No. 7. — *Explorations of the Surface Fauna of the Gulf Stream, under the Auspices of the U. S. Coast Survey, by* ALEXANDER AGASSIZ.

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I.

Notes on Acalephs from the Tortugas, with a Description of New Genera and Species. By J. WALTER FEWKES.

THE following pages contain descriptions of new medusæ collected at Key West and the Tortugas Islands, in March and April, 1881.* They contain an account of the anatomy and development of *Linerges, Cassiopea* (*Polyclonia*), *Ocyroë*, and a stage in the embryology of *Eucharis*. Six new species of *Siphonophora*, two new genera and three new species of *Hydroida*, are also described. New larval stages of growth, illustrative of the development of *Glossocodon*, are also figured and described.

CTENOPHORA.

Beroë ovata, Esch.

Plate IV. Fig. 1.

B. ovata is common along the Florida Keys. It has a quicker motion and is larger than *B. roseola*. The sense area is also more prominent.

Eucharis multicornis, Esch.

Plate VII. Figs. 11, 12.

A larva of *Eucharis*, closely resembling the young of *E. multicornis*, was found at Key West. It is smaller than the adults of *E. multicornis*,† and is

* An account of A. Agassiz's explorations of the Tortugas, when these medusæ were found, is published in Harv. Univ. Bull., XIX. p. 218, and Bull. Mus. Comp. Zoöl., IX. 3. I am indebted to A. Agassiz for affording an opportunity to visit Key West and the Tortugas as his assistant.

† Chun, Die Ctenophoren der Golfes von Neapel, &c., p. 297.

more transparent. It wants also the brown red color of the well-known Mediterranean species.

Ocyroë crystallina, Rang.

Plate I. Figs. 1-6.

A larval stage of this medusa * was found at the Tortugas. The anatomy of this Ctenophore is very characteristic. It differs from *Deïopea kaloktenota*, Chun,† in size, in the absence of tentacles, and in the presence of very prominent longitudinal muscles (*l m*) on the under and inner surface of the oral lappets. It has only a remote likeness to the young of other genera. The motion of the animal is very characteristic, as it is caused, for the most part, not by the movement of the vibratile combs on the outer surface of the body, but by the strokes against the water of the oral lappets or lobes.

When the animal is resting, the oral lappets are widely extended at right angles to the axis of the body (fig. 2). As movement begins, these lobes are quickly raised from that position to one above the actinal pole, so that their outer surfaces approach and almost touch each other over it (fig. 4). Both lobes are then swung simultaneously downward, passing through an angle of 180°, and made to approach each other below the mouth, as in fig. 1. A flapping motion of this kind is continued without interruption several times and then ceases, the lappets returning to the position of rest with which they started. When the inertia acquired by this flapping is lost, the motion is again repeated.‡ Practically the "combs" contribute nothing to the motion of the medusa. This larva, like the adult *Ocyroë maculata*, has neither tentacles nor tentacular sacs. The single specimen found was without doubt immature, and we should expect to find a true tentacle hanging from its body walls. In the young *Bolina* the tentacles are very large, while in the adult they are reduced to simple club-shaped processes. In the *Ocyroë* larva there is no indication of the tentacle nor of the tentacular sac. The adult also has nothing which can be homologized to these structures.§

The body of the larva has a short axis, and resembles distantly that of a young *Bolina*. The oral lappets are large, widely extended when at rest, and crossed on their lower, inner surface by longitudinal muscles (fig. 5, *l m*).‖

* It may be the young of *O. maculata*, *O. fusca*, or *O. crystallina*, as described by Rang (Établissement de la Famille des Beroides, *Ocyroë*, 1827).

† *Op. cit.*, p. 294, Pl. IV. figs. 1-4.

‡ A. Agassiz observed a similar motion of the oral lappets of *O. maculata*, Bull. Mus. Comp. Zoöl., VIII. 7.

§ This is true of the adult of *O. maculata*.

‖ The study of these muscles in the young *O. crystallina* leads me to believe that I was wrong in considering the "spots" on the lobes of *O. maculata* as muscular in character, an opinion expressed in a previous paper. (Bull. Mus. Comp. Zoöl., VIII. 7.) These spots in *O. maculata* are probably due to pigment in the walls of the lobes.

The same surface is covered by a network of muscular fibres, similar to that found on the inner walls of the oral lappets of *Bolina*, and other genera. Lips (*l*) simple, very flexible, and prominent, projecting below the mouth. The auricles (*a*) are stout and not very prominent. There are two swimming combs on each ambulacrum. The course of the chymiferous tubes does not differ from that of the vessels of *Bolina*. The lateral or subtentacular tube (*l t*) arises from the lower end of the funnel (*fn*), and passes down along the side of the body into one of the lips. At this point it bifurcates (*b*), sending a branch (*b′*) on each side to join the tube (*s t*), which arises from a short ambulacrum.* The vessel later formed by the union of these small tubes first skirts the margin of the auricle (*a*) and is then continued in the tube (*t*) around the rim of the oral lappets, joining half-way in its course a similar tube from the opposite side of the body. The branch from the lateral tube joins the auricular vessel just below the auricle.

The chymiferous vessels of the eight rows of swimming plates (*ambulacra*) primarily branch from the lower end of the "funnel" as two small tubes (fig. 6, *c*) on opposite sides of this medial vessel, in a vertical plane at right angles to that which passes through the longitudinal axis of the mouth (fig. 5). The plane in which they lie cuts at right angles the axis of the mouth and passes through the otocyst (fig. 5, *c*). Each of these primary branches bifurcates, at a short distance from its origin (*c*), and each smaller branch again subdivides (*c c*) into two members. In this way we have formed the eight vessels, which extend to the surface of the outer body walls, and form the meridional tubes, which lie directly under the rows of combs. The tubes (*s t*), which correspond to the "longer rows" of combs in the *Bolinidæ*, push their way into the oral lappets, and join in pairs, two in each lappet, while the shorter rows, after a more tortuous course, in which they unite with the bifurcations from the lateral tube (*l t*) and skirt the edge of the auricles, also eventually unite in the oral lobes, forming a loop, which encloses the union of the vessels (*s t*).† In the union of the "long tubes" adjacent vessels unite ; in the junction of short tubes, vessels separated by a pair of long tubes join.

The otocyst resembles that of *Bolina*.

No liver glands or folds of the intestine and stomach were observed.

In Dr. Chun's ‡ figures of *Deïopea* the tubes corresponding with the vessels (*s t*) end blindly in the oral lappets without junction. In *Ocyroë* these tubes join as shown above. *Deïopea* has tentacular filaments extending from the position where the tentacle hangs to that of the auricles, along the lower edge of the body. Tentacular filaments are wanting in *O. crystallina*.

Dr. Chun,‡ as is well known, divides the *Ctenophora* into the two groups

* The ambulacrum adjacent the tentacle on either side.

† These tubes are shorter than the others in the adult. They correspond with the "long tubes" in the young *Bolina*.

‡ *Op. cit.*, Pl. IV. figs. 2, 3.

Tentaculata and *Nuda*, accordingly as tentacles exist or are wanting. If this feature alone be used in classification, *Ocyroë* would be placed in the group of *Nuda* side by side with medusæ like *Beroë*, with which it has few other anatomical likenesses. If his classification be followed, *Ocyroë* must be regarded as a connecting form between *Ctenophora tentaculata* and *Ctenophora nuda*.

Ocyroë renders necessary some modification in the phylogenetic tree which Dr. Chun suggests, for the different genera of comb-bearing medusæ. The Beroids may have come from *Bolina* like jelly-fishes through *Ocyroë* rather than directly from other tentaculated Ctenophores. A. Agassiz has pointed out that this medusa has "structural characters of the *Lobatæ*, *Saccatæ*, and *Eurystomæ*." * It is the intermediate form connecting *Beroë* with Ctenophores like *Mnemiopsis* or *Bolina*. Although most closely related to the *Lobatæ*, it resembles genera of the *Eurystomatæ* in the absence of tentacles and the course of the lateral tubes. The resemblance to the *Saccatæ* is more distant.

DISCOPHORA.

Cassiopea frondosa, Lamarck.

Plate I. Figs. 7 - 19. Plate II. Figs. 1, 2. Plate III. Figs. 1 - 3, 9, 10.

Cassiopea frondosa † is very common in the moat outside Fort Jefferson on Garden Key (Tortugas Islands). Specimens were also found in the still waters and protected shallows in the lee of the Mangrove Keys, near Key West City.

Cassiopea frondosa is found lying on the coral mud at the sea bottom, with its bell reversed and the oral region turned uppermost (Pl. I. fig. 7.). When transferred to the aquarium it assumes a similar position, exhibiting little power of locomotion, but flapping the disk-shaped bell in a sluggish manner. This motion seems to be confined almost wholly to the margin of the bell. While it cannot be said to be fixed to the bottom in such a way that movement is impossible, it will be found, if its position from time to time be carefully observed, that it does move from place to place, although the amount is very small. It generally lies on its aboral region,‡ sluggishly flapping the bell margin in a monotonous manner, in general appearance, when seen from the boat floating above it, resembling a small cluster of nullipores. The habit of

* Bull. Mus. Comp. Zoöl., IX. 3.

† I regard this the same as *Polyclonia frondosa*, Agass. *Polyclonia* according to L. Agassiz has *twelve* marginal sense bodies and *twelve* radial markings. The specimens of *C. frondosa* studied by me had generally *sixteen* such structures. This is true of young as well as of adult *Cassiopeæ*, except in abnormal specimens.

C. frondosa is closely related to *C. Andromeda*, Esch.

‡ A similar posture has already been observed in *Cassiopea* by Mertens; in *Polyclonia*, by L. Agassiz; and in *Medusa æquorea*, Försk, by McAndrew. (Ann. Nat. Hist., IV., 1869, p. 295.)

clinging to the bottom by the upper (aboral) surface of the bell is also found in a genus widely separated in our classification from *Cassiopea.* We noticed last summer a young *Cyanea* (*C. arctica*), which was kept in the aquarium at Newport, fasten itself in the same way, and adopt the same sluggish movement of the bell-margin which is so characteristic of *Cassiopea.* It is not impossible, although as yet not supported by observation, that the "aboral papillæ" (Bull. Mus. Comp. Zoöl., VIII. 8, p. 669, Pl. VII. fig. 1) of the young *Cyanea* may serve to anchor the young medusa in this posture.*

The bell of *C. frondosa* is flat and disk-shaped, in larger specimens with a diameter of a foot or a foot and a half. When seen from the aboral pole (fig. 10), two regions can be distinguished on the surface. Of these the central part has a circular form, and a slightly concave surface. It is bounded by the circumference of a circle, whose diameter is about three fourths that of the whole disk, and whose circumference limits that rigid (fig. 7, *u*) portion of the medusa bell by which it is attached to the bottom.

The most marked feature in the structure of the central portion of the bell is the possession of sixteen radial stripes (*e*), which can best be seen from the aboral surface. These stripes are simple thickenings of the bell walls, and are most clearly defined near the periphery of the central region already described. At that point they assume a pyriform shape, while nearer the centre of the disk they become narrower until they disappear. A periphery drawn through the ends of these bodies, most distant from the middle of the bell, bounds the rigid portion of the umbrella and divides the central part from the flexible margin. The outline of the stomach cavity (*s*) can be easily made out through the aboral bell walls, in which, at this point, there are traces of the radial stripes. If the substance of the bell be cut in such a way as to make a cross section of a pyriform body, it will be found that it has a milky-white color, while adjoining parts of the bell are brown and green. Its tissue is also more compact than that of the rest of the bell. They seem to impart a greater rigidity to the bell walls, and not to be simply superficial coloration as sometimes supposed.

The marginal portion of the bell arches upward in the natural position of the medusa, and is very flexible. It is much thinner than the central part, and is almost wholly without radial markings.

The bell rim is destitute of tentacles. It has, however, marginal bodies which distantly represent these structures in tentaculated *Discophora.* These structures are of two kinds (*v l*, *o l*). They assume either the form of serrations (*v l*) placed peripherally (velar lappets), or take a crescentic shape (ocular lappets), (*o l*). In the latter case they are arranged in pairs and mark the position on the bell margin of the sense bodies. There are sixteen pairs of these structures (*o l*) having the more rounded shape, and each pair marks the position

* In the genus *Cephea* we find structures homologous to the aboral papillæ assuming the form of small excrescences. Haeckel, *op. cit.*, p. 574, Pl. XXXVI. figs. 3, 5, 6.

of an otocyst. They represent approximately those lappets which in the genus *Aurelia* project far beyond the bell margin.

Between each pair of crescent-shaped bodies there are three or four pointed serrations (*v l*) which represent in position the tentacles. The bell rim has a wavy crenate outline, slightly indented between the marginal serrations, and deeply incised between the crescentic bodies which have been mentioned above. The otocysts are found in the angle of these deeper incisions.

The anatomy of the oral region (fig. 11) of *Cassiopea* is in certain respects peculiar. When the jelly-fish is seen from this side, which is uppermost in the natural position of the medusa, a confused mass of bodies of all sizes covers it and conceals completely the bell itself. These bodies give to the *Cassiopea*, when seen from a distance, a remote likeness to a marine alga. If, however, the innumerable bodies which cover the oral pole of the medusa be pushed apart (fig. 11) so that their attachment can be seen, it will be found that they arise from branches which primarily originate from eight gelatinous arms (oral arms, *d*), which are themselves prolongations from a centrally placed projection (" Mundscheibe," *i*) from the oral surface of the bell.

In the middle of the lower floor of *Cassiopea* there rises a cylindrical body, Mundscheibe (*i*), of gelatinous consistency, which gives origin to the eight oral arms (*d*) of the stomach. It is an octagonal body, and is without opening on the upper surface. There is no single central mouth in *Cassiopea*, and no centrally placed orifice * into the cavity of this cylinder. The only external openings which are to be found are four orifices (*o*) on the sides of the body of the Mundscheibe, 90° apart. These openings lie in the intervals between the four pairs of branching oral tentacles, and are the sexual orifices. They communicate directly between the cavity of the ovaries which lie in that of the oral cylinder (Pl. III. fig. 3, *s o*) and the surrounding water.

Eight oral arms (*d*) are found branching in pairs from the sides of the oral cylinder, Mundscheibe (*i*). These appendages form the most important structures in the oral region of the *Cassiopea*, and bear organs which, as is probably the case in all *Rhizostomatæ*, represent the mouths of other genera of *Discophora*. Each oral arm extends at right angles to the sides of the oral cylinder, and parallel to the lower surface of the bell. It is irregularly branched (Pl. I. figs. 17, 19), and has solid walls of a gelatinous character. The outer surfaces (fig. 17) turned to the bell and the sides are smooth, while the upper surface (fig. 19) is covered with innumerable flask-shaped structures of different shapes and sizes. A system of vessels (*g v*) runs along the upper part of the oral tentacle just below the surface, communicating with the flask-shaped bodies and a centrally placed chymiferous cavity. There are two kinds of appendages found on the upper surface of the oral tentacles. Indiscriminately over the whole surface, and at the angle of bifurcation of smaller branches from the oral arms, we find ovoid bodies, "Kolbenförmige Blasen" (*p*),

* L. Agassiz, *op. cit.*, p. 147, mentions a central mouth opening in a young *Polyclonia*.

which, when extended, assume a flask-like form. The structures have walls of a greenish color with darker interiors, and communicate with the chymiferous tubes of the oral tentacles. They have no opening at their unattached end, and are simply closed sacs for the reception of fluid. The function of these bodies is unknown.

A second* kind of polyp-like bodies (*p'*) is scattered over the upper surface of the oral tentacles. These are more numerous and smaller than the first. They are the true mouths of the *Cassiopea*. They resemble frills, between which there are slits surrounded by a circlet or row of minute tentacles. It is in fact as if we had the whole upper surface of the oral tentacle covered with small fresh-water hydræ, with mouth-openings very much elongated laterally, and around which the circumoral tentacles are very numerous. The central opening, or mouth, may be a circular orifice or an elongated slit. Whatever its form may be, the circlet of tentacles about it is always arranged in a single series. These sacs or sucking mouths communicate with the same system of vessels (*g v*) as the flask-shaped bodies (*p*) mentioned above. They are the mouths of the jelly-fish.

Within the Mundscheibe, or oral cylinder, there is a thin disk-shaped cavity (Pl. III. fig. 3), which may be called the stomach. Its floor is formed by the upper surface of the bell, and its roof by the upper wall of the Mundscheibe. The most prominent structures in the stomach are the four sexual organs, or, more accurately speaking, the four sexual sacs, since the sexual organs themselves (*o*) are separated from the stomach by a thin gelatinous wall. The ova cannot pass into the stomach, but are dropped in these sacs, and from them into the water through the four openings (*s o*) on the side of the oral disk. It will be noticed then that the ovarian openings do not lead into the chymiferous cavity, but into four sexual sacs which lie in the stomach. Morphologically, as has been suggested, the sexual sacs are invaginations of the outer surface of the Mundscheibe at the point where the sexual openings (*s o*) lie, and their cavities are wholly independent of that of the stomach. There are four sexual glands hanging to the walls of the sexual sacs, which are fastened to the oral disk or roof of the stomach on a V-shaped line, each gland filling a quadrant of the circle in which it is found. On the roof of the stomach between the lines of attachment of the sexual sacs, four grooves (*g*) are left, which cross each other at the centre at right angles. These grooves are simply spaces left between the lines of attachment of the sexual sacs. Near its peripheral end each groove deepens, and at the extremity sinks into an opening (*b*),† which communicates with the system of chymiferous vessels (Pl. I., *g v*) in the upper walls of the mouth arms. The openings (*b*) into the stomach alternate in the oral disk with the sexual orifices (*s o*).

* One or two large white flask-shaped bodies were also observed. Compare Haeckel, *op. cit.*, p. 571.

† These openings were discovered by L. Agassiz in *Polyclonia*, *op. cit.* Haeckel, *op. cit.*, pp. 566–573, does not mention them. They are also omitted in his figures of *C. ornata*, *op. cit.*, XXXVII. 6.

Through them the food material collected from the mouths on the upper side of the oral arms by a system of chymiferous vessels (Pl. I., *g v*), is poured into the stomach cavity occupying the centre of the disk.

The chymiferous vessels of the bell of *Polyclonia* have been well described by L. Agassiz. My observations agree with his and those of Haeckel of *Cassiopea ornata.* I have nothing to add to the account which they give.

In regard to the marginal sense bodies, my observations are a little more complete than any yet recorded. The few points which can be added to our knowledge of these organs appertain only to their gross anatomy.

In external form the marginal sense bodies (Pl. I. figs. 12–16) of *Cassiopea* resemble those of *Aurelia* and *Cyanea.* There are sixteen of these structures, each of which lies at the extremity of a radius passing through one of the pear-shaped radial stripes (*e f*) which have been described in the bell. They are set in deep incisions in the bell margin, and are flanked on either side by the ocular lappets (*o l*). A "hood" (*h*) protects the sense organ on its aboral side. This structure resembles that of *Cyanea,* and is simply stretched from one ocular lappet to another. There is no aboral "Sinnespolster." The outer "Riechgrübschen" is wanting. There are no finger-like lappets, as in *Aurelia*, and only diminutive oral "sense curtains," as in *Cyanea.* The inner "Riechgrübschen" are very small.

The otocyst is mounted on a short peduncle, and is more spherical in shape than the same organ in most other *Discophora.* It seems to fit into the end of its style as an acorn into its cup, and not to be united to it by an elbow-joint as in *Aurelia* and *Cyanea.* The otoliths have a rhomboidal form and a yellow color.

An ocellus (*oc*), or cluster of pigment spots, can easily be seen through the walls of the hood. It is situated on the aboral side of the otocyst, near the enlargement of the style into the cup-shaped end into which the otocyst fits. In normal specimens (fig. 12) there is but a single ocellus to each otocyst, yet in many cases we find a style bearing an otocyst with two ocelli (fig. 16). In several instances, also, a bifurcated style supporting two otocysts (figs. 14, 15) as well as two ocelli was observed. Variations in the number of otocysts about the margin of the bell of *Cassiopea* are very common.*

Little is known of the development of *Cassiopea.* The youngest specimens taken were about an inch in diameter, and had already assumed the characteristic posture (*g a*) of the adult. In the youngest, however, the central mouth, spoken of by L. Agassiz in the young *Polyclonia*, was not observed. The larval *Cassiopea* (fig. 8) differs but little except in size from the adult as far as the oral region is concerned. The "sucker frills" (Saugkrausen) are less abundant and the large flask-shaped bodies fewer in number in the young medusa than in the adult. The coloration of the aboral side of the bell differs markedly from that of the adult. The disposition of color is as follows: —

* *Polyclonia*, which has twelve otocysts according to L. Agassiz, may be an abnormal *Cassiopea* in which the number of sense bodies is normally sixteen.

The young medusa seen from the aboral pole is shown in Plate I. fig. 8. Sixteen radial stripes (*e*), whose periphery bounds the central region of the bell, have already appeared, and can be seen faintly showing through the transparent walls of the bell. Their general shape is cuneiform. Situated on the bell margin, and alternating with the bodies last mentioned, are sixteen triangular white spots (*t'*). These triangular spots are the velar lappets (*vl*), which are now solid and not differentiated into the three serrations which characterize the interocular bell margin of the adult. The ocular lappets (*tt*) are also found on the bell rim. They seem from the very first to arise independently of the velar lappets. They are arranged in pairs alternating with the velar lappets, and enclosing the otocysts as in the adult.

In many of the young *Cassiopeæ* which were examined, one of the oral arms was much more developed than the others. Is this a remnant of a want of symmetry in growth similar to what exists in the strobila stage of the young *Aurelia ?*

Linerges Mercurius, Haeckel.

Plate II. Figs. 3, 4, 5. Plate III. Figs. 4 - 8, 11, 13. Plate IV. Figs. 3 - 22.

Representatives of the genus *Linerges,** probably *L. Mercurius,* are among the most abundant Discophores found in the Gulf off the Florida Keys. In the tide eddies near the Tortugas Islands, we passed through long windrows of these medusæ, reaching as far as the eye could follow. *Linerges* is locally called the "mutton-fish thimble," from its shape and the supposition, without foundation as far as I could learn, that they constitute the food of the mutton-fish. The bell is thimble-shaped, with vertical walls; its height is about half the diameter. The outer surface is covered with small excrescences or tubercles. The walls are thin and flexible. The walls of the apex are more rigid than the vertical, and less capable of motion. The bell margin is indented with sixteen deep incisions, from each of which hang alternately tentacles and otocysts. The marginal lobes left by these incisions in the bell rim are commonly carried folded inward at right angles to the vertical bell walls, resembling a discontinuous velum.

There are eight short tentacles, which hang from alternate incisions in the bell rim, and project but a short distance beyond the bell margin. They are capable of very little motion, and are probably solid.†

The lower floor or inner wall of the bell is formed of muscular fibres, and is

* Swartz (Neu. Abh. d. Schwed. Akad., IX.) described in 1789, under the name *Medusa unguiculata,* a similar jelly-fish.

† Haeckel, *op. cit.*, says they are solid in related genera. The specimens of *Linerges* described by Haeckel were alcoholic, which fact is an explanation of the difference in coloration in his drawings and mine. *Linerges* loses its brown color in preservative fluids.

thickly pigmented. At certain points it hangs down in spherical sacs, which will be described presently. Between this muscular layer and the inner surface of the vertical walls of the bell, below the pouches last mentioned, there is an anastomosing network of vessels, which grows more intricate near the bell margin, and finally ends in irregular dendritic marginal prolongations in the lobes of the bell. This network of tubes is formed by interstitial growth between the lower floor and the inner surface of the bell. All the anastomosing vessels unite near the upper part of the bell, and enter the stomach cavity through sixteen radial tubes. Eight of these tubes pass directly from the cavity of an otocyst to the stomach, gathering up as it goes the network of vessels, and eight others take a similar course from the tentacles to the central chymiferous cavity.

The common cavity into which these tubes open lies above the stomach properly so called. It is a small circular recess, bounded by the inner wall of the bell above, and the lower floor below. It occupies the central part of the bell above the stomach, with which, however, it communicates by means of a centrally placed opening in the floor. This chymiferous cavity is marked on its periphery by thirty-two pouches, which hang down into the bell cavity from its inner walls. These pouches are formed of baglike expansions of the lower floor of the bell, and are commonly found inflated with fluid. At times, also, they lose their contents, probably discharging it into the chymiferous cavity. They have a deep brown color from the growth of pigment in their walls, and are probably organs for the secretion of a biliary fluid.*

The chymiferous cavity is probably homologous with the central cavity in *Cambessa Tagi.*† It lies above the stomach in normal positions of the medusa, and communicates with it only through the central orifice already mentioned. The stomach proper of *Linerges* is bounded on the sides by folds hanging down from the inner bell walls and roofed over by the floor of the chymiferous cavity. The lateral walls of the stomach are short, curtain-like structures, which never project beyond the bell opening. The mouth is rectangular, cross-shaped, resembling closely that of some genera of hydroid medusæ. The walls of the lips are crossed by eight rows of pigment spots arranged in four pairs, each of which extends into one of the four divisions of the cruciform mouth.

Four clusters of gastral filaments are found suspended from the upper wall or roof of the stomach, in positions corresponding with the four angles of the mouth, and alternating with the extensions of the cruciform oral aperture. Each filament is dotted with crimson pigment-spots. They are in constant motion, and at times their extremities are found projected through the central

* This conclusion seems to me more natural than that they are testes, sacs for the reception of undeveloped ova or spermatozoa, organs of respiration, or kidneys. For enumeration of their possible function and discussion of their homology, see Haeckel, *op. cit.*, p. 493.

† Grenacher and Noll, Abhandl. Seuk. Gesell., X. Pl. III. fig. 3 ($c' c'$).

opening, which leads from the stomach into the chymiferous cavity above. Their function is unknown.*

The marginal sense bodies of *Linerges* are very characteristic. They are eight in number, and are situated in incisions alternating with the tentacles on the bell rim. Each otocyst is very prominent, and at first glance appears to be destitute of a "hood." This impression is, however, not a true one, for the hood in *Linerges* assumes a curious and at first unrecognizable form.

When the otocyst is looked at from above it resembles a spherical sac, in the centre of which, through the transparent walls, a *single* otolith mounted on a short peduncle can be seen. The transparent sac in which this *single* otolith is contained is the homologue of the "hood" of other Discophora. If the sac be viewed from below, it will be found to be not a closed capsule, but an open one, or that the wall of the sac is wanting on the under surface. The hood has thus in *Linerges* assumed a caplike form reaching outward so as to envelope the otolith on the upper side, and to leave the lower unprotected. The otolith is a single spherical body, and not a rhomboidal structure as in *Cyanea* and many others. There is no prominent ocellus.†

No representative of a "Sinnespolster," or of an outer "Riechgrübschen," was seen. Oral sense curtains and lappets are also wanting.

The ovaries hang from the inner bell walls and seem to be in free communication with the stomach. They are four in number, and have a horseshoe shape. Each ovary is made up of two halves, united together in such a way that the gland has the peculiar arched form shown in the plate. The ovaries have a dark brown color.

The ova (Pl. IV. fig. 7) are laid in small black clusters, composed of from fifteen to twenty eggs, which are agglutinated together. A segmentation of the ovum begins shortly after the egg is dropped, when it becomes more transparent and separates from its union with others of the same cluster.

The first change in the segmentation is the elongation of the ovum into an ovoid shape, blunt at one pole and more tapering at the opposite. The first plane of segmentation divides the egg into two unequal segment spheres; one formed from the pointed, and the other from the blunt pole of the ovum.

Shortly after this first cleavage of the egg into two unequal spheres, a second plane divides the larger of the two into two other spheres which are also of unequal size, and we have an egg in which three segmentulæ can be seen. All of these parts now assume a pyriform shape, and new segment-spheres are constricted from them in the same way that the two spheres were first formed from the original ovum. At the end of the second day after ovulation the ovum was in the condition shown in fig. 12. The segmentation takes place in the water,

* These filaments may be homologous to the "sexual filaments" of *Cyanea*. They resemble closely in position the early condition of these structures in the ephyra of *Cyanea*. See Bull. Mus. Comp. Zoöl., VIII. 8, Pl. VII. figs. 8, 9, 10.

† There are many scattered pigment-cells, which may be an ocellus, in the region of the style where this structure is commonly found.

and not in the sacs hanging from the inner walls of the bell.* The planula which follows the morula last described does not differ from the planula of other medusæ. It is an oblong spherical body richly ciliated and capable of rapid motion.

Intermediate stages of growth between the planula and that which is probably the ephyra of *Linerges* were not observed, so that I cannot say definitely whether *Linerges* has a direct development or not.

A medusa which resembles *Linerges* very closely, and which may be its ephyra, was found in great abundance in the water about Fort Jefferson (Tortugas Islands) at the same time that *Linerges* was so common.†

The shape of the youngest ephyra (fig. 4) is very similar to that of the young *Cyanea*. The bell is flat, disk-shaped, and with its margin continued into eight pairs of prominent lappets, two of which are represented in the figure. The walls of the bell have a yellow-brown color, and the surface (upper) is dotted with small round pigment-spots. In the deep incisions around the bell margin hang, alternating with each other, eight tentacles and as many otocysts. The tentacles are suspended from the deeper and narrower incisions of the bell rim, while the marginal sense bodies are found in the remaining indentations which separate adjoining pairs of marginal lobes.

The tentacles are single, hollow (?) bodies, which do not project beyond the tips of the marginal lobes when extended. As compared to the diameter of the bell they are relatively larger than the same bodies in *Linerges*.

The marginal sense bodies resemble closely those of *Linerges*, and consist of a single otolith of spherical shape enclosed in a capsule-like hood which is open below (figs. 16–18). It differs from *Linerges* in possessing an ocellus or well-marked black pigmented region at the base of the peduncle which bears the otocyst. The existence of an ocellus in the young, and not in the adult, is a very anomalous fact, and never before mentioned in any Discophore. It even leads me strongly to doubt whether I am right in considering this ephyra the young of *Linerges*. The ocellus of the ephyra is a complicated structure. It is not a simple mass of black pigment-cells, but resembles the complicated eye-spot of medusæ like the genus *Tamoya*. In the middle of the base there is a lens-shaped, apparently transparent body, which rises above the surface of the otocyst style, and around it, in which it seems to be imbedded, we find the black pigment (fig. 17). In this regard it is different from the ocellus of most *Discophora* in which the ocellus seems to be a simple pigment-spot on the peduncle of the otocyst.

* An observation which disproves the theory that the subumbral pouches are receptacles for the developing young.

† The resemblance between this ephyra and members of the family *Ephyridæ*, Haeck. is very close. It approaches very near the genus *Nausicaa*, Haeck. The figures of this ephyra made use of in my description were drawn from nature by A. Agassiz.

The mouth of the ephyra is simple, quadrate, and there is a single gastral filament in each quadrant. The lips are simple raised ridges from the lower floor of the stomach, and assume a cruciform outline when seen from beneath. The chymiferous tubes are broad extensions from the stomach to the tentacles and otocysts. No extensions of the central cavity as yet push out towards the marginal lobes.

In an ephyra still older than that just described, we have anatomical differences of a most important kind. While the general outline, color, and pigmentation is about the same as in the former, important additions have taken place in the internal anatomy. Prominent among these is the formation near the base of each tentacle of a spherical body filled with cells. These bodies are seen in fig. 3. They are the beginnings of the ovaries which in later stages assume a different form, and by coalescence form the horseshoe sexual glands of the adult. Intermediate between the broad prolongations from the stomach cavity, which in the young ephyra extend to otocyst and tentacle, smaller blindly ending tubes push out in the direction of the marginal lobes. They are as yet very short, hardly entering more than the base of the lobe.

By far the most interesting anatomical structure in this as well as subsequent stages of the ephyra is the differentiation of the stomach cavity into an upper and lower story, by the growth of a continuation of the lower floor of the bell into a partition in this structure. In an ephyra as young as fig. 3, this differentiation has been accomplished, and the only communication between the stomach proper and the chymiferous cavity above is through a centrally placed opening in the lower floor.

The number of gastral filaments in each cluster has very much increased, and their ends often project through the central orifice in the wall which divides the stomach from the chymiferous cavity, just as also happens in the adult *Linerges*.

In the oldest ephyra (fig. 15) the approximation in shape and color to the adult *Linerges* has gone still further. The depth of the incisions which separate the marginal lobes has diminished, and the bell has become more thimble-shaped, the apex rising and the walls becoming more vertical instead of horizontal. The circular muscles in the lower floor have also clearly differentiated themselves from the inner wall of the bell.

One of the most important changes which has taken place is in the form of the eight ovaries. As the spherical glands of the ephyra (fig. 3) grow in size with the development of the larva, two bulges form on adjoining sides near the ends, and gradually approach each other. As growth goes on, these projecting portions join, and we have the eight glands fused into four, each assuming a crescentic shape, as in the adult *Linerges*. The mode of growth of the ovaries has been one of the strongest facts pointing to the relationship of the ephyra to *Linerges*.

SIPHONOPHORA.

Stephanomia * Atlantica, sp. nov.

Plate V. Fig. 1. Plate VI. Figs. 18-22.

A new species of *Stephanomia*, M. E. was taken by us at Tortugas.

The most marked characteristic of the genus *Stephanomia* (*Forskalia*) is the multiserial arrangement of the swimming bells. Instead of being placed biserially on the stem, or with one row of bells at each end of diameters passing through the axis in one and the same plane as in *Agalma*, Esch., *Agalmopsis* (sensu strictiori) and *Halistemma*, Huxley, the nectocalyces of *Stephanomia* are arranged in several series, with their openings situated at the extremities of axes or diameters passing through the nectostem in several vertical planes, so that they seem to open on all sides, as shown in Pl. V. fig. 1, *n*. The nectocalyces are much more numerous than in any of the genera mentioned, and the motion which they impart to the animal is of a more varied kind. This genus is the only Physophore which has a multiserial arrangement of nectocalyces on the nectostem.†

The polypites are mounted on long peduncles (*w*) corresponding to the "Wimperwulst" ‡ of *Agalma* and related genera. From the distal end of this peduncle, near the base of the feeding-polyps, hang also clusters of undeveloped tentacular knobs (*j*) and covering scales. The base of the polypite when retracted is enlarged into a spherical body, as shown in Pl. VI. figs. 20, 22. This portion of the feeding-polyp is formed by the contraction of the base of the polypite. The walls of the feeding-polyp are thickly pigmented (Pl. VI. fig. 22) near the base with dark red pigment, which renders these bodies very prominent.

The tentacular knobs (Pl. VI. figs. 18, 19, 21) have a single terminal filament, a long pedicle, and are destitute of an involucrum. They arise from tentacles as those of other Physophores. The tentacles from which they hang

* In this account I regard *Forskalia*, Köll., a synonym of *Stephanomia*, M. E. (Vide Bull. Mus. Comp. Zoöl., VI. 7, pp. 132-134).

† A single species of *Physophora*, *P. tetrastica*, is said by Philippi and Delle Chiaje to have four rows of nectocalyces. This is probably a mistake. (Vide Keferstein u. Ehlers. Zoologische Beiträge, p. 30, note.)

‡ The base of the polypite from which the tentacular knobs bud. Claus, Ueber Halistemma Tergestinum, p. 35. Peron's *Stephanomia* may have been an *Agalma*, Esch. *Stephanomia*, Huxley, is nearer *Agalmopsis*, Sars, than it is to *Stephanomia*, Peron. *Agalmopsis*, Sars (1846), has the priority of *Stephanomia*, Huxley (1859). *Stephanomia*, Milne Edwards, has pedunculated polypites, which are not figured in *Stephanomia*, Peron. Milne Edwards's description is such that there is no doubt of his genus *Stephanomia*. If we abandon Peron's generic name *Stephanomia*, as applied by Milne Edwards, for Kölliker's later name, *Forskalia*, why should we retain it as applied by Huxley eleven years later ?

take origin from the base of the polypite, near its union with the peduncle. The axis is large, muscular, and spirally coiled.* The color of its wall is yellow and orange. The float is in no respects peculiar, and bears around the opening by which the air-sac communicates with the surrounding water a number of regularly arranged pigment-spots. The nectocalyces are arranged in many rows, opening laterally in spirals on all sides of the animal. The most distally placed bells from the float are the oldest, as in other Physophores. Directly under the float there is a small cluster (*u*) of undeveloped swimming-bells. Each nectocalyx has a cubical form, the flat faces of which conform to the surfaces of adjoining bells. The bell has in other particulars a great resemblance to the nectocalyx of other Physophores, and does not seem to differ from that of *Forskalia contorta*. The course of the radial tubes is like that in *Agalma*. At the union of the radial tube with the ring canal on the bell margin, there is a large yellow spot, which is an ocellus or sense organ of the same kind as similar bodies in certain hydroid medusæ. On either side of it, there is a short papilla of unknown function. In the undeveloped nectocalyx we find a single large yellow spot of this kind, which forms a very conspicuous body on the bell margin. Later in the growth of the nectocalyx, its comparatively large size diminishes. We should expect, if anywhere among the Physophores, a development of the sense organs in *Stephanomia*. Its motion through the water is so rapid that organs of this kind are necessary. Ocelli on the margin of the nectocalyx are, however, not peculiar to *Stephanomia*. In our common *Diphyes* similar ocelli are found, three in number, on the margin of the anterior nectocalyx. The attachment of the covering-scales to the base of the polypites and the distal end of the peduncle imparts to the polyx stem of *Stephanomia* a diameter relatively greater than that of other Physophores. In *Agalma* the covering-scales spring from the base of the polypite, of which the peduncle is very short. In *Stephanomia*, however, the pedicle, which bears the feeding-polyp, is so long that the covering-scale seems to hang from a point midway between the axis of the animal and the mouth of the polypite. The tastern do not differ from the tastern of other Physophores, except that they have long peduncles, as is the case also with the polypites.

The male and female bells arise from the same tastern at their junction with their peduncles. The colony is monœcious. The sexual bells resemble closely those of *Agalmopsis gracile*, sp. nov. In its motion through the water it is one of the most active of all the Physophores. The combination of so many series of nectocalyces can propel it in almost any direction with the greatest ease, whereas in *Agalma* and some others these propelling organs are obviously placed in a disadvantageous position for quick movement. As it passes through the water in the line of its axis, it sometimes combines a rotation of the stem with the direct forward motion.

When the colony is quiet in the water the peduncles of the polypites and the organs which they bear are widely extended, so that its diameter is very great as compared with its length. As the colony begins to advance in the line of

* In the same way as *Forskalia contorta*.

its axis the peduncles are retracted and the bracts are pressed closely together in order to offer less resistance to the direct advance of the animal.

The greatest care must be taken in transferring the colony from its native element into aquaria, otherwise it will drop all its nectocalyces and the bracts will fall off, their attachment to the colony is of such a fragile nature. *Stephanomia* is much more delicate than most other genera of Physophores.

Agalma papillosum, sp. nov.

Plate V. Figs. 5, 6. Plate VI. Fig. 27.

The genus *Agalma*,* Esch., is represented by at least two species in Florida seas. One of these is *A. elegans*, which is also found in Narragansett Bay. The other is a new species, *A. papillosum*, of which two immature specimens were found near Key West, Florida.

A papillosum resembles *A. elegans* in many particulars of structure, and might be mistaken for it. There is, however, this important difference between the two American species of the genus.

The most important characteristic of *A. papillosum* is the presence, on the outer surface of the covering-scales and upon the swimming-bells, of short papillæ, swollen at their extremities into spherical knobs (Pl. V. figs. 5, 6). As far as I have studied other genera of Physophores there are none where similar appendages are found on these parts.

The axis of the specimens taken was very short, and seemed to indicate an immature animal. A single feeding polyp (*p*) is found hanging from the end of the stem, and several tastern (*d d' d''*) could be seen protruded between the covering-scales (*c*). The float (*a*) is large, thickly pigmented at its apex with crimson spots. It has a small aperture communicating between its air-sac (*a a*) and the surrounding medium.

The nectocalyces were all immature and few in number. The largest swimming-bell (*n*) was about half grown, as its relative size seemed to indicate, and is shown, as seen from above, on Plate V. fig. 6. In most particulars of internal structure the swimming-bells resemble the young nectocalyces of

* I include in the genus *Agalma* those long-stemmed Physophores with a biserial arrangement of the nectocalyces and tentacular knobs, composed of a coiled sacculus, covered by an involucrum, and terminated by a vesicle and two lateral filaments. (Eschscholtz, Oken's Isis, 1825, I., and System der Acalephen, p. 150.) For a discussion of the limits of the genera *Agalma*, *Agalmopsis*, and *Halistemma*, see Bull. Mus. Comp. Zoöl., VI. 7, p. 132.

Sars evidently had two or three genera of Physophores which he called *Agalmopsis elegans*. One of these may have been my *Agalma elegans* (Fauna Littoralis Norvegiæ, pp. 32–44, Taf. 5, 6). The first form described by him had a tentacular knob like *Halistemma rubrum*, with a well-developed involucrum, which is wanting in *Halistemma*, Huxley. Such a knob is not very unlike that of *Agalmopsis Tergestinum* and *A. gracile*.

A. elegans. A characteristic feature in their anatomy is the prolongation of the upper wall of the bell cavity into two symmetrically placed recesses (*h n*), one extending into each of those prolongations of the nectocalyx which embrace the axis. The sides of the swimming-bell, on the external surface, are sparingly covered with papillæ which are enlarged at their ends into a spherical knob formed of large thread-cells (Pl. VI. fig. 27).

The covering-scales are more rectangular in outline than those of *A. elegans*, and are crossed by several longitudinal ridges (*r*) bearing lasso-cells closely crowded together. Their exact shape was not determined, as only two specimens were taken, and these were evidently larval. The sides and outer convex surface of the bract bear the characteristic papillæ which have been spoken of as found on the walls of the nectocalyces.

The tastern (*d d' d''*) are more slender than those of *A. elegans*, and have a greater flexibility of motion. Their extremities protrude far outside the limits of the covering-scales, and their very tips are armed with clusters of lasso-cells. From the base of each there hangs a long, flexible, highly contractile filament (*e*), which is commonly carried retracted at its base near the axis.

There is but one feeding-polyp, which appears to be the metamorphosed yolk mass, and is found at the lower end of the axis. The single tentacle (*t*) suspended from its base bears tentacular knobs (*k*) like those of *A. elegans*. Immature pendants (*j*) in all stages of growth are found at the base of the polypite, on the wimperwulst. The tentacular knob is composed of a coiled sacculus of dark red color, enclosed in an involucrum and terminated by a vesicle and two lateral filaments. These filaments are short and stunted, and seem to indicate that the specimens studied were immature.* No sexual bells were observed.

Agalmopsis fragile, sp. nov.

Plate V. Fig 2. Plate VI. Figs. 16, 17, 23, 24, 25.

In 1878 Claus † described from Trieste a new Physophore, to which he gave the name *Halistemma Tergestinum*. Metschnikoff refers the same, taken at Villa Franca at about the same time, to *Stephanomia picta*, sp. nov. Metsch. I have already discussed ‡ the synonomy of this genus.

A single specimen of an *Agalmopsis* closely related to *S. picta*, Metsch. (*H. Tergestinum*, Claus), was found at Key West. So close is its likeness to the Mediterranean species that it is probably the same. Direct comparison is necessary to prove their identity.

* This species is very different from *A. elegans* of about the same age. *A. elegans* with one polypite has *two* kinds of tentacular knobs and a prominent network of red pigment on the feeding polyp. It is destitute of the papillæ found on the necto-calyces and scales of *A. papillosum*.

† Ueber Halistemma Tergestinum, n. sp., in Arbeit. d. Zool. Inst. zu Wien, Heft I.

‡ Bull. Mus. Comp. Zoöl., VI. 7.

The axis (*b*) of *Ag. fragile* is very flexible, while the nectocalyces and scales admit of more motion on each other than is commonly the case among Physophores. These appendages also are very transparent and small in size as compared to the length of the colony. The whole animal is more slender than an *Agalma*, and the appendages, in respect to their size, less conspicuous. The float (*a*) does not differ from that of other Physophores. It is relatively large, and bears apical pigment-spots of crimson color. Similar colored spots are likewise found at intervals along the length of the axis, especially on that portion of it which bears the swimming-bells and is known as the nectostem. This peculiar distribution of pigment on the stem is confined to the two species *Ag. picta* and *Ag. fragile.* In other genera colored spots are found on the axis, but they are not so prominent as in these two species of *Agalmopsis.**

One of the main differences between the nectocalyces of *Agalmopsis* and those of *Agalma* is the existence of three or four bright orange ocelli (*o*) on the bell margin near the terminus of the radial tubes. The course of these vessels in the walls of the bell is almost identical in the two genera.

The portion of the axis upon which the bracts are borne is very long and highly flexible. The covering-scales (*c*) are small, inconspicuous, and transparent. They have a rectangular shape, and are fastened to the axis by means of a short peduncle. A blindly ending, medially placed tube penetrates their whole length on the inner concave surface. It opens into the stem cavity by an elbow-joint.

The polypites (*p*) are long, slender, flask-shaped bodies, which are very prominent on account of the network of bright crimson pigment on their sides and bases. The tentacles carry tentacular knobs (Pl. VI. fig. 17), which have a bell-shaped involucrum and a single terminal filament without a vesicle. The sacculus is tightly coiled, and has a dark red color. It bears near the attachment of the involucrum a double row of prominent thread-cells. The male and female bells hang in clusters from the base of the tastern (fig. 16, *s*), and are not separated from each other on different regions of the axis. The male bells (fig. 25) are smaller than the female (fig. 24) and have a crimson color. The female bells are colorless. As is true of most Physophores, the colony is monœcious.†

* The tentacular knobs of *Agalmopsis utricularia*, Claus, are so different from those of other Physophoridæ that I have considered it a new genus (Bull. Mus. Comp. Zoöl., VI. 7). It may be known as *Calliagalma utricularia.*

† In *Nanomia* according to Mr. Agassiz the two sexes are not combined in the same colony. (N. Amer. Acal., p. 208 ; Seaside Studies, &c., p. 80.) *Agalmopsis, Agalma, Physophora, Athorybia, Halistemma, Stephanomia*, and *Praya* have both male and female bells on the same stem. The same is said to be true of *Hippopodius. Abyla, Apolemia*, and *Diphyes* are probably diœcious. Sexual organs of but one kind are known in *Rhizophysa.* They resemble those of *Physalia.*

Nanomia will also be found to bear male as well as female sexual bells on the same axis, as it is probably the young of *Agalmopsis.* My reason for regarding *Nanomia* as the young of *Agalmopsis* and not of *Agalma* will be found in Bull. Mus. Comp. Zoöl., VI. 7, p. 141.

Rhizophysa gracilis, sp. nov.

Plate VI. Figs. 1-6.

One of the most interesting Physophores found by us is a new species of *Rhizophysa.*

It differs from *R. filiformis,* Lam., in the position of the sexual bodies and the form of the tentacular knobs. Its differences from *R. Eysenhardtii* are still greater. *R. gracilis* has two kinds of tentacular knobs, neither of which are present in *R. Eysenhardtii.* I am unable to say whether my species is the same as any of those described by Studer.* *Rhizophysa* has a long, thread-like axis, destitute of swimming-bells, covering-scales, and tastern. At one extremity there is a float which, in all species of the genus, is relatively larger than in other Physophores, with the exception of the single genus *Physalia.* The axis is very contractile, coiling up when touched at the base of the float, and then leisurely extending itself to its normal length. The stem walls seem to be extremely sensitive to the touch of a foreign body.

The float (fig. 2) is similar to an enlargement of the stem at one extremity, and is formed of two parts, an external float and an internal air-sac. The walls of the float are composed of two layers, and have the shape of an elongated sphere (prolate spheroid). The outer walls are dotted with small cells, irregularly placed. These cells are characteristic of the species, or at least are not found in *R. filiformis,* the common *Rhizophysa* from the Mediterranean. At the apical pole of the float there is an opening through which the cavity of the air-sac communicates with the surrounding medium.

The air-sac has the general form of the float, but is much smaller, and hangs inside this structure, being suspended from its upper pole. The cavity of the air-sac is in free communication with the external water through the apical orifice of the float. Around this opening there are large patches of dark brown pigment. The walls of the lower hemisphere of the air-sac (*g*) are thicker than those of the upper, and have a yellowish green color. From the lower surface of the air-sac, confined to the hemisphere (*g*) with thickened walls, there hang into the cavity of the float many finger-like pouches, which are sometimes bifurcated at their extremities, In *R. gracilis* these appendages to the air-sac are open at their distal ends, so that their cavities seem to freely communicate with that of the float. On one side of the base of the float, projecting from its external walls, is an excrescence (*e*) filled with small globules whose function is unknown.† A similar appendage to the float has not been seen by me in *R. filiformis.*

The polypites (*p*) of *R. gracilis* resemble closely in shape those of *R. fili-*

* Zeit. f. Wiss. Zool., XXXI.

† A natural homology of this body is that it is an undeveloped polypite. The transparent spheres within are probably bubbles of air which have made their way into the float through its apical opening.

formis, but are stouter and covered with small regularly placed patches of pigment, whose color was not noticed (fig. 4). The single specimen which we found had four feeding-polyps.

The tentacles (fig. 4) arise from the base of the polypite, and closely resemble the tentacles of *R. filiformis*. Along their upper side, near their proximal end, they bear many simple buds,* which are undeveloped tentacular knobs (fig. 4). The pendants, therefore, in this genus, seem to bud from the tentacles, and not, as in *Agalma*, from the base of the polypites. These buds pass by successive changes into well-developed tentacular pendants of two kinds. The adult form of these two kinds of tentacular knobs does not differ as radically in their anatomy as that of the pendants of *R. filiformis*.

The first and more numerous tentacular pendant consists of a simple coiled sacculus (fig. 5), without involucrum, mounted on a long, flexible peduncle. The termination (fig. 5′) of the sacculus is trifid, consisting of a prominent median projection and smaller lateral protuberances. The tip of each bears a black pigment-spot. The whole surface of the knob is abundantly supplied with thread-cells.

A second kind of tentacular pendant, similar in some respects to the former, was also observed (fig. 6). It differs from the former in having an undivided tip which bears a small pigment-spot. The second form of tentacular pendant is more slender than the first, and may be found to be simply the immature condition of that described above. The "first form" of tentacular knob in *R. gracilis* corresponds part for part with the "first form" of knob in *R. filiformis*. Representatives of what are known as the "second" and "third" † kind of pendant in the latter species seem not to exist in the present species, *R. gracilis*. The whole outer surface of the tentacle is thickly covered with large lasso-cells.

The sexual organs (*s*) differ in shape, size, and position from those of most other Physophores. They resemble most closely homologous structures in the genus *Physalia*. Instead of arising in clusters from the stem, each placed midway between two polypites as in some genera, or from the base of a taster as in others, they hang from the axis at a point immediately below the base of attachment of the upper polypite.‡ In the single specimen studied they are wanting on the other feeding-polyps.

The cluster (fig. 3) has a botryoidal shape, and hangs from the axis by a single slight peduncle. The pedicle of the sexual bodies opens directly into a spherical body, as shown in fig. 3. This body varies in size and shape, and contains a simple cavity. It is sometimes so contracted that it is indistinguish-

* Huxley, *op. cit.*, Pl. VIII. fig. 18, represents similar buds near the proximal end of the tentacle.

† By the "second" and "third" form of tentacular pendants in *R. filiformis*, I refer to those structures which Gegenbaur (Beit. z. n. Kennt. d. Schwimp., Taf. XVIII. figs. 8, 9) calls respectively the *Handförmiges Angelorgan* and the *Vögelkopfähnliches Organ*.

‡ They occupy a similar position as regards the polypites as the female bells of *Agalma*.

able from the peduncle itself. There are four clusters of sexual bodies arising from this enlargement of the peduncle. Each of these subordinate clusters is attached by its own peduncle, and bears several buds in various stages of growth. Of these buds the more proximal are generally the most developed, and they have not yet taken on the form of a bell. The axis and peduncle of each cluster is very contractile. The sexual cluster is a very prominent body on the stem, swaying backward and forward with passing currents of water. None of the single bells which form this cluster were observed to separate from the axis, nor were their contents seen to be discharged. In none of the buds could an egg be distinguished, and it is impossible to tell whether the animal was male or female, so little is known of the difference between the sexes in the genus *Rhizophysa*. "Mace-like" sexual organs, such as are found in *R. filiformis*, probably develop into sexual glands similar to those which we have described in *R. gracilis.**

Many parasitic Crustacea were found infesting *R. gracilis*. They clung to the float and polypites with such pertinacity that it was almost impossible to tear them away without rupturing the *Rhizophysa*. Six of these parasites were found upon a single Siphonophore. The same, or a closely related parasite,† is also one of the greatest enemies of the genus *Physophora*.

Athorybia formosa, sp. nov.

Plate V. Figs. 3, 4. Plate VI. Figs. 7-14.

A new species ‡ of *Athorybia* was taken at the Tortugas. This remarkable genus has never before been found in American waters, and very little is known of the anatomy of the other species, *A. rosacea*, although it is very common in some parts of the Mediterranean. §

Athorybia differs from other *Physophoridæ* in the absence of a long axis and nectocalyces, although possessing a well-developed float, and bracts or covering-

* See Proc. Bost. Soc. Nat. Hist., XX., Note on *Rhizophysa*. The likeness of the sexual organs of *R. gracilis* to the bundles of "medusa buds" in *Physalia* and *Tubularia* is very striking. Whether the medusoid buds always remain attached in this Physophore, as in *Tubularia*, is unknown. The resemblance between the sexual organs of *Physalia* and *R. gracilis* is so close that the embryology of the two genera must be very similar.

† The genus and species of this Crustacean were not determined.

‡ Three species of *Athorybia* (sensu strictiori) are described by Eschscholtz, *A. heliantha*, *A. melo*, Q. & G., and *A. rosacea*. Since his time nothing has been added to his descriptions of the two former. Practically what is known of the anatomy of the genus we owe to the accounts of *A. rosacea* by Kölliker (Die Schwimmpolypen oder Siphonophoren von Messina, pp. 24–28, Pl. VII.), Sars (Middelhavets Littoral Fauna, Nyt. Magaz. f. Natur., X. pp. 6, 7), and Huxley (*op. cit.*, pp. 86–89, Pl. IX.). *A. formosa* differs from their account of the anatomy of *A. rosacea* in the form of the tentacular knob.

§ Rare at Naples and Villa Franca.

scales. The form and development of these latter structures impart a peculiar outline to the *Athorybia*. The float (*a*) is large, pear-shaped, and sometimes it protrudes above the circlet of covering-scales, as in the figures of *A. melo*, Q. & G., but generally it is drawn below the upper edges of the bracts so that it can only be seen by looking through the body of the scale. When seen from above, the float has a cherry or claret-red color on the periphery surrounding a dark brown middle. In the centre there appears an opening giving a free communication between the air-bladder (*a a*) and the surrounding water.

The air-bladder (*a a*), which hangs within the float, is an elongated sac suspended from the inner walls of the upper pole of the float. It resembles closely the air-bladder of *Agalma*, and is destitute of those finger-like processes which characterize the same structure in *Rhizophysa*. No communication was observed between the cavity of the float and that of the axis. Swimming-bells are wanting in *Athorybia*.

The covering-scales arise from all sides of the short axis below the float, and in their method of attachment to the rudimentary stem are not unlike the petals of a flower. When seen from the side, they give the whole animal a rhomboidal shape. The covering-scales (Pl. VI. fig. 14) are curved and spatulate, with the convex surface turned outward. At its origin the bract is narrow, but gradually as it recedes from that point it widens, and its bounding edges are indented with a pair of teeth, one on each side about two thirds the distance from the attachment to the distal rim of the scale. The outer, convex surface of the covering-scale is slightly rounded laterally, and is crossed by four rows of lasso-cells (*l*) arranged in longitudinal lines.* When the scale is seen from one side it appears serrated along these four lines. The scale of the *Athorybia* stage in the young *Agalma* has a somewhat similar serrated appearance. Along the medial line of the bract, on its inner concave surface, there runs a longitudinal vessel which communicates with the stem cavity and ends blindly at the most distal extremity of the scale.

From their position of attachment, as commonly carried, the scales at first extend outward almost at right angles to the axis of the float, and the natural curvature which they have imparts the somewhat spherical outline to the animal. These covering-scales can be made to extend themselves or draw together, receding from or approaching the line passing through their attachment and the apical portion of the float. This expanding and contracting power of these bodies is limited to the extremities, which are moved apparently by muscles in the base of the scale and its peduncle. The motion of the scale may

* Huxley (*op. cit.*, p. 86) says the outer surface of the covering-scale in his species of *Athorybia* is crossed by *six* rows of small thread-cells. Kölliker describes the bract of *A. rosacea* as crossed by *five* or *six* white ribs, formed of small lasso-cells which sometimes traverse the whole length of this structure and sometimes do not. The same may be said of the lines of lasso-cells in the bract of *A. rosacea*, with the exception that in no specimen were there more than four ribs of these bodies. The specimens which were taken may have been immature, and other specimens may be found with six lines of these cells, as in *A. rosacea*.

in part make up for the loss of swimming-bells and propel the animal in the water. As far as my observations go it is rather sluggish, and but poorly adapted for rapid progression. As the colony floats along, the covering-scales are generally extended to their greatest width, but when alarmed the scales are contracted closely together around the feeding-polyps and those other organs which arise near their base.

The polypites, tastern, and sexual bells arise from a slight enlargement of a structure corresponding to the axis of the other Physophores. This enlargement does not differ greatly from a similar sac at the extremity of the stem of the genus *Physophora*. The polypite (*p*) resembles the same structures in other Siphonophores. They are long, flask-shaped bodies, projecting beyond the covering-scales (*c*) when extended, and have a mouth at the free extremity. The walls have a pink color with patches of dark crimson pigment near the base of the feeding-polyp. From each polypite, near its origin, there hangs a single tentacle. This tentacle (*t*) is dotted along its whole length by secondary appendages or tentacular knobs (*k*), of which there are two very different forms.

The existence of more than one kind of tentacular pendant in an adult Physophore * has up to this time been thought peculiar to the genus *Rhizophysa*. Two forms of these bodies exist in the young of several genera. In the young *Agalma* we find the permanent knob of the adult coexisting with an embryonic form. The same is true of the young *Agalmopsis* and *Nanomia*. Each kind of knob, however, in the larval Physophore, is limited to its own tentacle, and in the case of the embryonic knob the tentacle itself has the same provisional nature as the structure which it carries.

The adult *Rhizophysa* † has three different kinds of tentacular knobs hanging from one tentacle, and as far as we now know none are embryonic. A similar condition exists in *A. formosa*, with the exception that there are here two forms of tentacular knobs instead of three.

The first and more numerous kind of tentacular pendant (Pl. VI. figs. 9, 10) is in many respects like that of the adult *Agalma*. It has a sacculus (*d*), an involucrum, and two terminal filaments (*b*), one on either side of a spherical bladder or vesicle (*c*). The terminal filaments are, however, shorter than those of *Agalma*, and are commonly carried stiffly elevated like two horns.

The peduncle of the knob is very flexible and of moderate length, admitting a free motion of the pendant in all directions. The involucrum closely surrounds the sacculus, and its walls are with the greatest difficulty distinguishable from those of the latter body which it contains. The saccalus has a single coil upon itself, and its walls have a dark crimson color. At its base there are rows, generally two in number, of large lasso-cells, homologous to similar bodies in the knob of other Physophores.

* See reference to Sars's genus *Agalmopsis* on preceding pages.

† Proc. Bost. Soc. Nat. Hist., XX. These three kinds of knobs in *R. filiformis* are distinct from their earliest embryonic condition, and do not develop one from another.

The most peculiar structure in the anatomy of the knob is the prolongation of the margin of the involucrum on its lower side into a conical appendage (*a*), which extends out from the knob slightly beyond the vesicle. This conical body appears to be solid, and is crossed by lines or annulations, as shown in figs. 9, 10. It has a yellow color, and may be called the apex.

If now we compare the first kind of knob in *A. formosa* with that of *A. rosacea*, Esch., we find this important difference between them. In *rosacea*, according to Kölliker, there is a "stalked elongated capsule" hanging to the knob at its base, near the origin of the involucrum. That capsule is undoubtedly homologous to the apex (*a*) of the knob in *formosa*. Its closest homology, however, is with the "second kind" of knob in *A. formosa*, as we shall show presently.

Sars * has already compared the knob of *A. rosacea* with that of *Agalma*. The resemblance of the first kind of pendant in *A. formosa* to that of *Agalma* is even more striking, since it possesses an involucrum of a form which has not been observed in *A. rosacea*.

A second kind of tentacular knob (figs. 7, 8) is sparingly scattered along the tentacle of *A. formosa*. Besides being less numerous, it is also much larger than the former, with which it is homologous. It may eventually be found to have been developed from the preceding. This knob has one of the most peculiar forms which this organ, highly variable among Siphonophores, assumes. Its general shape is shown in figs. 7, 8.

The knob, when seen from the side (fig. 8), has a pear shape, and hangs from a short flexible peduncle. The great mass of the pendant is made up of a very large involucrum or structure of the same homology. The walls of this body are very thick, and seem to be composed of large cells. At one end it is continued into dendritic branches (*a a*) of a yellow color. The body of the involucrum is transparent, and through its walls there can be seen a crimson and orange-colored sacculus (*d*). The sacculus is not coiled, as is generally the case with other Physophores, but has a simple curved shape, and in its walls can be traced the rows of large thread-cells, which are a common feature of all these organs.

Fastened to the upper side of the involucrum, near its articulation with the peduncle, there spring three bodies very similar to those found on the first kind of knob. One of these structures is the ovoid vesicle (*c*), and on each side there rises a short lateral filament (*b*). These organs differ in no respect from the same in the former kind of pendants.

The most exceptional feature in the second kind of knob in *Athorybia* is seen in the structure of the distal extremity of the involucrum or the apex (*a*). The apex (fig. 8, *a a*) is bifid at its base, and after a basal bifurcation each part subdivides into many smaller unbranched divisions. Each division has the general appearance of the apex of the first kind of knob. It is capable of great extension and retraction, and when drawn back has a corrugated surface, like similar branches in the "Handförmiges Angelorgan," described by Gegenbaur

* *Op. cit.*

in *Rhizophysa*. I have already (Bull. Mus. Comp. Zoöl., VI. 7) compared the undeveloped knob of *Physophora hydrostatica* and that of *Athorybia*.

The tastern * (fig. 13) of *A. formosa* are very long, highly flexible bodies of pink color, protruding through the spaces left between adjacent covering scales. They are in continued motion, and resemble, with the exception of their color, more the filamentous bodies found between the swimming-bells of *Apolemia* than true tastern. Their tips bear several large thread-cells. They were not observed to bear tentacles.

A. formosa is monœcious. The female bells (fig. 12) are borne on short stems,† and have a botryoidal shape. Each bell contains a single ovum. The course of the chymiferous tubes in the bell walls is similar to that in *Agalma*. The male bells (fig. 11), like the female, take the form of grape-like clusters on short stems. They are smaller than the female. The male and female clusters are colorless, and the bell-walls transparent.‡

Praya, sp.

Fragments of a large *Praya*, too mutilated for specific identification, were taken on two occasions at the Tortugas Islands. *Diplophysa*, sometimes called the diphyizoid of *Praya*, has been taken in Narragansett Bay.§ It was not collected in Florida.

Galeolaria aurantiaca, Vogt.‖

Plate VI. Fig. 26.

Galeolaria (*Epibulia*) was taken on two occasions. It is unfortunate that only the posterior nectocalyx was found. Although this is sufficient to deter-

* Huxley (*op. cit.*) does not mention these structures in his *Athorybia*. Kölliker's description of them is much the same as that which is here given. The tastern of the two species seem to have much the same form.

† Huxley (*op. cit.*, p. 87) says that in his *Athorybia* a single stem bears both male and female bells, as well as small tastern. According to Kölliker (*op. cit.*, p. 28), the male bells in *A. rosacea* are isolated, and a *single* male bell is found with a grape-like cluster of female bells near the base of a polypite. In *A. formosa* male and female bells are found in clusters of about equal numbers.

‡ My measurements of the size of *A. formosa* are about the same as those given by Kölliker for *A. rosacea*. They are larger than Förskal's or Huxley's measurements of the *Athorybiæ* which they had. *A. formosa* is half an inch in diameter (distance taken at right angles to the axis, when covering-scales are extended).

§ Bull. Mus. Comp. Zoöl., VI. 7, and VIII. 8.

‖ Sur les Siphonophores de la Mer de Nice. Mem. de l'Inst. Genev., I. pp. 72, 73, Pl. IV. figs. 12, 13.

Since my return from Florida, the U. S. Fish Commission has sent me a specimen of *Gleba hippopus*, Forsk., and two new Physophores for identification. *Gleba* was also collected by Mr. Agassiz in the cruise of the "Blake" along our eastern mine the genus, it is hardly enough for the species. The nectocalyx resembles closely that of *G. aurantiaca*, Vogt.*

Although *Galeolaria* is not recognized by some naturalists as a distinct genus from *Diphyes*, the form of the nectocalices, the course of the gastrovascular tubes, and especially the flap-like appendages to the inferior (posterior) swimming-bell, are so characteristic that it is here looked upon as a distinct genus.

HYDROIDA.

Halitiara formosa, gen. nov. et sp.

Plate IV. Fig. 2.

The young of a new Tubularian medusa was taken by us at the Tortugas. Generic characteristics are as follows : —

The bell is tall with a small apical projection. Chymiferous tubes, four in number, simple, broad, without lateral glands. There are four long tentacles which correspond with the radial tubes, between each pair of which are three small tentacles. Otocysts wanting.

H. formosa, sp. nov.

The bell is tall, its height being double the diameter. At its apex it bears a slight apical protuberance. The surface of the bell is smooth, and its wall thin and transparent. The proboscis (manubrium) is unpedunculated, and hangs down about one third the depth of the bell cavity. The basal portion is filled with spherical cells, which are probably ova. The lips are smooth and without appendages.

coast in the summer of 1880. Leuckart (Siphon. von Nizza, p. 33, note 1) speaks of the same genus from the coast of Greenland. *Abyla*, *Halistemma*, and *Apolemia* have not yet been taken in our waters. There is in the collection of the U. S. Fish Commission for 1881 a mutilated fragment of the stem of a Physophore, which may have belonged to an *Apolemia*, and a new genus, *Haliphyta*, which is elsewhere described.

* The choice between the two generic names *Galeolaria* and *Suculceolaria* to designate this medusa is purely arbitrary. Lesueur gave the former to the anterior, the latter to the posterior nectocalyx of the same Diphyid. Vogt named the first complete form of this medusa *Epibulia aurantiaca* (later also *Galeolaria aurantiaca*). *Epibulia* must give place to either of the two previous names of Lesueur. The specific name, *filiformis*, Delle Chiaje, adopted by Leuckart (*Galeolaria filiformis*), although the oldest, is derived from a wrong identification. The specific name *quadrivalvis* adopted by Gegenbaur, Sars, Keferstein, and Ehlers, with others, from Lesueur and Blainville (Actin. Zoöl. Atl., VI. 6), has more in its favor, but the fragment to which it is applied by Lesueur cannot be distinguished from those other bells which bear the names *biacuta* and *minuta*. The oldest specific name applied to a *Galeolaria* the use of which leaves me no doubt of the animal intended, is that of *aurantiaca* by Vogt. To choose between it and *quadrivalvis* is very difficult.

At the extremity of each chymiferous tube on the bell margin springs a long tentacle, which is commonly carried tightly coiled about the tentacular bulb. On the bell margin, between each pair of long tentacles, are three short tentacular appendages, which are generally more or less coiled around their bases, and are carried upright, as shown in the figure. There are no otocysts. The coloration of the genus was not observed.

Tiaropsis diademata, Agassiz.

Plate VII. Figs. 13 14.

A larval stage of this medusa, younger than any *Tiaropsis* yet figured, was found by us at the Tortugas. The youngest *Tiaropsis* described by A. Agassiz * has a deeper bell and more tentacles, but in other respects seems the same.

Halicalyx tenuis, gen. et sp. nov.

Plate VII. Fig. 15.

In January, 1878, A. Agassiz found at Key West a hydroid medusa with the following characteristics.

Bell low, hemispherical, with thick walls and smooth surface. Apex of the bell destitute of protuberance. The chymiferous tubes are four in number, and from along their course in the bell hang dendritic ovaries. Through all the windings of the sexual glands there runs a bright crimson stripe, which has the appearance of being jointed.

The tentacles are twelve in number, and are carried elevated or stiffly extended at right angles to the axis of the bell. They are thickly ribbed along their whole length with lasso-cells, and enlarged at the extremity into a knob. At the base of each tentacle there is an otocyst containing a single otolith.

The proboscis is short, extending barely to the bell opening, and is without peduncle. The mouth is rectangular, and with short lips, which are sometimes turned backwards and reversed over the outer walls of the stomach.

Aglaura vitrea, sp. nov.

Plate VII. Fig. 10.

A new *Aglaura* was found by us at the Tortugas. The shape of the bell resembles that of *Trachynema*, with which the medusa is easily confounded.

* North American Acalephæ, pp. 69, 70; Illust. Cat. Mus. Comp. Zoöl., II.; Proc. Bost. Soc. Nat. Hist., IX. p. 93. See also Morch, Beskriv. af Groenland; and Agassiz, *op. cit.*; also Mem. Am. Acad., IV. p. 289.

There is this marked difference between *Aglaura* and *Trachynema*. In *Aglaura* the sexual glands hang from the distal end of the peduncle which bears the stomach, while in *Trachynema* they are suspended from the upper part of the bell cavity.

The bell of *Aglaura* is high, cup-shaped, and without apical projection. The walls are thin, rigid and transparent. There are eight simple, narrow, chymiferous tubes. The velum is very muscular, and it is mainly by its efforts that the medusa is propelled through the water.

The proboscis is pedunculated, and bears the eight sausage-like ovaries near its point of division into peduncle and stomach. The upper part of the stomach is spherical in shape, and through its walls the half-digested food can be easily seen. Its mouth is formed by labial walls, in which are imbedded lasso-cells. Many patches of red pigment are present in the lips and the walls of the stomach.

The tentacles are very numerous, long, and flexible, and are generally broken off near their bases, leaving stiff projecting stumps, as in *Trachynema digitale* A. Ag. Several specimens were captured which carried the flexible tentacles unbroken, but for the most part these bodies presented the appearance shown in the figure.

There are eight otocysts, alternating in position with the chymiferous tubes. Each otocyst contains a single otolith. The ovaries are cream-colored. The development of the egg is unknown.

A. vitrea resembles very closely the *A. hemistoma*, Peron et Lesueur, found so commonly in the Atlantic Ocean and Mediterranean Sea. It has, however, no apical projection to the bell, and the umbrella is half-egg-shaped. The form of the bell is so variable that it may eventually be found to be identical with the well-known *A. hemistoma*.

Glossocodon tenuirostris (sp. Agassiz).

Plate VII. Figs. 1-9.

In 1857 McCrady* gave a description of a new species of *Liriope*, to which he affixed the name *Liriope scutigera*. L. Agassiz † in 1862 mentions from Key West, Florida, another species, *L. tenuirostris*, which he says has a more slender proboscis than *L. scutigera*. A. Agassiz ‡ gives a figure of a *Liriope*, which he identifies with *L. scutigera*, and mentions the form *L. tenuirostris*, from Florida, without description. The figure of *L. scutigera* by A. Agassiz has slighter ovaries than those mentioned in McCrady's description, and has not the interradial tentacles ("four short" tentacles) spoken of by the last author. The figure, however, was but a sketch, and the medusa from which it was made is probably correctly referred to *L. scutigera*, McCr. Haeckel takes excep-

* Gymnophthalmata of Charleston Harbor. Proc. Ell. Soc. Nat. Hist., 1857.

† Contributions to the Natural History of the United States, IV.

‡ *Op. cit.*, p. 60.

tion to this identification, and makes it a new species of *Liriope*, to which he assigns the name *L. conirostris*. From the fact that no mention is made by McCrady of "blinde Centripetal-canäle," Haeckel refers *L. scutigera*, McCr. to his own genus *Liriantha*.

In my work on the medusæ of Narragansett Bay a very poor figure of what I regard the same as *L. scutigera* is given, as taken at Newport, R. I.*

Fritz Müller † has published an anatomy and development of *L. Catharinensis*, F. M., which differs from the medusa about to be described only in the want of the blindly ending centripetal canals, which lie between the radial tubes. In all details the likeness is very close. It also is placed in the genus *Liriantha*, Haeck., by Haeckel, ‡ on account of the want of these centripetal structures. In the use of the generic designations *Glossoconus* and *Glossocodon* in the "System der Medusen" of the latter author, the medusa which is here described would be placed under the latter rather than the former genus; yet in the figures of the oldest stage found there will be noticed two kinds of tentacles on the bell margin, whereas *Glossocodon* has but one kind, viz. tentacles of the radial tubes. In *Glossoconus* there are two kinds of tentacles on the bell margin, as well as blindly ending centripetal canals between each pair of radial tubes. In younger stages, however, according to Haeckel, there is only one such canal between every pair of tentacular vessels.

Many specimens § of the genus *Glossocodon*, which is strictly speaking in the *Glossoconus* stage described by Haeckel, were found at the Tortugas. It has the ovaries well developed and to every appearance is sexually mature. No specimen was taken with less than eight tentacles, and consequently if on further study it should be found to drop certain tentacular bodies on the bell rim midway between the tentacular vessels (radial tubes), it should be referred to *Glossocodon*. In its present condition it belongs to the genus *Glossoconus*, Haeckel.

The species differs from *Liriope scutigera*, McCr. in having but one kind of otocyst, and in possessing the blindly ending centripetal tubes (*d*, Pl. VII. fig. 1). The figure of *L. scutigera*, A. Ag., has four long tentacles, and ovaries of a different form, while there are no centripetal tubes. It resembles *L. Catharinensis*, F. Müll., in every respect except that the centripetal canals are wanting in Müller's figure and description. In L. Agassiz's short description of *L. tenuirostris*, there is nothing to eliminate our species. Instead of introducing a new name, his specific designation has been adopted.

The adult *Glossocodon* has a deep, almost spherical bell (Pl. VII. fig. 1). The

* Studies of the Jelly-fishes of Narragansett Bay. Bull. Mus. Comp. Zoöl., VIII. 8.

† Polypen und Quallen von S. Catharina. Arch. f. Naturg., 1859, pp. 310–321, Taf. XI. figs. 1–25.

‡ Das System der Medusen, I. 1, p. 287.

§ The adult and young of this medusa figured on Pl. VII. figs. 1–9, were drawn from nature by A. Agassiz.

bell walls are thick, especially at the apex, although there is no apical protuberance. The surface is smooth; its walls very transparent. The bell cavity, when seen in profile, is rectangular. The floor opposite the bell entrance is almost flat, and not concave, as in many other medusæ. This characteristic in the shape of the bell cavity is noticeable even in young stages. It differs in this respect from the figure given by Fritz Müller of *Liriope Catharinensis.*

Upon the walls of the bell cavity there are found two kinds of chymiferous tubes. Four of these vessels are radially arranged, and pass from a circular tube about the bell opening to a highly flexible proboscis, along the sides of which they extend, opening eventually into the stomach at the extremity of the proboscis. These tubes are narrow, unbranched, and without lateral appendages. The sexual glands hang from the radial tubes, extending about two thirds their length, in the inner surface of the bell. They end at the point where the radial vessels bend at right angles to the outer walls of the bell. Midway between each pair of radial tubes, arising from the bell margin and extending in the bell walls about one third the height of the cavity, there is a single blindly ending centripetal canal (*d*), characteristic of the adult. These tubes (?) are four * in number, and do not bear ovaries.

The largest and most important appendage to the bell is the long, slender, and highly flexible manubrium or proboscis. It springs from the centre of the floor of the bell cavity, and, when the jelly-fish is quiet in the water, hangs far outside the vail. At other times it is so contracted that its termination barely projects beyond the bell margin. It consists of two parts, a hyaline base, which resembles in character the bell walls, and a distal pink-colored stomach with a terminal mouth. The only structures which can be recognized in the peduncle of the proboscis are the four chymiferous tubes just below the surface. These are extensions of the radial chymiferous tubes, which have been described above. These tubes open into the stomach near the distal end of the proboscis. The distal end of the peduncle of the proboscis is continued inside the stomach into a conical projection or tongue. In fig. 9 we have a view of the distal end of the manubrium with the walls of the stomach reversed to show the projecting tongue.

The stomach of *Glossocodon* is a bag-shaped structure with pinkish walls, situated at the distal extremity of the manubrium. When the mouth is expanded, as in the figure, it assumes a quadrangular shape. The edges of the lips are lined with clusters of lasso-cells (fig. 9) arranged in bundles equidistantly arranged around the border of the mouth. Similar cells are described

* In the only complete drawing of the adult which we have, there is only a single centripetal canal between each pair of ovaries. There are probably three such structures instead of one in that position. This can be seen in sketches of a portion of the bell margin which I have not copied. The medial of these three canals, which is that figured in fig. 1, is larger than the two lateral, which are little more than slight protuberances.

in *L. Catharinensis* by Fritz Müller. The stomach walls are capable of great expansion, and the mouth opening is very large. Oftentimes the lips are turned back, leaving the projecting tongue very prominent. When not feeding, or when alarmed, the lips are pressed closely together, concealing the tongue and closing the entrance into the stomach. The stomach walls are not transparent, but contain many small pigment-dots and minute lasso-cells, irregularly imbedded in their substance.

There are two forms of tentacular appendages found on the bell margin. At the end of each radial tube there is a tentacle which is long, hollow, and very flexible. The surface of each such tentacle is covered with lasso-cells arranged in rings surrounding the appendage. We thus have along its whole length annulations of lasso-cells, alternating with smooth depressions. The correlation between the stomach and tentacles is very well shown in this *Glossocodon*. The voracity of *Liriope* is mentioned by McCrady,* and in this animal it is equally great. The abundant lasso-cells upon the tentacles and the lips are but necessary to capture living food to satisfy an enormous appetite.

In addition to the long tentacles there are four others likewise springing from the bell rim. In the adult *Glossocodon* these appendages are wanting, and in the oldest form which we found they were reduced to the mere "stump" of a tentacle. We have, however, no drawing of our jelly-fish in which they are not represented. Each of these appendages is situated midway on the bell margin, between two long tentacles. In the adult stage (fig. 1) they are club-shaped bodies, united to the bell by means of a slender peduncle, and are carried stiffly erect. They are solid, inflexible, and on their outer convex surface there are clusters of lasso-cells arranged with regularity. At the position of union of the bell walls and the peduncle of this appendage there is a slight spur or solid extension of the base on the outer surface of the bell, extending upwards a short distance on the bell walls.

The adult *Glossocodon* has eight otocysts, which are arranged on the outer edge of the bell margin near the points from which the tentacles, long and short, arise. Those which are found near the tentacular bulbs of the long tentacles are placed at one side of the tentacle, and not at its very base. The other set of otocysts are placed in the immediate vicinity of the origin of the pedicle which bears the solid tentacle. There is but one kind † of otocyst found on the bell margin, and it is a simple sac containing a single otolith. The sexual organs hang like heart-shaped pouches from the four radial tubes. They are sometimes so inflated that the walls of adjoining glands almost touch. Their size and shape vary greatly, depending solely on the maturity of the ova. Their color is white and sometimes pink. Male and female glands may be found later to be distinguished by a difference in color, but little is known of the difference of the sexes in *Glossocodon*.

* McCrady saw *L. scutigera* with its tentacles and lips seize a small fish "thrice as large as itself" (*op. cit.*, p. 209).

† According to McCrady there are two kinds in *L. scutigera* (*op. cit.*, p. 208).

The youngest larva of *Glossocodon* which we have found was approximately in the same stage as that figured in fig. 18 of Fritz Müller's paper. It resembles closely the larva which Haeckel * figures, Pl. III. fig. 35, as the young of *G. eurybia*. In Haeckel's representation of this stage, no chymiferous tubes are to be found. The bell in his figure is also more spherical, and the profile of the bell cavity lacks the rectangular shape which our youngest larva had. The bell is low, disk-shaped, transparent, and has a smooth outer surface. The bell cavity has a cylindrical shape, its walls following closely the outer surface of the bell. The bell walls are of about uniform thickness throughout. There are four radial tubes passing from the bell margin to the centre of the upper floor of the bell cavity. They bear no sexual pouches.

The proboscis is the least developed of all the appendages to the bell in the youngest larva which was captured. It has the form of a simple, raised wall of rectangular shape, arising from the upper floor of the bell cavity. There is in it no division into stomach and peduncle. The lips are simple, and are destitute of the clusters of lasso-cells found in the adult.

There is only one kind of tentacular appendages to the bell margin in this larva, and these are the club-like bodies situated midway between the tentacular or radial tubes. The long flexible tentacles at the end of the radial vessels have not yet begun to form. Those tentacular bodies which are present are solid and are carried stiffly elevated at the side of the bell. Their length is about that of the radius of the bell, and their diameter near their distal extremity is very much greater than at the attachment to the bell rim. The inner concave side of the appendage is smooth and without lasso-cells ; the outer, convex surface bears many clusters of cells arranged in bundles in a series. These bodies are especially numerous near the terminal end of the tentacle. On the outer surface of the appendage, near its junction with the bell margin, a small conical tooth is developed. A similar spur is not to be found in the published figures of *G. eurybia* or *L. Catharinensis*. These tentacles are represented in the adult by bodies (*c*) of reduced size, which are said eventually to disappear in *Glossocodon*.†

While these bodies are the only tentacles found upon the bell margin, they are not the only appendages of a tentacular nature which the youngest *Glossocodon* has. A second kind of appendage, also embryonic, is situated on the outer surface of the bell walls. At right angles to the sides of the bell, in the same spheromere in which the radial tubes lie, there spring four solid appendages, which are true tentacles. At its distal end each of these tentacles is enlarged, and bears many lasso-cells ; but of its minute anatomy and the arrangement of cells at that point nothing was observed. Its base of attachment is about one third the distance between bell margin and apex, and is connected by a rib (*b*) with the bell rim. This rib is probably a solid body

* Die Familie der Rüsselquallen, 1865, Pl. III. fig. 35, pp. 67, 68. Called by Haeckel the fourth stage (*Eurybia-like larva*).

† Haeckel, *op. cit.*

and not a tube, and is strictly homologous to a like structure in *Cunina discoides*, Fewkes. It lies on the outer surface of the bell, while the radial tube follows the inner or the bounding wall of the bell cavity. There are *four* otocysts, each closely resembling the otocyst of the adult in the larval form which has just been described. Each otocyst is placed on the bell margin at the point of attachment of the solid tentacle.

The next oldest larva to that already described is one which, together with the following (figs. 3, 4), may be referred to the "*fifth period*" (Haeckel) of *G. eurybia*. It corresponds in some respects with fig. 20 in Fritz Müller's account. In this larval stage (fig. 3) the most marked addition to the former is the growth of tentacular bodies on the bell margin midway between the solid tentacles (*c*). They lie near the union of the radial vessels with the circular tube, and are the beginnings of the long flexible tentacles. They are in a larva even as young as fig. 3 banded with the lasso-cells characteristic of the adult, which seems to be true in a larva of the same age figured by Haeckel (Pl. III. fig. 37). Fritz Müller represents two of these appendages as formed prior to the remainder. The stage of such a larva may be a little younger than my fig. 3, in which all these bodies, four in number, were equally developed. The most important difference between the two figures (figs. 3, 4) which are given to represent the *fifth period* is the result of the growth of the proboscis, which even in this larva is differentiated into a basal peduncle and a terminal stomach. The larva has still only four otocysts.

Haeckel's account of the development of *G. eurybia* closes with the *fifth period*. Between that and the adult he has given no figures of intermediate stages. Fritz Müller's paper, however, has one more stage intermediate between these two, in which there appear to be ten otocysts on the bell margin intermediate between the radial canals, before the organs corresponding to the tentacles (*a*) are dropped. In the present species the otocysts of the long tentacles do not develop before the complete loss of the bodies (*c*).

Fig. 5 represents a larva in the *sixth period* of its development. This larva differs from that last represented (fig. 4) in the growth of the long tentacle on the bell margin and the total loss of the tentacle (*a*). It is to be noticed, however, that there are still but four otocysts, and that these bodies lie at the bases of the solid marginal tentacles (*c*). A larva still older than this, but undoubtedly to be placed in the same period (*sixth period*) is the first in the series having eight otocysts. The four sense bodies additional to those at the base of the marginal solid tentacles appear at the base of the long tentacles for the first time in a larva represented in fig. 6. This larva has assumed the form of the adult in many particulars, one of the most prominent of which is the enormous development of the proboscis. The sexual glands have not yet begun to form, or at least are not represented. In a larval form which approaches very closely the adult, the sexual glands are well developed and crowded with ova. Such a larva is figured in fig. 7, which represents the *Glossocodon* as seen from the aboral pole. In the adult the only representative which can be found of the embryonic structure (*b*) is a tooth or spur which is represented in fig. 8.*

* It will be seen, if my account of the development of *Glossocodon* be compared with Fritz Müller's (*op. cit.*), that, while according to my account the peduncle (*Stiel*) of the stomach appears long before the secondly formed otocysts, he represents them both as developing at about the same time. It will also be seen that the four secondary otocysts follow instead of precede the appearance of the long tentacles. According to him the otocysts, as the long tentacles, appear in pairs situated diametrically opposite on the bell rim. No observations were made by us on this point.

EXPLANATION OF THE PLATES.

PLATE I.

Fig. 1. *Ocyroë crystallina* (young).
" 2. The same, with oral lobes expanded.
" 3. A single oral lobe extended.
" 4. Position assumed by the oral lobe.
" 5. View of oral lobe from the aboral pole (expanded).
" 6. The same contracted.
" 7. *Cassiopea frondosa* in natural position.
" 8. Young of the same (aboral view).
" 9 *a*. Side view of young *Cassiopea.*
" 9 *b*. Older larva of the same.
" 10. *Cassiopea frondosa* (aboral view).
" 11. The same (oral view).
" 12. Marginal sense body of the same (aboral side).
" 13. The same (oral side).
" 14. Double marginal sense body of *C. frondosa* (monstrosity).
" 15. The same (aboral view).
" 16. Marginal sense body with two ocelli (monstrosity).
" 17. Extremity of the oral arms of *Cassiopea.*
" 18. Mouths and pouches of the same.
" 19. Oral appendage from upper side.

a. Auricles.
b. Bifurcation of the lateral tubes.
c. Primary tubes from the base of the funnel.
c c. Secondary tubes, branches of the primary.
d. Oral branches.
e. Radial stripes.
e'. Intermediate spaces between the radial stripes.
f. Marginal zone.
h. Hood.
i. Oral disk.
i. Otocyst.
k. Stomach.
l. Lips.
m. Mouth.
o. External sexual opening.

p. Chymiferous reservoirs.
p'. Oral tentacles.
t. Auricular tubes.
t'. Velar lappets.
t t. Ocular lappets.
l t. Lateral tubes.
oc. Ocellus.
os. Otocyst style.
ot. Otoliths.
s t. Lobular tubes.
u. Central zone.

PLATE II.

Fig. 1. *Cassiopea frondosa* (aboral view).
" 2. The same (oral view).
" 3. *Linerges Mercurius* (side view). The marginal lobes are infolded.
" 4. The same. The marginal lobes are extended and the crescentic form of the ovaries is shown.
" 5. *L. Mercurius* (aboral view).

PLATE III.

Fig. 1. Portion of the oral surface of *C. frondosa.*
" 2. Peripheral extremity of a canal lying in the central cavity between two ovaries. Showing also the opening (*b*) leading from it into the chymiferous system of the oral arms.
" 3. Oral cylinder cut off from the bell, so as to expose its cavity.
" 4, 5. Life-size figures of *L. Mercurius* in attitudes assumed while swimming.
" 6. Section cut through the cavity which lies above the stomach of *L. Mercurius.* One half this sinus is drawn in longitudinal plane, i. e. section cut in the direction of the axis of the medusa.
" 7. View of the opening by which this cavity communicates with the stomach.
" 8. The same opening shown in an ephyra in order to illustrate its relations to the remaining structures of the same.
" 9. *Cassiopea frondosa.*
" 10. The same (position assumed in floating).
" 11. Ovary (shrunken) of *L. Mercurius.*
" 12. Portion of the inner bell wall of the same medusa.
" 13. *L. Mercurius* from oral side.

a. Circular orifice, centrally placed, communicating between the stomach and the cavity situated above it.
b. Opening leading from the cavity of the oral cylinder into the chymiferous vessels of the arms.
c. Cavity above the stomach.

e. Sac (subumbral).
f. Margin of the bell.
gf. Gastral filaments.
h. Patches of pigment.
i. Substance of the bell.
k. Pouches.
ls. Row of pigment-spots on the walls of the stomach.
o. Ovary.
p. Chymiferous reservoirs.
p'. Oral tentacles.
ot. Otocyst.
so. Sexual openings through which the ova are discharged.

PLATE IV.

Fig. 1. "Sense area" (*Beroë ovata*).
" 2. *Halitiara formosa.*
" 3. Ephyra (?) of *Linerges Mercurius.* (Quadrant of disk from below.)
" 4. Ephyra (*L. Mercurius*) younger than fig. 3.
" 5. Ovaries and subumbral pouches (*L. Mercurius*).
" 6. Subumbral pouch (*L. Mercurius* adult).
" 7, 8, 9, 10, 11, 12. Eggs and stages of their segmentation (*L. Mercurius*).
" 13. Planula (*L. Mercurius*).
" 14. Ephyra (?), (*L. Mercurius*).
" 15. Ephyra more developed than fig. 3. (Octant.)
" 16. Marginal sense body of ephyra (*L. Mercurius*).
" 17. The same (side view).
" 18, 19. Marginal sense body (*L. Mercurius* adult).
" 20. Gastral filaments (*L. Mercurius*).
" 21. Tentacle and bell margin (*L. Mercurius*).
" 22. Single marginal tentacle (*L. Mercurius*).

PLATE V.

Fig. 1. *Stephanomia Atlantica.*
" 2. *Agalmopsis fragile.*
" 3. *Athorybia formosa.*
" 4. *A. formosa.* (From above.)
" 5. *Agalma papillosum.*
" 6. *A. papillosum.* (From above.)

a. Float.
a a. Air-sac.
b. Axis.
c. Covering-scale.
d, d', d''. Tastern.
e. Filament of the taster.

fs. Female bells.
g. Papillæ.
h. Somatocyst.
h n. Recesses opening into bell cavity.
j. Undeveloped tentacular knobs.
k. Adult tentacular knobs.
l. Lasso-cells.
m s. Male bells.
n. Nectocalyces.
o. Ocellus.
p. Polypite.
r. Chymiferous tubes.
t. Tentacle.
u. Undeveloped nectocalyces.
w. Wimperwulst. Peduncle of polypite.
x. Structure of unknown homology.

In figure 1 the bell margins are too prominent, and the spiral lines in which the openings into the cavities of the nectocalyces lie are imperfectly shown.

PLATE VI.

Fig. 1. *Rhizophysa gracilis*, sp. nov.
" 2. Float (*R. gracilis*).
" 3. Sexual organs (*R. gracilis*).
" 4. Polypite and proximal part of the tentacle (*R. gracilis*).
" 5. First kind of tentacular knob (*R. gracilis*).
" 6. Second kind of tentacular knob (*R. gracilis*).
" 7. First kind of tentacular knob (*Athorybia formosa*).
" 8. The same from one side.
" 9. Second kind of tentacular knob (*A. formosa*).
" 10. The same from one side.
" 11. Male bells (*A. formosa*).
" 12. Female bells (*A. formosa*).
" 13. Taster (*A. formosa*).
" 14. Covering-scale (*A. formosa*).
" 15. Tentacular knob of *Agalma papillosum*.
" 16. Taster and sexual bells of *Agalmopsis fragile*.
" 17. Tentacular knob (*Ag. fragile*).
" 18. Tentacular knob of *Stephanomia Atlantica*.
" 19. The same, uncoiled.
" 20. Polypite (*S. Atlantica*).
" 21. Tentacular knob (*S. Atlantica*).
" 22. Polypite (*S. Atlantica*).
" 23. Polypite (*Ag. fragile*).
" 24. Male bell (*Ag. fragile*).
" 25. Cluster of male bells (*Ag. fragile*).

Fig. 26. Nectocalyx (*Galeolaria aurantiaca*).
" 27. Papilla from the nectocalyx (*A. papillosum*).

a. Apex.
b. Lateral filaments.
c. Terminal vesicle.
d. Sacculus.
e. Appendage to the float (undeveloped polypite ?).
f. Circular plates.
g. Thickened walls of the air-sac.
p. Polypite.
s. Sexual organs.

PLATE VII.

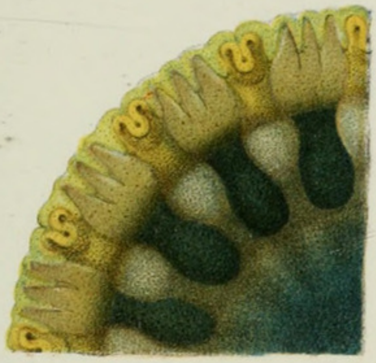
Fig. 1. *Glossocodon tenuirostris.*
" 2. Larva of the same (fourth period, Haeckel).
" 3. The same more developed (fifth period, Haeckel).
" 4. Larva in fifth period.
" 5. Larva in sixth period.
" 6. Same, more developed.
" 7. Fig. 1 from aboral pole.
" 8. Base of the adult tentacle.
" 9. Everted stomach walls and protruded gastrostyle.
" 10. *Aglaura vitrea.*
" 11. *Eucharis multicornis* (one half body of the young).
" 12. Same at right angles to fig. 11.
" 13. *Tiaropsis diademata* (young).
" 14. Quadrant of the same (oral view).
" 15. *Halicalyx tenuis* (only four of the twelve marginal tentacles are drawn).
" 16. *Staurophora laciniata.*
" 17. Tentacular knobs and "spur" of the same.

a. Embryonic tentacles from bell walls.
b. Ribs connecting the embryonic tentacles with the bell rim.
c. Club-shaped tentacular bodies.
e. Tentacular spur.
f. Auricle.

CAMBRIDGE, April 1, 1882.

J.W.F. ad. nat.

Printed by A. Meisel



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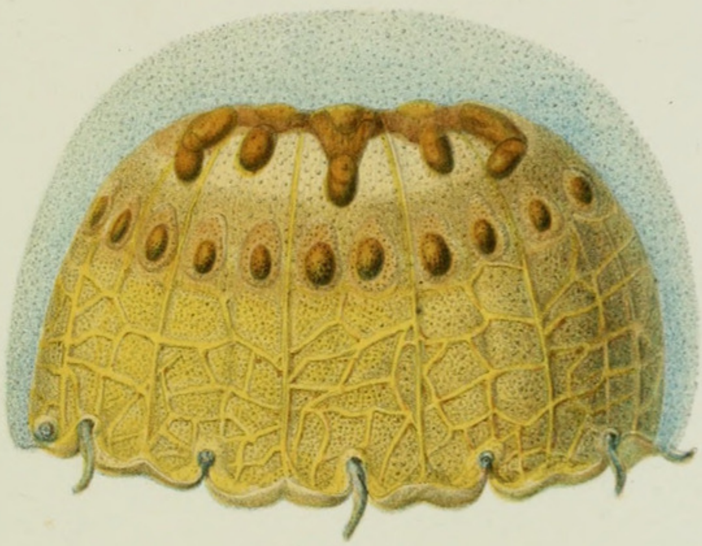

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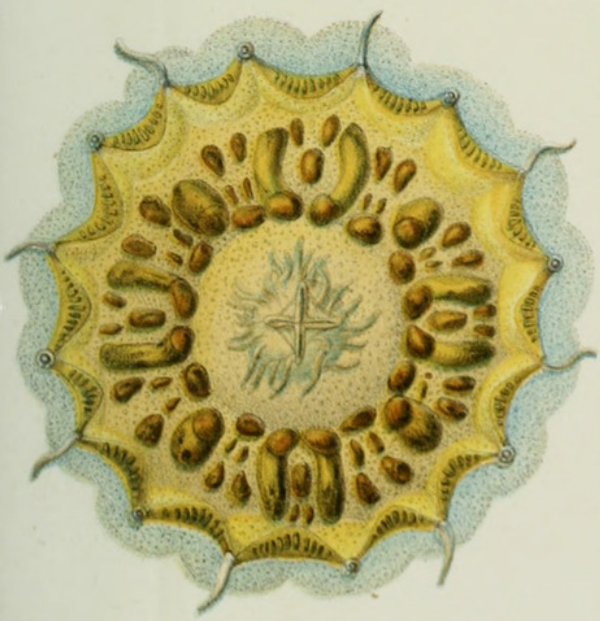

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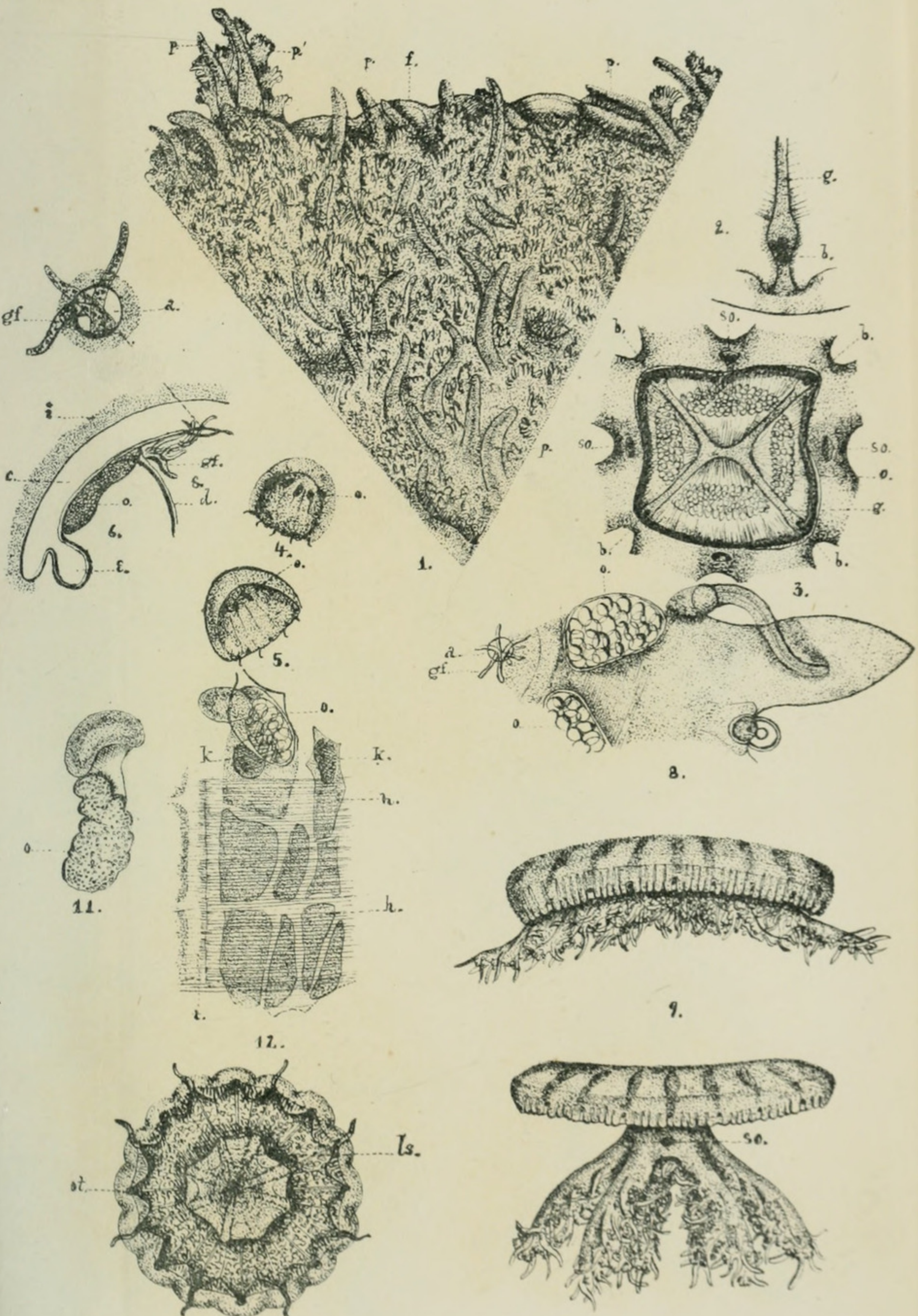

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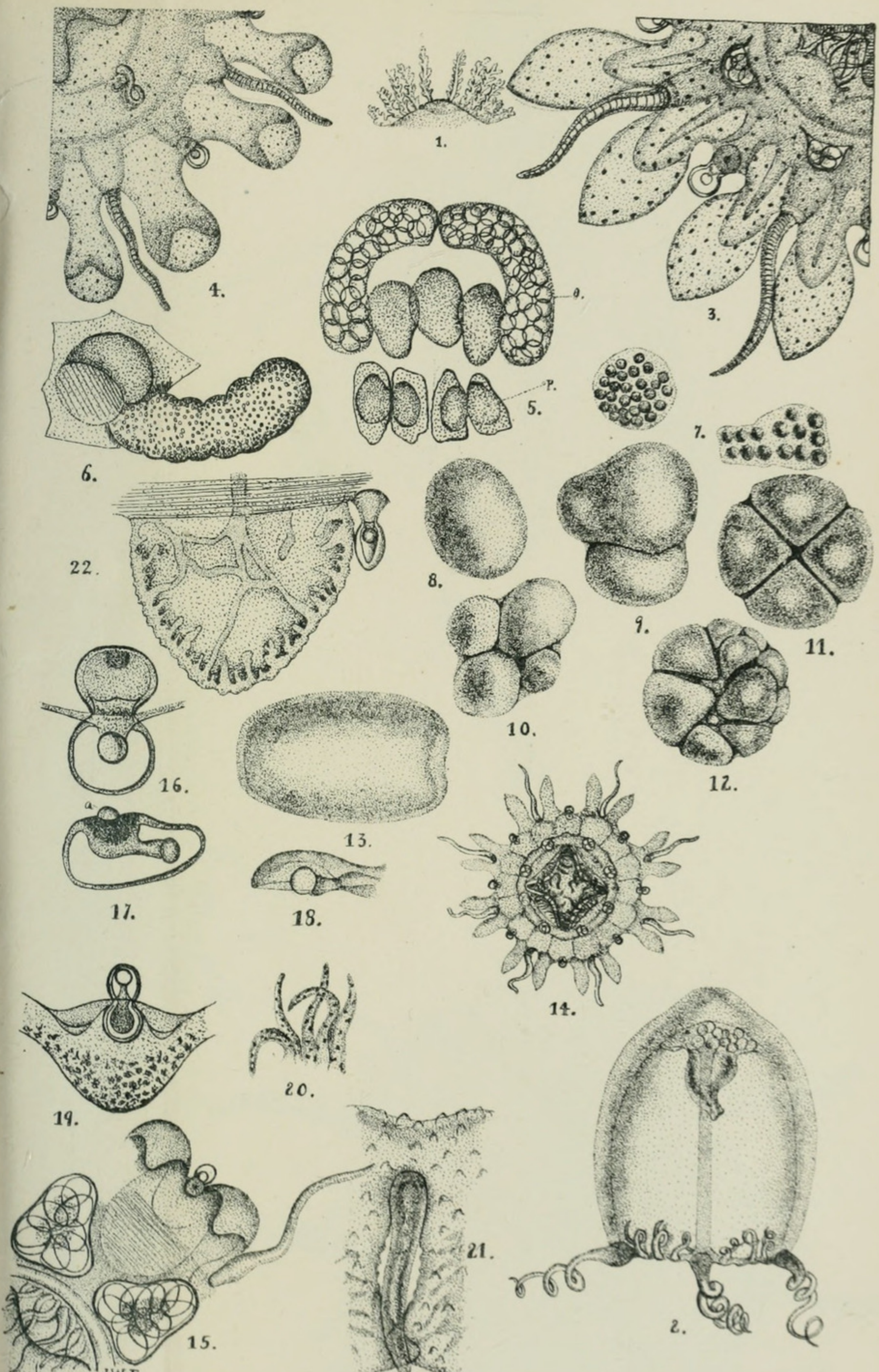

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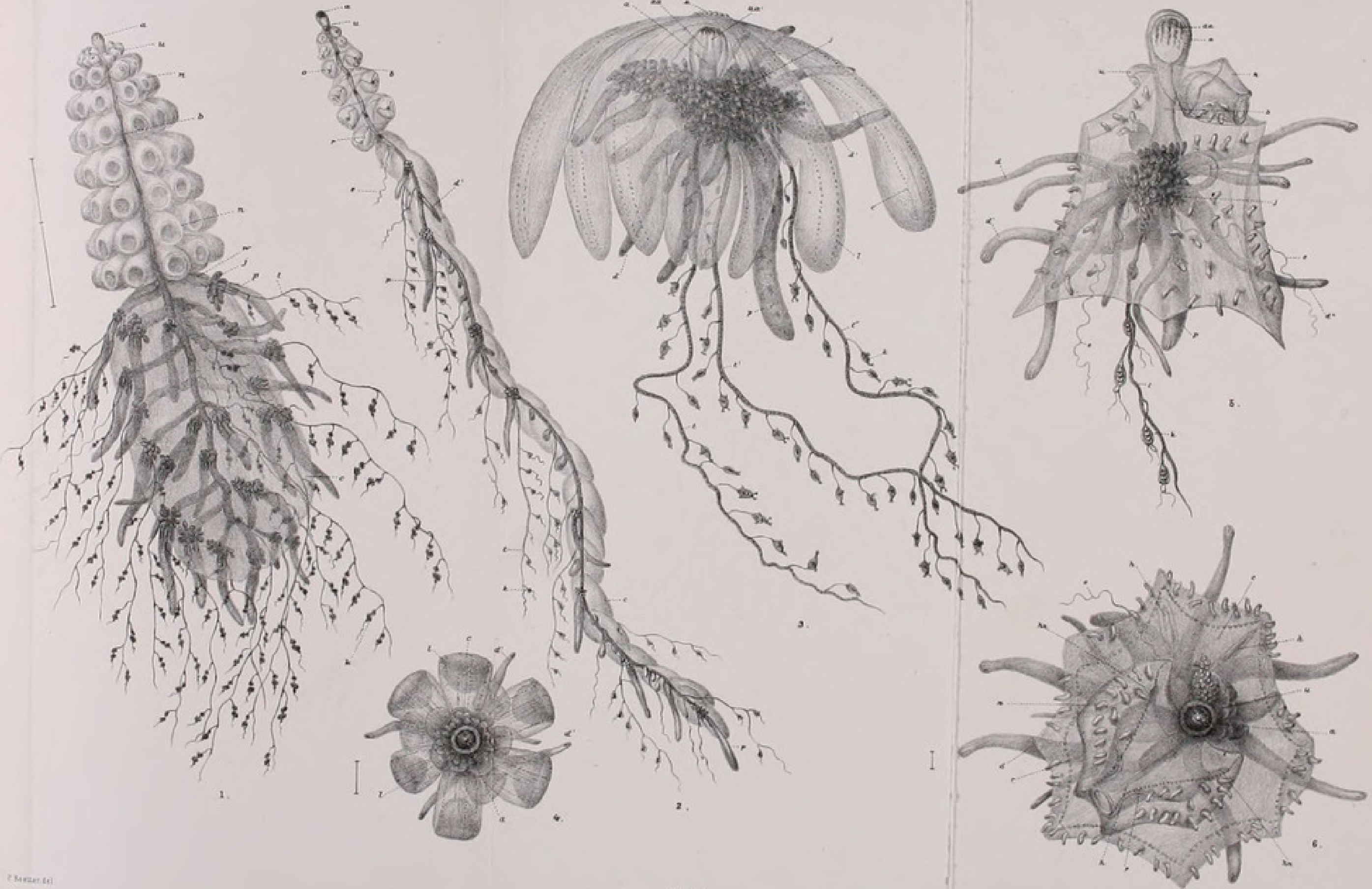

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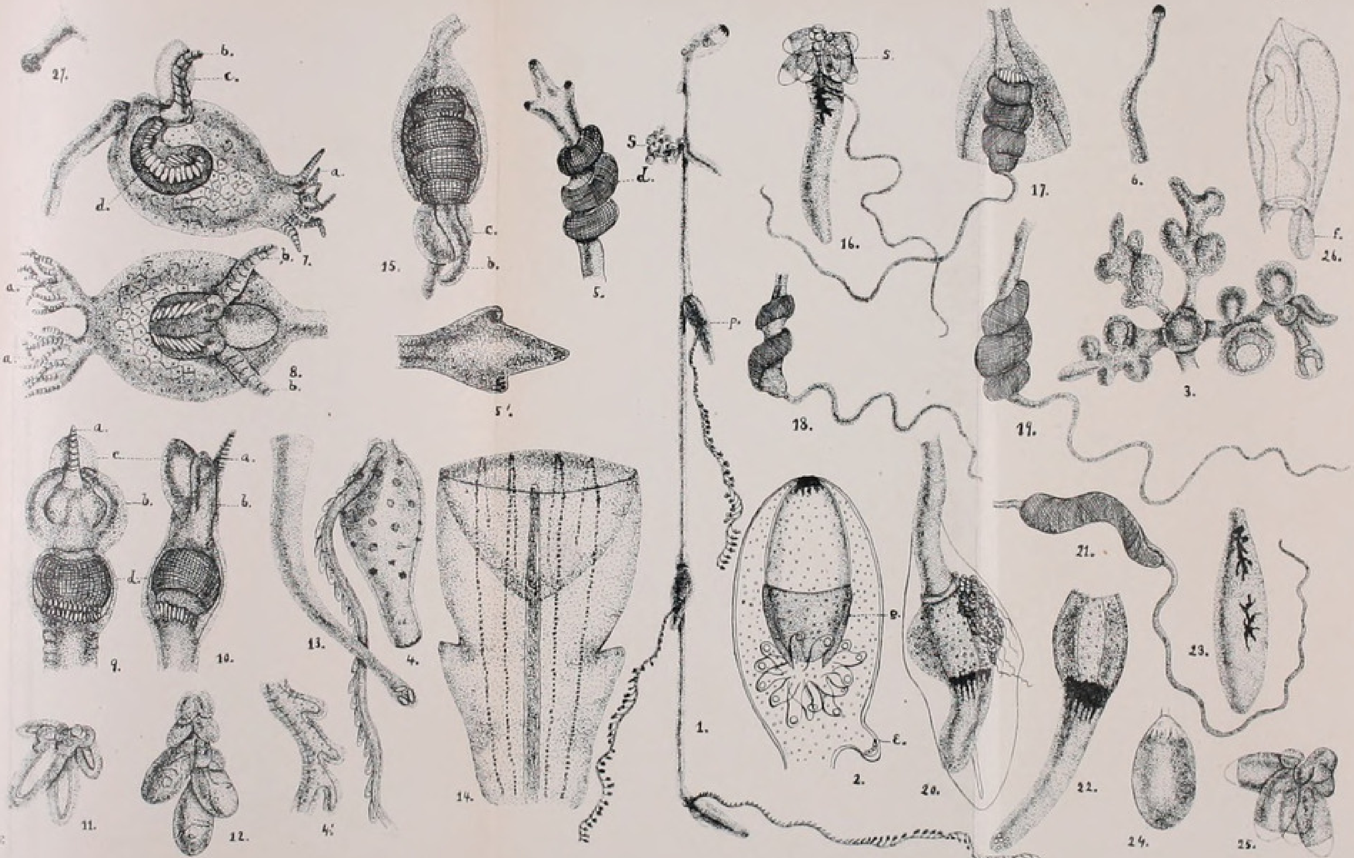
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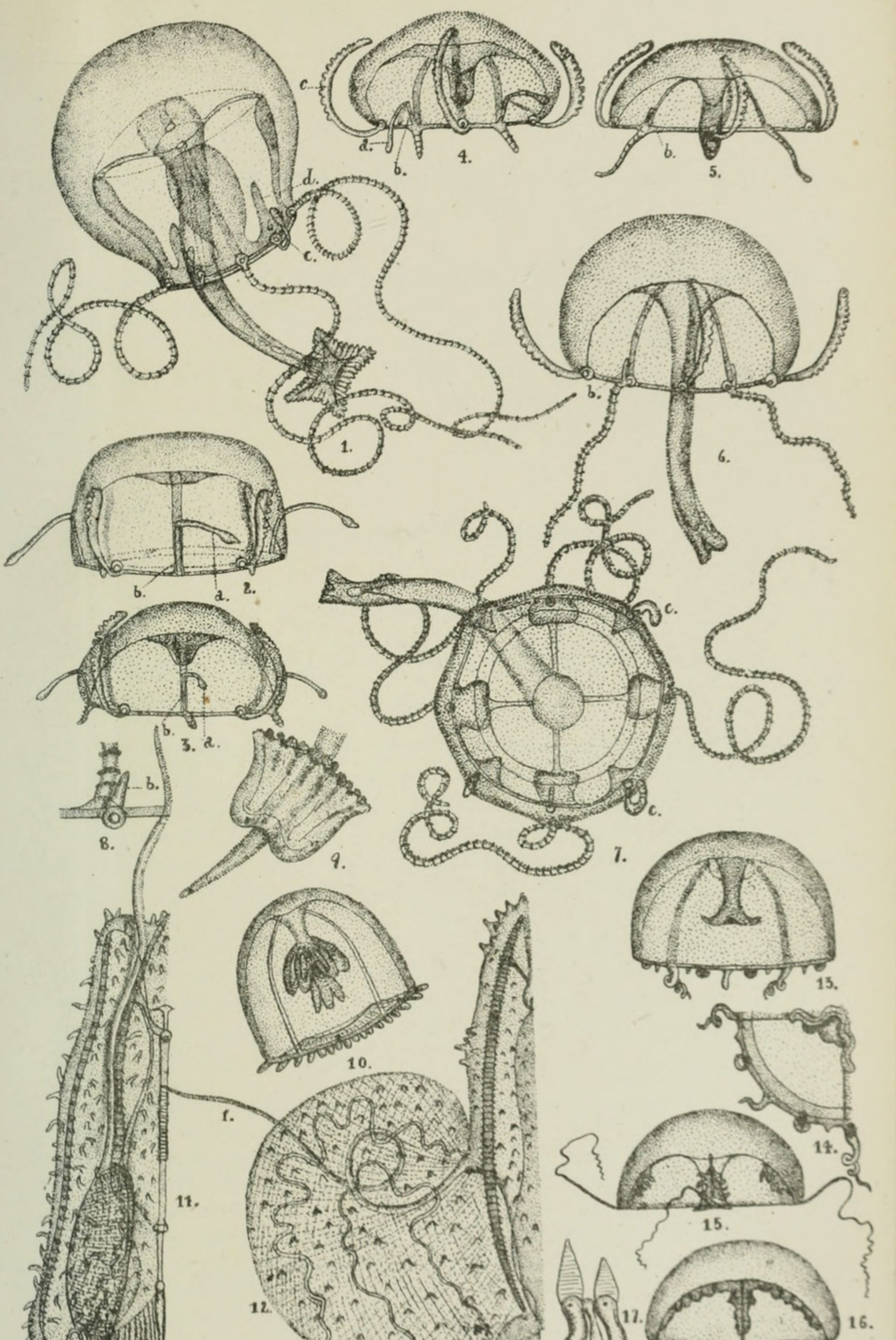

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