No. 3. — *Exploration of the Surface Fauna of the Gulf Stream, under the Auspices of the United States Coast Survey, by* ALEXANDER AGASSIZ.

IV.

On a few Medusæ from the Bermudas. By J. WALTER FEWKES.

LIST OF FREE JELLY-FISHES FOUND IN CASTLE HARBOR, BERMUDA, IN MAY AND JUNE, 1882.*

Aurelia flavidula PER. et LES.
Pelagia cyanella PER. et LES.
Linerges Mercurius HAECK.
Mnemiopsis Leidyi A. AG.
Pleurobrachia rhododactyla AG.
Beroë punctata CHAM. et EYS.
Chiaja † **multicornis** M. EDW.
Physalia Arethusa TIL.
Velella mutica BOSC. (fragment).
Agalma Okenii ESCH.
Stephanomia (Forskalia) Atlantica F.
Rhizophysa filiformis LAM.
Rhizophysa Eysenhardtii GEG.
Diphyes acuminata LEUCK.
Diphyes formosa F.
Lizzia octopunctata FORBES.
Dysmorphosa fulgurans A. AG.
Halitiara formosa F.
Modeeria multitentacula F.

* During my stay in the Bermudas very little pelagic life was seen. The above list probably contains only a small part of those jelly-fishes which frequent its waters.

† The name *Eucharis* was preoccupied in 1825, when first applied to this Ctenophore. The name is as old as 1809 among the Mollusks.

Modeeria (Turritopsis) nutricula F.
Tima formosa A. Ag.
Oceania languida A. Ag.
Eucheilota ventricularis McCr.
Cunina discoides F.
Unknown **Ephyra** with sixteen tentacles.
Tamoya punctata sp. nov.
Eucheilota quadralis sp. nov.
Oceaniopsis Bermudensis gen. et sp. nov.
Ectopleura sp.
Eucope sp.

Unknown Ephyra with sixteen tentacles.

Fig. 16.

An Ephyra, which was at first regarded as the young of *Linerges*, on closer examination was found to have sixteen instead of eight otocysts, and the same number of tentacles. In many other respects, however, it closely resembles the young *Linerges*. The bell is flat, disk-shaped, with a slightly raised and rounded apex. The marginal lappets, which are thirty-two in number, are long and flat, thin and pointed at their free extremities. When they are extended, the central region of the bell, as seen from one side, appears as a slight protuberance above the plane in which they lie. When the marginal lappets of the bell are contracted, they fold under the oral side of the bell so that their tips meet at a point in the centre below the mouth. The incisions which separate the marginal lappets of the bell extend to two depths; one set of incisions corresponding to the position of the tentacles, and the other to that of the sense bodies. The former are the deepest, and the bell margin is cleft by them in such a way that the rim of the bell is divided into sixteen pairs of marginal lappets. The color of the bell is a brownish yellow, in which are darker spots and patches of black pigment. The mouth is simple, like that of the young *Linerges*, and from its lips hangs a single row of small papillæ, which are wanting in the Ephyra of *L. Mercurius*, Haeck. The adult of the Ephyra will certainly be found to be a very unusual Discophore. Three genera which it approximates in the number of marginal sense-bodies are *Cassiopea*, *Collaspis*, and *Atolla*. From both of the last two, however, it differs so widely in the form of the bell and other particulars that it cannot be referred to either of them. *Cassiopea*, which has sixteen otocysts, has no tentacles in the youngest larvæ studied.* The Ephyra of *Linerges* is easily distinguished from that described

* The only genus to which I have been able to refer this Ephyra is *Cassiopea*. *Cassiopea* (*Polyclonia*) *frondosa* is one of the most common Medusæ on the shoals along the Florida Reefs, and probably is also found in the Bermudas, although I

above, in having eight otocysts and the same number of rudimentary tentacles alternating with them on the bell margin. The marginal lappets, instead of being long and pointed, as in the above Ephyra, are rounded, and almost oval in contour. The tentacles are very short, resembling little buds in the interval alternating between the marginal bell lappets.

The youngest Ephyra of *Linerges* which was taken is much younger than any yet figured. The umbrella has a disk-like form, is flat, and has a coloration similar to that of the adult. It was not traced into a larva like that which is elsewhere* doubtfully described as the young of *L. Mercurius*.

Agalma Okenii Esch.

Several specimens of *A. Okenii*† were collected in Castle Harbor. This species has never before been taken on this side of the Atlantic. *A. Okenii* resembles our common *Agalma, A. elegans* F., but is easily distinguished from it by the rigid character of the body and the thickness and peculiar form of the covering-scales.

The axis in larger specimens is about three inches long, and has little flexibility. The polyp stem, or that part of the axis which bears the polypites and their covering-scales, is almost straight, and on account of the thickness and close approximation of the covering-scales is never thrown into those curves which impart so much grace to the *Agalma* when in motion. The color of the axis is yellow and orange. The float and axis resemble in most of their external features the same structures in *Agalma*. The swimming-bells are similar to those of *A. papillosum* F. in possessing blind extensions of the bell cavity into the gelatinous horns which arise on either side of the attachment to the axis and embrace the stem.

The covering-scales are very thick, and stand out at right angles to the stem at their points of attachment. In looking at the Physophore from the side, it

was not successful in my search for it. *Cassiopea* has sixteen sense-bodies, and in that respect differs very widely from most Discophora. In one or two other genera, as *Collaspis* and *Atolla*, there are more than eight marginal sense-bodies, but the differences between these genera and the Ephyra mentioned seem too great for a reference of it to them.

If my Ephyra is in reality the young of *Cassiopea*, or some other genus with like sedentary habits, it furnishes us with the interesting fact, which I have long suspected, that in its younger larvæ *Cassiopea* is free-swimming, and has embryonic tentacles in the Ephyra which are lost in the adult.

* Bull. Mus. Comp. Zoöl., Vol. IX. No. 7.

† This species of *Agalma* closely resembles *Crystallodes rigidum* Haeck., with which it is probably identical. It seems also to be the same as a Siphonophore described by Gegenbaur, from the South Atlantic, lat. 2° S., long. 26° W. (Neue Beiträge zur näheren Kenntniss der Siphonophoren). I have followed the latter author in considering it the same as the *Agalma Okenii* described by Eschscholtz, from the North Pacific Ocean.

will be noticed that the flat faces which make up the sides of the animal below the swimming-bells are not formed, as in *A. elegans*, by the upper surfaces of the covering scales, but by planes of the same at right angles to the upper and lower surfaces of the bract. These faces are produced by the great thickness of the scale. Its breadth is simply the thickness of the distal edge of the scale. The upper surface of the lowest covering-scale is flat, and fits closely to the lower surface of that bract which is immediately above it in the series, and so on throughout the whole length of the polyp-stem to the lowest nectocalyx. The thickened border of the bract does not present, when seen from the side, a single continuous plane surface, but is made up of three or four slightly concave furrows, separated by ridges, which extend at right angles to the upper face of the scale, in the direction of the length of the stem. Both the swimming-bells and the covering-scales are infested with *Distomæ*. The appendages to the polyp-stem all arise from one side of the axis and hang downward in such a way that when the axis is extended longitudinally the free extremities of the polypites slightly protrude beyond the covering-scales. The polypites are more highly colored than those of *Agalma*. No tasters were observed. The tentacles resemble in character and origin those of *A. elegans* F. Each tentacular knob has a coiled sacculus, a well-developed involucrum within which it can be drawn, and two lateral terminal filaments, one on each side of a median vesicle. The distal extremities of the lateral filaments are slightly enlarged, and colored with reddish pigment.

NOTE. —It may be found, when older larvæ of *A. papillosum* F. are studied, that it is the same as *A. Okenii* Esch.

Rhizophysa Eysenhardtii (?) GEG.

A single specimen of *R. Eysenhardtii* (?) was taken in Castle Harbor. The species is well marked, and can easily be distinguished from *R. filiformis** by the absence of tentacular knobs on the tentacular filaments. When first taken from the water, the tentacles cling with the greatest pertinacity to whatever foreign body they touch. *R. filiformis* is also said to grasp any adjacent object in the same way; but those which I have studied do not fasten the tentacles with the same persistency as *R. Eysenhardtii*.

* The anatomy of the above species of Bermuda *Rhizophysa* resembles closely that of *R. planestoma* Per. et Les., although in the figures of this species no side branches to the tentacles are represented. It also agrees closely in form with a species of *Rhizophysa* described by Huxley, from the Indian Ocean. In the Bermuda species no sexual clusters were found at the base of the feeding polyps, as mentioned by Huxley in his species.

Several specimens of *R. filiformis* were found at Bermuda; one of these measured over three feet in length. In this specimen the sexual bells were very large, and resemble very closely the sexual bodies of *Physalia*.

The extended axis of the specimen captured was a foot and a half long. The size of the float, as compared with the diameter of the stem, is proportionally very large, as in *Athorybia* and *Physalia*. Its apex has a crimson color, and its apical walls are broken through by a circular opening. The longitudinal axis of the float swims vertical upon the surface of the water.* Cellular appendages hang from the lower portion of the air-sac into the cavity of the float. The axis is slender, very contractile, and has a pale pink color, while that of *R. filiformis* is greenish in color. When the stem is retracted it forms a twisted snarl below the float, but at other times, when the *Rhizophysa* floats extended in the water, the tentacles and their side branches reach widely outward, and the polypites are turned at right angles to the stem. Just below the float the polypites are quite small, numerous, arise close together, and are destitute of tentacles. Their outer walls have a pale pink color, with more of an orange tinge than the axis and tentacles. The inner walls of the larger polypites bear characteristic "villi," like those described by Huxley in *Physalia*, and likewise a prominent dark brown, almost black body, which closely resembles the "liver" of *Velella*. The "villi" on the inner walls of the polypites of *Rhizophysa* are homologous with the well-known "tubes" which have been described in the liver of *Velella*. The polypites arise from all sides of the axis.

Each of the larger polypites bears a single long flexible tentacle, which is destitute of tentacular knobs, but possesses filiform side branches, which are thickly set with large cells on one side, where the tentacular walls are enlarged. While many of the side branches are claret-colored, several are colorless. When the animal is captured, the tentacles must be almost torn from objects to which they fasten themselves, before it can be raised out of the water.

The sexual organs resemble those of *R. filiformis* and *R. gracilis* F., and, like those of the former species, arise from the stem midway between two polypites. The close resemblance of the sexual clusters in *Physalia* and *Rhizophysa* has been pointed out elsewhere.† The side branches of the *Rhizophysa* tentacle are homologous with the reniform thickenings on the tentacles of *Physalia*.‡

* The longitudinal axis of the float of *R. filiformis* lies horizontally on the surface of the water.

† Bull. Mus. Comp. Zoöl., IX. 7.

‡ The close likeness between the sexual organs in *Physalia* and *Rhizophysa* was pointed out in my description of *R. gracilis* in 1882. The comparison of the tentacular knobs in these two genera was made by Huxley (Oceanic Hydrozoa). Chun raises these two genera, *Physalia* and *Rhizophysa*, to the rank of an *order*, to which he gives the name "Pneumatophoridæ" (Pneumatophoræ), and which he regards as of equal rank with the Physophoridæ (Physophoræ) and the "Calycophoridæ" (Calycophoræ). In *Rhizophysa gracilis* F. we have a close approximation to *Physalia* in the structure of the body of the tentacle. The "sac," loose folds on one side of this organ in *Physalia*, are likewise found very well developed in the closely allied *Rhizophysa Eysenhardtii* Geg.

Tamoya punctata sp. nov.

Figs. 4-6.

A small *Tamoya*, different from any species of this genus which has yet been described was found several times at the Bermudas. It is probably the young of a species of the genus *Tamoya*, although it has differences from the known species of the genus which may later, when more is known of the development of *Tamoya*, call for its separation. The absence of enlargements of the bases of the tentacles into "wings" separates it from the adult *Tamoya*. The youngest larva (fig. 4) has the following characters. In many respects it resembles *Procharagma* Haeck., from which it however differs in the possession of a well-marked "velarium" and clusters of cells upon the external surface of the bell.

The bell of this larva has very rigid walls, as that of related Trachynemidæ. The bell walls are colorless, and without radiating chymiferous tubes. The height of the bell is a little more than its diameter. Its external surface bears parallel circles of cells, each composed of several small clusters, and arranged as shown in the figures. Instead of radial chymiferous tubes, we find four radial muscles, which extend along the inner bell walls from a point just below the apex of the bell to the marginal sense-bodies.

The proboscis is at first a bag-like fold hanging downward in the bell cavity, and slightly separated from its upper inner walls. It is a little more opaque than the adjacent bell walls, and has a reddish or brownish color. There are four short, stiff tentacles springing from the bell margin. Each is carried projecting outward, and is ribbed on its outer walls with rings of lasso-cells. The tentacles have a reddish color at their extremities.

The sense-bodies are four in number, and are set in deep incisions in the bell margin, midway between the points of origin of the tentacles. Each sense-body is covered externally by a well-developed "hood" (*h*), which is visible even in the youngest specimens. A radial muscular band passes from the base of each sense-body to the stomach, along the inner bell walls. A similar band also makes its way directly from the point of origin of the style of the sense-body into the "velarium." These last-mentioned muscles end blindly near the inner rim of this structure. Each marginal sense-body has the form of a spheroidal sac mounted on a short peduncle. This sac (otocyst) contains a solid spherical body, which occupies most of the chamber of the otocyst opposite that into which the cavity of the style opens. The otolyth is nearly transparent and colorless. There is a pair of ocelli situated in the lateral walls on the sides of each otocyst.

The "velarium" is thick, muscular, and propulsion is brought about by its strokes on the water combined with movements of the bell walls.

A second, somewhat older larva of *T. punctata* was also found. It differs primarily from that just described in the greater length of the tentacles, and in the modification in the shape of that part of the apex of the bell from which the proboscis hangs. While the proboscis of the youngest *Tamoya* springs

directly from the inner wall of the bell cavity, as the larva grows older a rounded protuberance forms in the upper walls of the bell cavity from which the proboscis hangs. This protuberance, when seen from the side, is hemispherical in shape. It forms, however, by means of mesenteries which join the inner wall of the bell in the four meridians passing through the sense-bodies, four pockets, or blind cavities, enclosed by it and the inner bell walls. These pockets are extensions of the bell cavity into the apical walls of the bell, and are separated from each other on the sides by the mesenteries which join the sides of the proboscis and the inner bell walls. In these recesses transparent globules were observed in several specimens. Two of these are represented in Fig. 5.

Figs. 2, 3.

Two small jelly-fishes which are closely related to the above, or are the larvæ of a Medusa like *Tamoya*, were found on several excursions in Castle Harbor. They are slightly smaller than the youngest larvæ of the above-mentioned Acaleph, and for lack of better knowledge have been provisionally referred to *S. punctata*.

The bell walls are thin, rigid, and without chymiferous radial tubes, while the outer surface is destitute of the characteristic cells which have suggested the name *punctata*. The proboscis is very slightly developed, resembling a simple muscular layer split off from the inner walls of the bell below the apex.

The bell margin bears four tentacles alternating with as many sense-bodies, all of which are situated in one and the same plane. The four tentacles are rigid, and crossed by annulations of cells arranged in bands, as in *T. punctata*. Each otocyst is a simple spherical sac, in which is found an otolith. The style which bears the otolith has well-defined pigment spots in its walls; these are probably ocelli. No well-marked "hood," such as exists in *Tamoya*, is yet developed. Near the point of attachment of the otocyst, which has no peduncle, to the bell margin, there is a thickening of the bell margin, forming a protuberance on either side of which are small clusters of nematocysts.

Ectopleura sp.

Fig. 11.

A small Medusa, evidently larval, is referred to the genus *Ectopleura*. Unlike the young* of *E. ochracea* A. Ag., it has only two well-developed tentacles.

* Bull. Mus. Comp. Zoöl., IX. 8. An unknown Tubularian (Fig. 14), probably larval, which was unlike any of the species of American genera, was taken at Newport during my work there last summer. Description of a single specimen: —

Bell colorless, high, with thin walls and well-marked apex, crossed by four broad radial tubes; outer surface irregularly covered with lasso-cells. The tentacles are two in number, and are placed opposite each other on the bell marg'n. Proboscis mounted on a hemispherical projection of the apex of the bell into the bell cavity. Stomach diminutive, lips small, smooth, slightly colored.

and these are arranged opposite each other on the bell margin. The eight rows of lasso-cells on the outer surface of the bell are similar to those in *E. ochracea.*

The youngest larva of *E. ochracea* from Newport has four tentacles. A larval *Ectopleura* with two tentacles has not been recorded previous to this observation of the Bermuda species.

Fig. 12.

The *Ectopleura* mentioned above was accompanied by several young Tubularians, all in a like stage of development, which could not be placed in any known genus. The outlines of the bell are similar to those of *Sarsia.* Its outer surface is covered with nematocysts, arranged without regularity.

The Medusa is peculiar in possessing two simple tentacles placed opposite each other on the bell rim, and a pair of small, apparently rudimentary tentacles at the extremities of the two remaining chymiferous tubes. These Medusæ are the larvæ of some unknown Tubularian related to *Sarsia.*

Oceaniopsis gen. nov.

The genus *Occaniopsis* differs from other members of the *Oceanidæ* in possessing four octocysts, from the neighborhood of each of which, on the bell margin, there arise small tentacular filaments.

Oceaniopsis Bermudensis sp. nov.

Figs. 8, 9, 10.

Two stages in the development of this jelly-fish were found. The younger of these has two large, opposite tentacles, while the older has four.

The characters of the former (Figs. 8, 9) are as follows. The bell is low, without raised apex, with smooth external surface and thin flexible walls. There are four spherical ovaries (*s*) which hang from the chymiferous tubes midway between the proboscis and the bell margin. Two long tentacles (Fig. 8) take origin opposite each other on the bell rim. The rudiments of two others (Fig. 9) are plainly visible on the bell rim, midway between the last, as prominent projections on the bell margin. The bell bears four otocysts. From the neighborhood of each otocyst on the bell margin spring three or more, sometimes two, small filaments. No filaments are found, as in *Eucheilota,* in the neighborhood of the tentacular bulbs.

An older stage (Fig. 10) of the same Medusa has four well-developed tentacles, each of which arises from a tentacular bulb, situated at the terminus of the radial tube near the bell margin. There are no other additions of importance in this larva, which is probably not far removed in shape from that of the adult. Several larvæ of *Oceania languida* A. Ag., occurred with *Oceaniopsis.*

These invariably have eight otocysts instead of four, even before the ovaries were developed, and while there are but two tentacles which are opposite each other.

In connection with *Oceaniopsis* it may be well to mention a new species of *Eucheilota*, a young stage (Fig. 13) of which was taken in surface collecting at Newport last summer. This jelly-fish resembles closely the young of *E. ventricularis* McCr., but, unlike it, has only four otocysts. There are two tentacles, which arise diametrically opposite each other on the bell margin, at the junction of radial and circular chymiferous tubes. Near the base of each tentacular bulb there hang two short filaments, as in *Eucheilota*.

The otocysts are situated on the bell rim, half-way between the peripheral end of the radial tubes. Near each otocyst there hangs a short filament, not unlike those situated near the tentacular bulbs.

The single specimen taken was undoubtedly larval, and no indication of the sexual organs was seen. If the number of otocysts does not increase as the larva grows older, this Medusa is probably the young of a new genus; otherwise, it may be the immature form of some well-known Medusa like *Eucheilota*. Provisionally, therefore, I have referred it to *Eucheilota*, and designate it as the young of *E. quadralis* sp. nov.

Cladonema sp.

The genus *Cladonema* has up to the present time never been taken from American waters. A species of this genus, found by Dr. C. O. Whitman near Key West City, in 1883, is in certain particulars different from the *C. radiatum* Du Jardin, and may be found, on a more extended study, to be a new species.

Cladonema was found with *Cassiopea* on the shoals near Fleming's Key.* At the time of capture it was apparently at or very near the sea bottom, and was brought up in a dip-net with sand from the shoal.

The bell is almost spherical, and is destitute of an apical projection. The outer surface is smooth, and the bell walls thin. No indication could be seen, either in sketches of the animal when alive or in the preserved specimen, of a cavity at the base of the proboscis called a "brood sac" in the related genus *Dendronema*.

There are nine chymiferous tubes in the bell walls. Of these tubes, six only originate from the base of the proboscis. Three chymiferous tubes pass directly without sudivision from the proboscis to the bell margin, and three bifurcate a short distance from their origin. The three bifurcating tubes alternate with those which do not divide.

There are nine large tentacles hanging from the bell margin, each at an extremity of a chymiferous vessel. At the base of each there is an "eye-spot" of black color. Two kinds of lateral branches arise from the tentacles. The first

* A mangrove key, a short distance north of Key West, Florida.

kind hang in a small cluster from the under side of the tentacle, not far from the origin of the same from the bell margin. They are said to bear suckers at their distal ends. In the single specimen this structure could not be made out. The second kind of appendages to the tentacles are more slender than the former, and bear along their sides small lasso-cells. These branches are longer and appear more flexible than the former. The manubrium extends from its origin from the inner bell walls to the vicinity of the bell opening. The number of oral tentacles is probably five. Six small lateral projections on the outer walls of the manubrium, about midway its length, indicate the future ovaries or sexual organs.

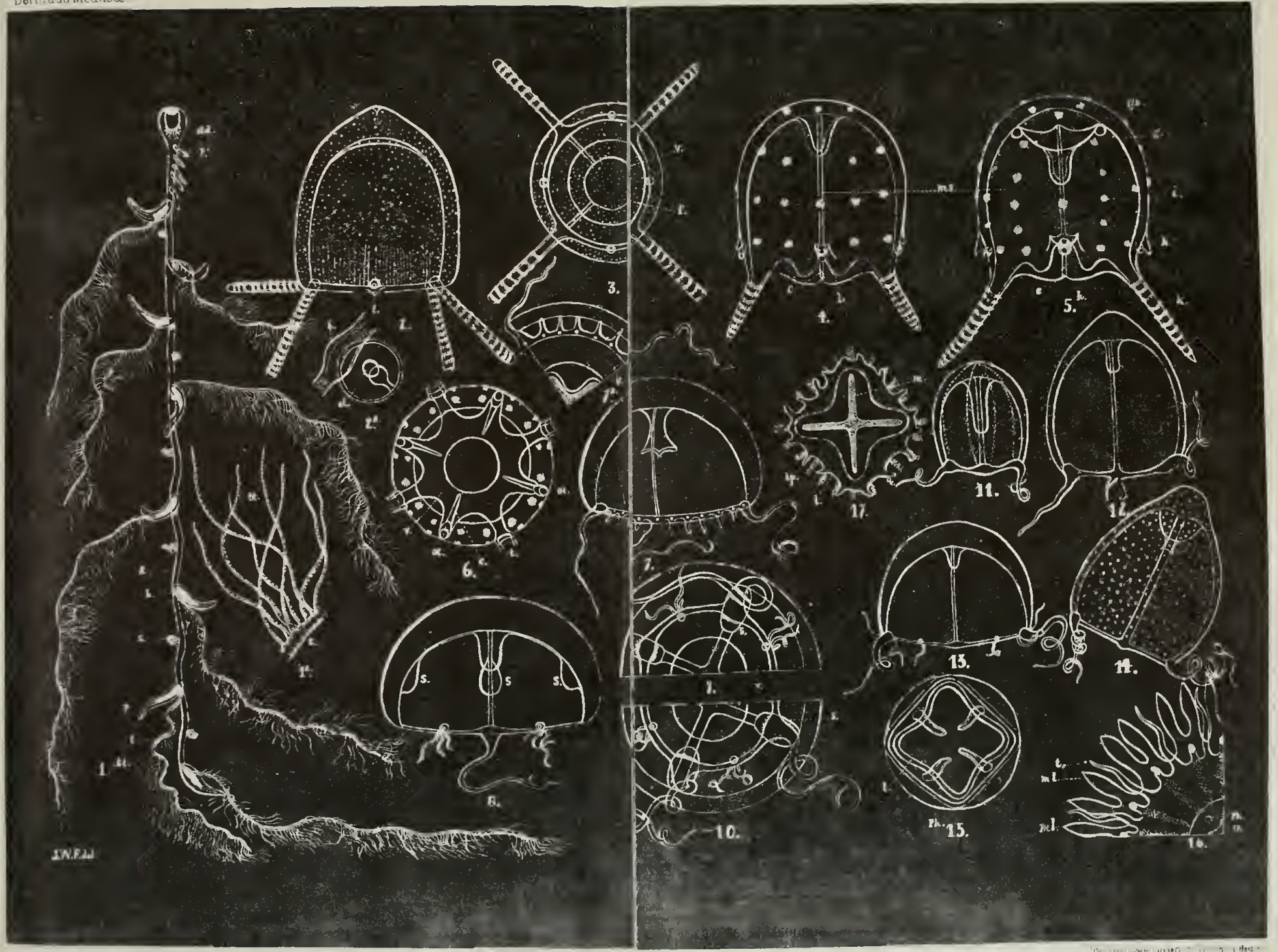
Cambridge, August, 1883.

EXPLANATION OF THE PLATE.

a. Axis.
a a. Float.
b. Contents of polypite (Alga?).
c. "Peroniæ."
d. Extension of bell cavity into the "velarium."
e. Projection of the bell margin near an otocyst.
f. Mouth (opening into a gastric cavity).
g. Projection into the bell cavity from which the stomach hangs.
h. Hood.
i. Cluster of nematocysts.
k. Annulations formed by rows of nematocysts on the tentacles.
l. Lips.
l p. Labial papillæ.
m. Mouth.
m l. Marginal lappets.
m s. Muscular bands.
o c. Otocyst.
p. Polypite.
p h. "Phacellen." Sexual filaments.
s. Sexual organs.
t. Tentacles.
t t. Tentacular appendages.
v. Velum.

Fig. 1. *Rhizophysa Eysenhardtii* Geg.
" 1ª. Portion of a tentacle of *R. Eysenhardtii.*
" 2. Young of an unknown Medusa.
" 3. The same from below.
" 4. Larva of *Tamoya punctata*, sp. nov.
" 5. Older larva of the same.
" 6. View of *T. punctata* from below
" 7. Larva of an unknown Tubularian.
" 7ª. The same from below.
" 8. *Oceaniopsis Bermudensis* gen. et sp. nov.
" 9. View of half of the same from below.
" 10. The same, from larva somewhat older.

Fig. 11. Larva of *Ectopleura* sp.
" 12. Larva of an unknown Tubularian.
" 13. *Eucheilota quadralis* sp. nov.
" 14. Larva of an unknown Tubularian.
" 15. "Phacellen" of very young *Linerges*.
" 16. Quadrant of the Ephyra of an unknown Discophore.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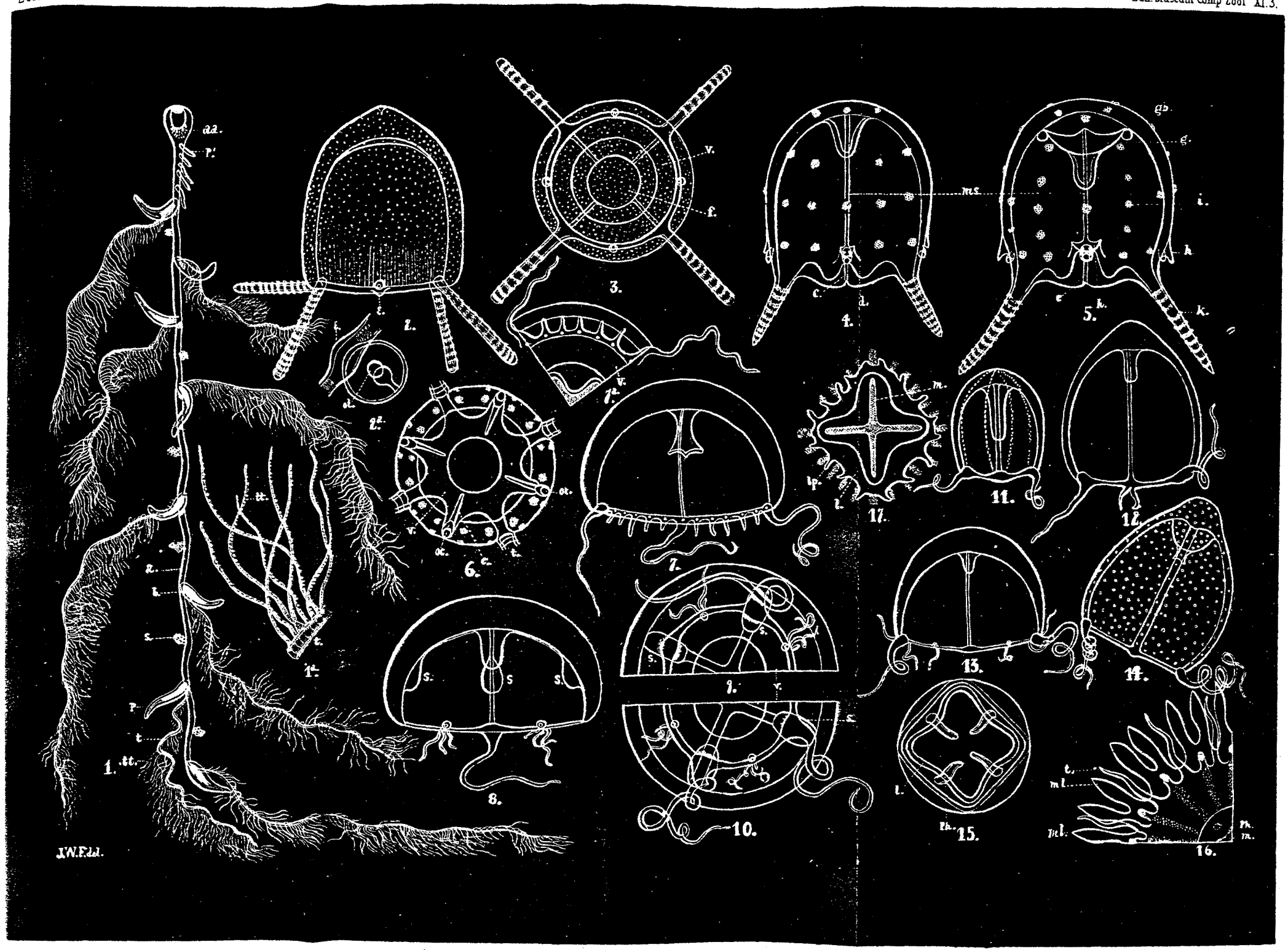

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