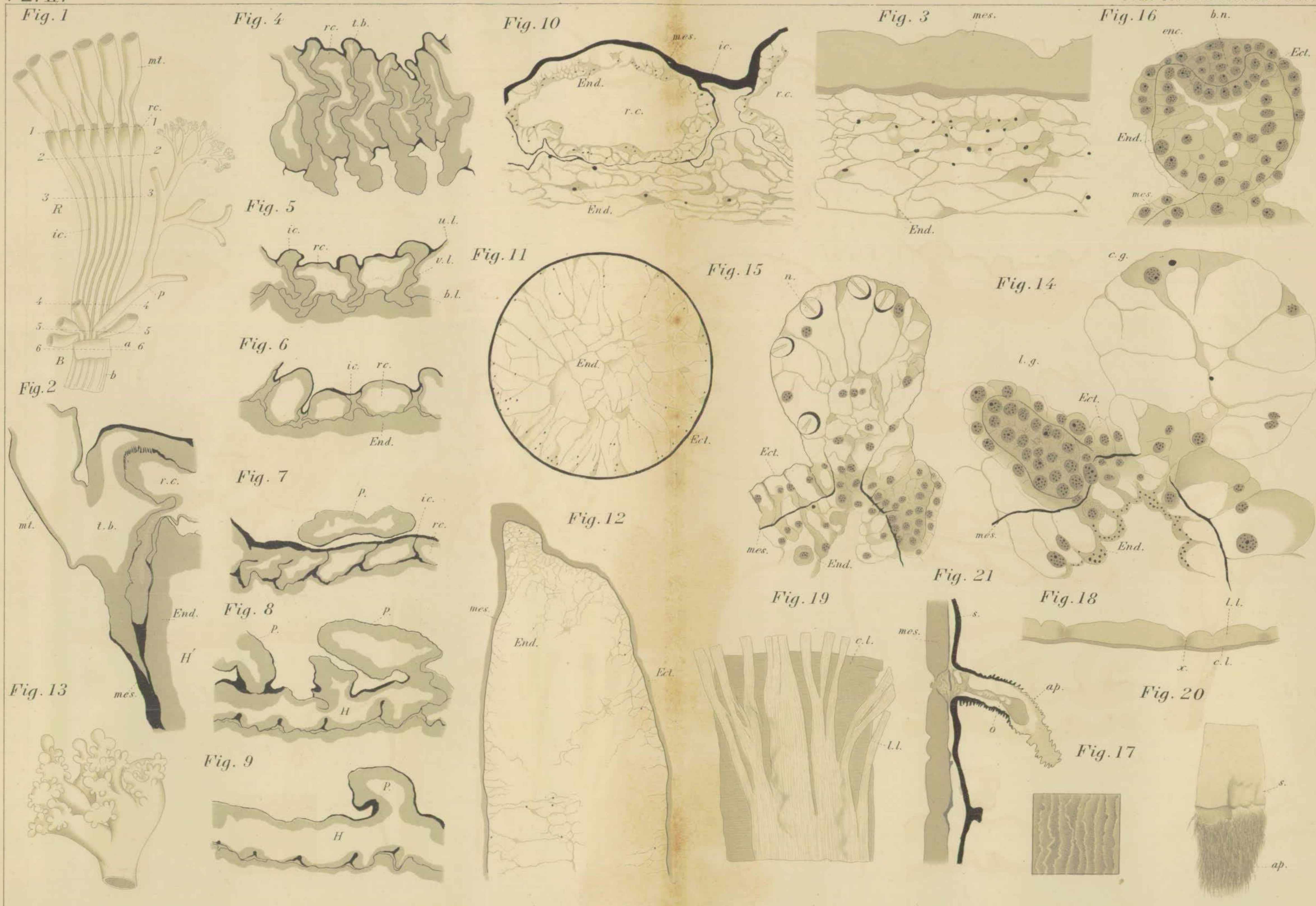
Fig. 1
mt.
rc.
ic.
R
B
a
b
p
Fig. 2
mt.
t.b.
r.c.
End.
H'
mes.
Fig. 3
mes.
End.
Fig. 4
rc.
t.b.
Fig. 5
ic.
rc.
u.l.
v.l.
b.l.
Fig. 6
ic.
rc.
End.
Fig. 7
p.
ic.
rc.
Fig. 8
p.
H
Fig. 9
p.
H
Fig. 10
mes.
ic.
End.
r.c.
Fig. 11
End.
Ect.
Fig. 12
mes.
End.
Ect.
Fig. 13
Fig. 14
c.g.
l.g.
Ect.
mes.
End.
Fig. 15
n.
Ect.
mes.
End.
Fig. 16
b.n.
enc.
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mes.
Fig. 17
Fig. 18
l.l.
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c.l.
Fig. 19
c.l.
l.l.
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