

7. On Medusæ from the Coast of British Columbia and Alaska. By LOUIS MURBACH and CRESSWELL SHEARER, F.Z.S.

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(Plates XVII.-XXII.*)

INTRODUCTION.

The Medusæ forming the basis of the present paper were collected by one of the authors, during a short trip to the coast of British Columbia, in the summer of 1900, in company with Prof. MacBride, of Montreal. They were obtained mostly in the immediate vicinity of Victoria Harbour, Vancouver Island, and the adjoining waters of Puget Sound. The rocky nature of the coast, shelving off rapidly into deep water, combined with the strong tidal currents of the main portion of Puget Sound which sweep in close to the shore, make this a very favourable point for the collection of pelagic life. Victoria Harbour itself, almost completely land-locked and several miles in length, affords shelter for many Medusæ not found in the more exposed and open waters of the Sound.

We are indebted to Prof. Kincaid for kindly placing at our disposal a small but well-preserved collection of Medusæ from Alaska and the region of Puget Sound about Port Townsend. The range of our original collection has been considerably extended, and we have obtained valuable material for comparison from different localities. While the number of species obtained is small, we have been fortunate in securing numerous examples of almost all of these. Where only a few individuals of a species have been obtained, doubt has been expressed as to identity. Measurements apply to material preserved in 3 per cent. formalin in sea-water.

Our best thanks are due to Dr. Newcomb, President of the Natural History Society of Victoria, B.C., for the facilities he kindly afforded us in collecting and for much general information regarding the fauna, for which we feel deeply grateful, and to Mr. Adam Sedgwick, of the Morphological Laboratory, Cambridge, for placing the resources of the Laboratory at our disposal.

The list of species represented in the collection is as follows:—

Codonium apiculatum, sp. nov.†

Syndictyon angulatum.

Diphyrena dolichogaster.

* For explanation of the Plates, see p. 192.

† This list, with a brief notice of the new species, has been published in the 'Annals and Magazine of Natural History,' ser. 7, vol. ix. (1902).

Turris brevisconis, sp. nov.
Hippocrene mertensi.
Thaumantias cellularia.
Polyorchis minuta, sp. nov.
Probosciodactyla brevicirrata.
Phialidium languidum.
 " *gregarium*.
Mesonema victoria, sp. nov.
Gonionemus vertens.
 " *ayassii*, sp. nov.
Muggicea kochii.

A. ANTHOMEDUSÆ.

I. CODONIDÆ Hæckel

CODONIUM Hæckel (18, p. 13).

1. CODONIUM APICULUM, sp. nov. (Plate XVII. fig. 1 and Plate XXII. figs. 4 & 5.)

Specific description.—The bell is nearly one-half taller than it is broad (1.5 cm. by 1 cm.). In some individuals the difference between height and breadth is not so marked. The diameter at the velum is somewhat less than it is nearer the apex. The apical process on the external surface is small and not abruptly set off. The apical canal (Stielcanal) is likewise short but always present. The velum is well developed.

The four tentacles are rather stout, and in the contracted condition are two-thirds to one and a half times the diameter of the bell in length. They are attached to the bell-margin by large prominent tentacle-bulbs, brownish in colour, having each a distinct black ocellus. On either side of each tentacle-bulb is a large nematocyst-pad (*cf.* Grönberg, 17).

The stomach passes without distinction into the proboscis, which is cylindrical and contracted into circular ridges. The thin membranous end bears the small circular mouth, which is not lobed. The stomach is very distensible, being filled in most of our specimens with a mass of small Copepods. Often it is only the upper end, near the attachment to the bell, that is so distended; when this is the case the lower end is usually contracted and collapsed, as shown partially in Pl. XVII. fig. 1. The proboscis seems seldom to be extended beyond the velum, although, if required, it can be protruded a distance of over a centimetre.

The radial canals are very slender, and terminate in circular openings in the upper end of the narrow stomach. Above the point of their entrance into the stomach is the apical canal. In the circular folds of the stomach are masses that look like gonads; the preservation, however, was not sufficiently good enough to

make certain of this in sections. No medusa-buds were observed, although they were sought for in a large number of individuals. In sections, the lumen of the stomach-cavity is seen to be quadrangular (Pl. XXII. fig. 5). In some examples the approximation of the stomach-walls forces out the corners of this quadrangle, so that they are thrown into folds something like the condition described by Linko (25) in *Sarsia brachygaster*.

Colour.—Bell-margin and radial canals pale blue, proboscis reddish violet or light purple. Ocelli black.

Habitat.—Victoria Harbour, Puget Sound, collected by Shearer.

Discussion.—This Medusa is perhaps the commonest species in the waters of Puget Sound during the month of July. It was seen every day in great numbers, frequently the shoals or banks in places so dense as to obscure the colour of the water. The Medusæ allow themselves to drift passively in the tidal currents, once in a while making a few vigorous contractions of the bell, then remaining quiet as before. While being carried along in this manner, their tentacles are extended a considerable length behind them, one individual having been noticed with its tentacles extended a distance of over 9 cm., although its bell measured less than one centimetre in height. When suddenly taken up from the surface of the sea with their tentacles in the extended condition, they contract them quite slowly and with an irregular jerky motion, the animals taking two or three minutes to contract them to the normal length.

The size and length of the proboscis and stomach in the *Codonidae* seem to be subject to great variation; this is markedly the case in this species, in which it varies from a short stump several millimetres long to a condition in which the stomach protrudes almost beyond the velum. One individual of *C. apiculatum*, kept for several days in a small jar of sea-water, had a habit of resting about half a centimetre from the bottom of the jar, allowing its proboscis to drop down every now and again. As soon as this touched the bottom it was rapidly withdrawn into the bell, and then slowly allowed to drop down again. Many examples of this Medusa which have been preserved in formalin show interradial contractions of the bell-surface, giving it a cubical appearance; these contractions are not present in the living condition, and are caused by preservation. It may be contractions similar to these which Hineks (22) mentions as interradial on the bell of *Sarsia (Codonium) pulchella*, and which Haeckel calls "inter-radial furrows" in the same species. The examination of a large number of individuals shows considerable variation both in the size of the bell, the shape of the apical canal, the general shape of the proboscis, and in the length of tentacles. Apart from these variations, its specific distinctive characters would seem to be: the truncate shape of the bell; the small apical process on the exumbrella; the short pointed apical canal, which is never knob-shaped; the

pear-shaped tentacle-bulbs, having each two nematocyst pads; the relatively short proboscis and tentacles.

Fewkes (14) has described a Medusa from the Southern coast of California under the name of *Syncoryne rosario*, the hydroid form of which he thinks is the *Coryne rosario* of Agassiz. Although he figures it with no apical process it is undoubtedly a true Codonid. It seems to be very closely related to our species, so far as can be determined. Possibly it is a southern variety, or possibly the two are identical. From Fewkes's description it is difficult to definitely identify his species. While it is possible to determine little from his figures and description (the latter answering for almost any known Codonid), it seems his species possess a rather sharp conical bell, no apical process, and a proboscis a third shorter than in our species. On the other hand, if he identifies it with *Syncoryne* or *Coryne rosario*, then from what we know of Agassiz's (2) description of this medusa, the bell would not be so pointed, and the proboscis would be longer than in our species. In a memoir published the same year as the paper mentioned above, but in a different journal (15), Fewkes names it *Syncoryne occidentalis*, sp. nov.; no reference is made to his former paper or classification, the same drawing and description being used for both papers. It is unfortunate, after finding this Medusa in such abundance at different places on the Californian coast, he has not given us a more definite description.

Brown (8) has remarked, in speaking of *C. pulchellum*, that while he has always found the apical process (the "Scheitel-Aufsatz" of Haeckel) present, the "Stielcanal" is frequently very difficult to distinguish and is sometimes absent. In *C. apiculum* absence of the "Stielcanal" was never observed, although numbers were examined with this point in view. On the other hand, the apical process, or "Scheitel-Aufsatz," was very poorly marked in some individuals, especially in small and young specimens, some of which had the sharp conical bell shown in Fewkes's figure (14, pl. xxv. fig. 7).

Agassiz (2) in his figure of *Coryne rosario*, p. 177, represents it as possessing a "Stielcanal" but no apical process, the top of the bell being rounded. Haeckel (18) divided the original genus *Sarsia* of Forbes into the two genera *Codonium* and *Sarsia*. *Codonium* is characterised by the possession of an apical process and "Stielcanal," *Sarsia* by their absence. While Haeckel places the *Sarsia pulchella* of Forbes under *Codonium* (this species, according to Brown, sometimes having the "Stielcanal" absent), he has retained the *Coryne rosario* of Agassiz under *Sarsia*, although Agassiz plainly represented it with a "Stielcaual." Both these forms possess certain characters of each genus.

Codonium apiculum differs from *C. princeps* in the shape of the bell, the tentacles, and the tentacle-bulbs. It also differs

from *C. princeps*, figured by Grünberg (17), in the shape of the bell, the proboscis, and the tentacle-bulbs. It differs from *C. codonophorum* in the shape of the bell and of the peduncle, this species producing medusa-buds. It differs from *C. pulchellum* in the shape and size of the bell and the tentacles: this species again produces medusa-buds. Brown (8, p. 473) states that he has found medusa-buds in the young of *Amphicodon fritillaria*, *Margellinum octopunctatum*, and *Lixia blondina*. He thinks that it is probably characteristic of the immature condition to produce medusa-buds, while in the adult condition there are gonads on the stomach. For this reason he considers it probable that *C. gemmiferum* and *Sarsia prolifera*, which both produce medusa-buds, and are regarded as distinct species, will ultimately prove to be only the early stages of other known species. The peculiar shape of the bell in Haeckel's (18) *C. conicum* (Nachtrag, p. 634) can hardly be compared with *C. apiculum*. It is also different from *C. gemmiferum* in the size and shape of the bell, the tentacles, and the tentacle-bulbs. The last-named species also produces medusa-buds.

The various species at present included under the family Codonidae certainly need careful revision; until more is known of their individual life-histories it is difficult to estimate their systematic value. Undoubtedly, as Brown has suggested, many will prove to be immature stages of other species. Whether this will be the case with *C. apiculum* can only be said when its life-history is known. Without any knowledge of this it is difficult to find a place for it under any of the species already known.

SYNDICTYON A. Agassiz (Haeckel, 18, p. 20).

1. SYNDICTYON ANGULATUM (Mayer).

Specific description.—In outline the shape of the bell is that of a truncated oval, 1.5 mm. high by 1 mm. broad at the velum. In the preserved condition it has the peculiar quadrangular form mentioned by Mayer (27, p. 5) in his recently described species *S. angulatum*. The wall of the bell is thin and is usually covered with nematocysts, but these are absent in some examples. In all but one of the specimens there is a depression in the top of the bell, and this is met by a canal from the subumbrellar surface forming a complete tube through the apex of the bell. This is the remains of the canal originally connecting the animal with its hydroid form.

The velum is well developed. The four tentacles are much contracted, apparently swelling at their distal ends, and covered with rows of nematocysts arranged in a spiral manner. The tentacles are attached to the bell-margin by means of large tentacle-bulbs, which bear on their outer surface a slight elevation containing the ocellus (*cf.* Mayer, *loc. cit.*).

The base of the stomach is small, gradually enlarging into a cylindrical proboscis, which extends from nearly two thirds to the whole length of the bell. In the contracted condition it is more spindle-shaped. The mouth is small and circular, without lobes or folds.

The radial canals are four simple tubes running from the highest point of the stomach to the circular canal. The latter runs near the inner wall of the bell and makes the quadrangle that is seen from the under surface in Agassiz's figure (2, p. 178) of *S. reticulatum*. No gonads are to be distinguished.

Colour.—Bell light brown, proboscis yellow, ocelli black.

Habitat.—Victoria Harbour, collected by Shearer.

Discussion.—The presence of urticating-organs on the exumbrellar surface of the bell (unless they are arranged in a definite manner retained in the adult stage) used as a generic character by Hæckel (18) is invalidated by the fact that these structures occur in many young Medusæ, e. g. *Aurelia flavidula*, *Dinematella carosa* (Fewkes), *Proboscoidactyla flavicirrata*, *Gonionemoides geophila*, *Polyorchis penicillata*, and the young of *Sarsia*. This is emphasised by Agassiz's statement that this character is lost in the adult *Syndictyon*. The bell in one of our examples was entirely free from nematocysts. Agassiz (2) indicates a similar apical canal in his *S. reticulatum* just freed from the polyp-nurse (fig. 291, p. 178).

The absence of gonads, the presence of this apical canal, and the presence of urticating-organs on the exumbrellar surface of the bell indicate the immature condition of our examples. Possibly they may be the young of some other species; it has been placed under the species it resembles most. *Syndictyon angulatum* was found by Mayor (27, p. 5) off Turks Islands in the Bahamas.

DIPURENA MacCrady.

1. DIPURENA DOLICHOGASTER (Hæckel, 18, p. 25).

Specific description.—The bell is a low truncated cone, 2 mm. high by 1.75 mm. broad in the region a little above the tentacles. From this, its widest diameter, the bell draws rapidly inwards, ending in a rounded cone-shaped top. The velum is narrow. The four tentacles are small and rather spindle-shaped, and in the contracted condition are surrounded by six or seven rings or welts of urticating-organs. The end-rings cause the appearance of bulbs at the base of the tentacles.

The tentacle-bulbs are very large in proportion (1.5 by 1.25 mm.) to the other organs, somewhat crescent-shaped, seated in a curved depression on the bell-margin. On the outer end of each bulb there is an eye-spot.

The digestive cavity is a large cylindrical tube hanging down a

distance of about two-thirds the length of the bell-cavity. The proboscis is long, and the mouth a plain circular opening. The radial canals run from the tubular end of the stomach slightly upwards and then downwards to the circular canal of the bell-margin. Their course is marked by refractive granules which look like nematocysts, but which are not regularly arranged. No gonads were seen; it is probable the single example obtained was immature.

Colour.—Organs pale blue.

Habitat.—Victoria Harbour, collected by Shearer.

Discussion.—Some doubts as to the accuracy of the above identification are raised by several of the characters, the most striking being the tentacle-bulbs. Only one individual was obtained and that had been badly preserved.

II. TIARIDÆ Hæckel.

TURRIS Lesson.

1. TURRIS BREVICONIS, sp. nov. (Plate XVIII. figs. 1 & 2.)

Specific description.—The bell is 4.5 cm. high by 3.5 cm. broad at the level of the velum. It is somewhat cubical and quite massive in appearance. The general shape of the bell corresponds with Hæckel's (18) figure of *Tiara pileata* (pl. 3. fig. 7). The velum is well developed and strong. On some parts of the bell-margin there appears to be but one row of tentacles; for the greater part, however, there are two rows, arranged in a zigzag manner. The tentacles are numerous, over a hundred and forty in all. They seem quite uniform in size when mature; the smaller ones are more irregular and evidently less developed. They are coiled and show the structure peculiar to coiled tentacles, as do those of *Physalia*, the ectoderm being very much enlarged on one side, while the contractile fibres of the inner side are covered with but a thin layer. There are no special tentacle-bulbs, but the tentacles spread out, clasping the bell-margin, as Hæckel (18) has described for *Tiara pileata*. In the preserved condition no eye-spots could be made out.

The walls of the stomach are very much folded, and pushed out into pouches on either side of the radial canals, forming dependent diverticula from the angles of the stomach. There are four or five pairs of these diverticula. They bear the gonads, and are suspended to the radial canal by a double band or mesentery (cf. Hæckel, 18). The proboscis is poorly developed.

The four rather large mouth-lobes are periradial in position, scalloped, and finely fringed.

The gonads and stomach occupy less than the upper half of the bell-cavity. The radial canals are spindle-shaped in outline, Hæckel's "lanzettformig." Throughout their length they have

well-marked unbranched lateral diverticula. These diverticula are absent on the upper margin of the circular canal, and are thus unlike the condition described in *Catablema* by Hæckel.

Colour.—Bell bluish throughout; tentacles, gonads, and stomach dark red or purplish.

Habitat.—St. Paul Island, Pribyloff Islands, collected by Kincaid.

Discussion.—The large number of tentacles in double rows and the opposite position of the diverticula of the stomach, bearing gonads, are the reasons for placing this form under *Turris*. It is true that the stomach and gonads are small for *Turris*, but the size of these organs is variable. Beyond these considerations this form seems to resemble more *Tiara pileata* than any species of *Turris*. It differs from *Turris digitalis* in the smaller apical process, the size of the gonads, the shape of the radial canals, and the length of the manubrium; from *T. neglecta* in the shape of the stomach which is not cubical, in the regular opposition of gonad-pouches, and in the number of tentacles. The specific characters are:—the short conical apex, the large number of tentacles (140), arranged in two rows, the spindle-shaped radial canals having simple lateral diverticula throughout their length, the five or more pairs of gonadal pouches from each of the four stomach-lobes, the small size of these and the stomach; in these respects it approaches the condition in *Tiara*, and, lastly, in its size. *Turris digitalis*, the original *Medusa digitale* of Fabricius, is remarkable for its extensive distribution in northern waters; it is probable that *Turris neglecta* will be found to have a similar distribution. Four out of the seven genera of Hæckel's subfamily Pandæidæ have been reported from arctic waters.

III. MARGELIDÆ Hæckel.

HIPPOCRENE Mertens.

1. HIPPOCRENE MERTENSII (Hæckel, 18, p. 92).

Synonym *Bougainvillia mertensii* Agassiz.

Specific description.—The bell is nearly spherical, somewhat flattened, and contracted at its four meridional points, having thus a cubical appearance, 5 mm. by 4 mm. The velum is well developed. The oral tentacles are situated at the upper end of the proboscis—two large, one small, and one rudimentary: this last being due possibly to imperfect preservation or an abnormality of the specimen. There is a marked inequality of the tentacles and the tentacle-bulbs. The former are stout, branched at the base, each branch dividing dichotomously about six times. Two of the tentacle-bulbs are large, horseshoe-shaped, and twice as broad as the proboscis. Each bears twenty-one tentacles and as many eye-spots. The other tentacle-bulbs could not be

clearly distinguished. The radial canals are four in number, simple, and opening into the angles of the stomach. The stomach is short and broad, a short proboscis connecting it with the lobed mouth below. The gonad-masses are interradiar. No gastral peduncle could be distinguished.

Habitat.—Victoria Harbour, collected by Shearer.

Discussion.—The single specimen was so badly preserved as to render certain identification almost impossible. It has been placed under *H. mertensii*, the form it seems to resemble most. This Medusa was first described by Lesson (24) under the name of *Cyanea bougainvillii*. Brandt, five years later, described it from the drawings and manuscripts of Mertens under the name of *Hippocrene bougainvillii* Lesson, changing this again a year later to *Bougainvillia macloviana*. Lesson met with it at the Island of Soledad, while Mertens found it at St. Matthoi Island, Behring's Strait. Agassiz reports this species from the region of Puget Sound, Port Townsend, and the Harbour of San Francisco. Hartlaub (20) has suggested that Agassiz is mistaken in identifying his species with that of Mertens on account of size. Agassiz states that his specimens were larger than *B. superciliaris*, while Brandt describes the species as the size of an "ordinary pea," *B. superciliaris* measuring some 8 mm. in height; this would make *B. mertensii* of Agassiz some 9 or 10 mm. in height. Hartlaub (20) has recently given an extensive description of the Heligoland species of *Bougainvillia* in the 'Meeresfauna von Helgoland.'

B. LEPTOMEDUSÆ.

I. THAUMANTIDÆ Gegenbaur.

THAUMANTIAS Eschscholtz.

1. *THAUMANTIAS CELLULARIA* Hæckel (18, p. 129). (Pl. XVII. figs. 2, 2 a, & 2 b.)

Synonym *Laodicea cellularia* A. Agassiz.

Specific description.—The bell is rather flat, 5 to 9 cm. broad by 2.5 to 3.5 cm. high, somewhat resembling *Staurophora* in appearance. The tentacles form a fine fringe around the bell-margin, being not more than a third of its diameter in length, coiled up to their oval spindle-shaped tentacle-bulbs, which are so numerous as to almost touch one another. The number of tentacles is about 340. In specimens preserved in formalin neither ocelli nor cirri are visible. In proportion to the size of the animal the velum is narrow and delicate, being only 5 mm. broad.

The radial canals run from the circular tube of the bell-margin to the highest point in the roof of the stomach, where they cross

as ciliated grooves, a condition somewhat like that shown by Hæckel (18, pl. iv. fig. 7, for *Catablena*) (this is not to be confused with the "gastrogenital Kreuz" of *Staurostoma*). In the preserved condition the walls of the quadrangular stomach are so low that the mouth gapes widely. The crenulated, somewhat twisted, oral fringes are very characteristic, from one to one and a half times the diameter of the stomach in length. The gonads are wavy or serpentine bands depending from the radial canals throughout almost their entire length.

Colour.—Bell pale blue, bell-margin and gonads deep violet-blue.

Habitat.—Puget Sound, Victoria Harbour, collected by Shearer; Friday Harbour, collected by Kincaid.

Discussion.—The general appearance of this Medusa is very like the figure given by Forbes (16, pl. viii. fig. 1 a) for *Thaumantias pilosella*. The bell is somewhat flatter and the tentacles more numerous, the gonads are also less developed. This flat condition of the bell is very well portrayed by Brandt's (6) figure of *Staurophora mertensii* (pl. xxiv. fig. 2), which also well represents the number, colour, and appearance of the tentacles. There is a delicate shade of blue through the substance of the bell, so that when in water they would almost escape observation, if it were not for the darker colour of the bell-margin and of the tentacle-bulbs. The colour of the bell so closely matches the blue colour of the sea-water, that the Jelly-fish become indistinguishable, nothing but the dark ring of the bell-margin showing, contracting and expanding as the animals swim.

It will be seen that the shape of the bell is somewhat different from that pictured by Agassiz for this species (2, p. 127, fig. 195). There is also considerable difference in size. Agassiz's species measured 3 cm. across the bell; the majority of our specimens measured 5 cm., and some fully 8 and 9 cm.—in fact, were so large that we had no suitable jars in which to place them. Again Agassiz states that the tentacles number about a hundred, whilst in the Victoria examples there are considerably over thrice that number, this last difference being due to increase in size. The number of tentacles in each quadrant of the bell-margin is seldom the same, and not necessarily a multiple of four, no two quadrants have exactly the same number, the average for a quadrant being 84.

This species made its appearance suddenly in Victoria Harbour on July 7th 1900, in great numbers; it was abundant for three days, after which few were seen. Agassiz (2) also found it in the region of Puget Sound, July 1859. It is remarkable how readily foreign particles adhere to the bell-surface of this Medusa, little bits of debris, sand, and seaweed sticking to it with great tenacity; many of our specimens were ruined on this account. It is difficult to say in the preserved condition whether this is due

to a sticky secretion on the bell-surface or to mere roughness of this surface on which small particles become lodged. Forbes (16), in speaking of *T. pilosella*, says of the bell: "It is transparent and smooth, except on the sides towards the margin, where it is as if woolly, being invested with minute epidermic hairs composed of fibrous cells." Perhaps the presence of these foreign bodies was due to some similar condition. The question cannot, however, be settled from formalin material, as in this fluid the bell-surface takes on a peculiar scaly appearance, no woolly or hairy condition can be made out. Haeckel (18) has called attention to the similarity between this species and that reported from Greenland. Our specimens differ from the Greenland species in the possession of broader oral lobes, the bell- or bottle-shaped tentacle-bulbs, and the fact that the gonads are situated throughout the whole length of the radial canals.

II. CANNOTIDÆ Haeckel.

Subfamily POLYORCHIDÆ A. Agassiz.

POLYORCHIS A. Agassiz.

1. *POLYORCHIS MINUTA*, sp. nov. (Plate XIX. fig. 3 and Plate XXII. fig. 1.)

Specific description.—The bell is 15 mm. high by 12 mm. broad, a truncated oval with thick walls. It is broadest above the middle of its height, measuring the 12 mm. already given.

A prominent cone-shaped gelatinous peduncle depends from the bell-roof, and to this the stomach, the upper ends of the radial canals, and the gonads are attached. The bell is drawn in towards the mouth so that its diameter at this point is only 9 mm. The lower truncated edge of the bell is nearly as broad as the velum. This is strong and 2.5 mm. in breadth. There are eight delicate adradial lines running meridionally in the bell-substance.

There are 55 tentacles—26 large, 20 medium, and 9 rudimentary. There are nine more spaces, so that 64 tentacles should be present in all. The hollow tentacles are stout and taper to form a rather long root at their proximal end. They are slightly swollen just at the junction of the root and tentacle proper forming the tentacle-bulb. The mature tentacles which are attached to the bell-margin by these long roots are carried very much as shown in Pl. XIX. fig. 3. Small tentacles during growth move outward on the lower truncate bell-margin, producing thus the appearance of several rows one above the other. On some of the tentacles there appear smooth areas free from nematocysts, whereas, as a rule, the whole surface of the tentacle is usually covered with large and small nematocysts.

The ocelli are yellowish green in the preserved condition, and

situated on an elevation on the outer side of the tentacle-base, where the latter leaves the margin of the bell. No otcysts are present. The stomach rests with a small angular base on the gelatinous peduncle, receiving at this level the radial canals. It then widens into a pouch, becoming again constricted into the proboscis which bears the mouth below. In the living condition the digestive cavity is circular in outline. In the distended condition it looks thin-walled. The mouth has four short lobes which turn outward. Each lobe is again lobulated or coarsely toothed. The four radial canals are well marked, cylindrical tubes running direct in their course. They pass from the angles of the stomach upward along the peduncular cone to the highest point of the subumbrellar space and then descend directly to the circular canal of the bell-margin. Along the whole course of these radial canals short lateral diverticula are given off, the ends of the canals alone being free from them. Only a relatively small number of diverticula on one side of a radial canal are placed opposite those on the other side of the canal. None are branched or have their ends enlarged in a club-shaped manner. On either side of each radial canal there are about 32 of these diverticula. They are shorter near the ends of the radial canals, where these approach the bell-margin being mere protuberances. Gradually towards the middle of the bell they increase in length, until they measure about twice the diameter of a radial canal in length.

The gonads are long finger-shaped processes dependent from the proximal part of the radial canals, the part most free from diverticula. There are eight gonads in each of the four groups, the central ones being the longest and reaching to the level of the velum. The outer shorter gonads may be mere rudiments. The latter cannot be mistaken for diverticula, being thicker and hanging free in the subumbrellar cavity. There are a few small diverticula on the radial canals over the region where the gonads are attached.

Colour.—Transparent and colourless except the gonads and tentacles, which are tinged a pale yellow in preserved material.

Habitat.—Puget Sound, collected by Kincaid.

Discussion.—In Agassiz's figure (2) of *P. penicillata* only 22 of the diverticula are on an average arranged opposite one another on the sides of the radial canals. It is very doubtful if any importance can be attached to the position of these diverticula; certainly their opposite arrangement is unworthy the generic importance assigned it by Haeckel (18). In the generic diagnosis, p. 149, he says of the radial canals of *Polyorchis*: "...im Distal-Theile mehrere Paar von gegenständigen geschlechtslosen Fiederästen tragen." Both Eysenhardt & Chamisso (12) and Eschscholtz (11) represent the diverticula on the course of the radial canals, in their figures of these Medusæ, by cross-lines drawn at right angles to the canals; this produces the appearance

of the greatest regularity in the arrangement of the diverticula, exactly opposite one another. As a matter of fact, this opposite character arises only from a crude manner of representation. Probably this kind of symmetry is as little marked in them as in *P. penicillata* or *P. minuta*; for these reasons in future this character should be omitted from the generic diagnosis. Fewkes (14) draws the diverticula in his species opposite, yet identifies it with *P. penicillata* of Agassiz. Our specimens approach the species of Fewkes more than they do the original descriptions given by Agassiz for this same species. Agassiz (2) obtained *P. penicillata* in the region of Puget Sound, and also on the coast as far south as the Harbour of San Francisco, where he found it very abundant; Fewkes collected his examples at Santa Barbara and Santa Cruz on the southern coast of California. He does not doubt that these southern examples belong to the same species Agassiz described as *P. penicillata* from a more northern range. As already stated, this revised version of *P. penicillata* by Fewkes approaches very closely *P. minuta*; in fact we have only ventured to give it separate specific rank on account of size, a feature of no very great importance. We only attach importance to it here because our form was evidently mature, the great development of the gonads, the number and length of tentacles making this almost certain. Yet the height of the bell is 15 mm. in *P. minuta*, as compared with 40 or 50 mm. in the *P. penicillata* of Agassiz and Fewkes. While Fewkes identifies his species with that of Agassiz, as already stated, if his drawings and descriptions are accurate there would seem to be striking differences between the two. Some of these are the shape of the bell, which is broader, a less developed condition of the diverticula on the ends of the radial canals next the circular canal of the bell-margin, the club-shaped even branched ends of these diverticula, the position of the gonads on the part of the radial canals descending to the stomach, while Agassiz (2) states they are "attached at the highest point of the four chymiferous tubes."

Agassiz figures four gonads in each group, and these reach halfway to the velum; Fewkes figures eight, and these reach almost to the level of the velum. Although Agassiz only figured four gonads, Fewkes says he subsequently found their number to be much greater. We should hesitate, however, in emphasising these distinctions, for Fewkes, as assistant to Prof. Agassiz, had doubtless ample opportunity of referring to the original specimens and notes of Agassiz.

Agassiz considers his species to be the same as that described by Eschscholtz (11) under the name of *Melicerium penicillatum*, p. 106. Eschscholtz gives a very short description and poor figure, from which it is hard to determine anything exact. It was found by Eschscholtz on the coast of California. Haeckel (18) follows Agassiz in arranging this species under *P. penicillata*,

although he thinks they may possibly be different; in this event he proposes that it should be called after Eschscholtz. Blainville (4) gives a description and coloured figure of the *Melicerium penicillatum* of Eschscholtz, but these are copied directly from Eschscholtz without further additions.

So far as can be judged, the species figured by Eschscholtz was not based on immature specimens, considering the number and length of the gonads, the tentacles, and the height of bell. From the papers of Agassiz and Fewkes we are familiar with the young stages of the Pacific species of *Polyorchis*; these are quite different in essential points from Eschscholtz's drawing of the form which he took off the coast of California (11, fig. 4, pl. viii.). The eight long tentacles, four radial and four interradial, are out of all comparison with the four rather large tentacles at the ends of the radial canals in the young stages figured by Fewkes. It is to Agassiz (2) that we owe the present name of *Polyorchis*, Hæckel (18) retaining this name and placing it under the Leptomedusæ, family Cannotidæ.

Of the three species already known, by far the most interesting is *P. campanulatus*, originally described as *Medusa campanulata*, by Eysenhardt and Chamisso (12). Here the bell is much lower and more conical than in the other species. It is eight-sided, and the sides meet in angles. These characters, combined with the position and structure of the gonads as found in all *Polyorchis*, are remarkably like what is found in the Aglauridæ. For instance, the long finger-shaped gonads of *Aglantha* in position and structure are very strikingly similar to the gonads in *Polyorchis*, although they are more numerous. While there are never more than four radial canals in *Polyorchis*, as compared with the eight of the Aglauridæ, no great significance can always be attached to the number of radial canals.

The possession of free "Hörkolbchen" by the Aglauridæ would seem to separate them definitely from *Polyorchis*, although there are Leptomedusæ, such as *Laodice*, which possess the true endodermal sense-clubs of the Trachomedusæ. The most distinctive character between these two groups is the possession by *Polyorchis* of diverticula on the radial canals, but these undergo marked change during the growth of the animal. Hardly distinguishable in the young, they become apparent as the animal increases in age; this points to their being a recent acquisition in the evolution of the race, probably within the limits of this particular group.

Of the three species of *Polyorchis* at present known, two are from the Pacific, the third from the Adriatic. It has already been mentioned that Agassiz (2) found *P. penicillata* in the region of Puget Sound, while Fewkes (14) found it as far south as Santa Cruz on the southern coast of California; it would seem to be, therefore, one of the few *Medusa*-forms common to both the northern and southern fauna of the West Coast of N. America.

PROBOSCIDACTYLA Brandt.

1. PROBOSCIDACTYLA BREVICIRRATA Haeckel (18, p. 160).

Synonym *P. flavicirrata* A. Agassiz.

Specific description.—The bell is a truncated oval, 7 mm. high by 6 mm. broad; the subumbrellar cavity occupies less than half this bell, leaving a clear thick mass of jelly forming the roof of the dome. Agassiz has well represented this in his figure in the *N. A. Aculephæ* (2, fig. 280, p. 173). The velum is quite narrow. The tentacles are short, and number in our largest specimen 54, being half as long again as the diameter of the bell. Small tentacle-bulbs bear the dark ocelli, and young tentacle-buds are seen between some of the older ones. Seen from the aboral side, an opaque cross marks the position of the four lobes of the stomach, on which a portion of the gonads rest. The lower portion of the stomach is more cylindrical, ending in the tubular much-folded mouth. This sometimes appears as four double folds, curved outwards and upwards. The gonads lie in the interradial folds of the stomach, and pass out along the unbranched portion of the radial canals. The radial canals branch twice dichotomously, and then somewhat more irregularly, so that there is finally a canal for each tentacle. Between the terminal branches of the radial canals are blind delicate canals running in centripetally from the margin of the bell, reaching halfway up. These canals are on the exumbrellar surface, and do not appear to be hollow in section; the radial canals are nearer the subumbrellar surface. Nematocysts are seen scattered in clusters along these tubes at varying intervals, so that many masses of nematocysts may be found along the course of one tube.

Colour.—The stomach is a dirty yellow. Agassiz (2) states that this Medusa is quite transparent. Whilst this is true of the upper part of the bell, the thick yellow mass of the stomach renders the lower portion quite opaque. Preservation in formalin seems to have caused considerable shrinkage: our measurements apply to preserved animals.

Habitat.—Victoria Harbour, collected by Shearer; Pleasant Beach, collected by Kincaid.

Discussion.—Nothing was seen answering to Agassiz's (2) description of the granular covering of the bell, except the patches of nematocysts already mentioned scattered here and there along the centripetal canals. Haeckel (18) has thrown doubt on the presence of nematocysts on these canals; they are so well marked in all our examples that it seems strange he should have overlooked them.

This Medusa was first found by Martens on the coast of Kamchatka. Agassiz (2) reports it from the region of Puget Sound, but Haeckel considers Agassiz's species different from that of Mortens, naming it *P. brevicirrata*. These names are liable to give rise to some confusion. It is very doubtful if this

separation is justifiable, seeing that Brandt seems to have misunderstood the structure of his species. We should hesitate, therefore, to base any distinctions on his account.

III. EUCOPIDÆ Gegenbaur.

PHIALIDIUM Leuckart.

1. PHIALIDIUM LANGUIDUM Haeckel (18, p. 185).

Synonym *Oceania languida* A. Agassiz.

Specific description.—The bell is hemispherical, about 12 mm. in diameter by 6 mm. high. It is folded in the peculiar manner described by Agassiz (2).

The velum is narrow and delicate. The tentacles all told number sixty, some closely coiled, others straight. The tentacle-bulbs are somewhat smaller here than in *P. gregaria*, the tentacles being sharply set off from the bulbs. There are two otocysts between each two tentacles.

The stomach is small and cross-shaped, the arms of the cross receiving the radial canals. There is no proboscis. The curled and fringed oral lobes are about the same length as the arms of the stomach cross. The four radial canals bear the gonads on their distal half. They are oblong linear bodies, one-third the length of the radial canals, attached to their outer half, but not reaching quite to the circular canal of the bell-margin.

Colour.—Greenish blue.

Habitat.—Victoria Harbour, collected by Shearer.

2. PHIALIDIUM GREGARIUM Haeckel (18, p. 188). (Plate XX. figs. 1 & 1 a.)

Synonym *Oceania gregaria* A. Agassiz.

Specific description.—The bell is 12 mm. by 7 mm., and so nearly hemispherical. The velum is quite small. Of the tentacles and buds destined to develop there are sixty. The tentacle-bulbs are spherical and relatively large. The otocysts are evenly distributed, one or two between consecutive tentacles; they usually contain one, sometimes two otoliths.

The stomach is very small, quadrangular, receiving the delicate radial canals at its angles, and ending in the four perradial, moderately long, curled, and fringed oral lobes. There is no proboscis. The four radial canals run from the angles of the stomach to the circular canal, bearing on their distal half or third the gonads, which, however, do not reach quite to the circular canal. As the gonads are very narrow linear bodies, our specimens may be immature. This is borne out by the size and number of small tentacles.

Colour.—White, becoming slightly brown on preservation in formalin.

Habitat.—Puget Sound, collected by Kincaid; Victoria Harbour, collected by Shearer.

Discussion.—The principal points in which this species approaches the Pacific form given by Agassiz and Mayer (3) are the large size of the tentacle-bulbs, the distribution of the otocysts and their contents. It differs from it in the shape of the simple oral lobes, the tentacle-bulbs, and the position of the gonads. Several of our specimens seemed to agree more closely with *P. variabile* than with *P. gregarium*, apparently the only difference being in the number of tentacles. From Claus's paper (10) it would seem that cirri are present in all the *Phialidia*, and that they are usually on the sides of the tentacle-bulbs.

Haeckel distinguishes three species of *Phialidium*—*P. variabile*, *P. languidum*, and *P. gregarium*. Maas (26) departs from Haeckel in retaining the species *P. flavidulum*, with its larger number of otocysts and tentacles, Haeckel placing it under *P. variabile*. Haeckel has arranged some twenty or twenty-five names under *P. variabile* as synonyms; the original descriptions of many of these, as Brown has remarked, are far too vague for their identification to-day. Brown (8) distinguishes as distinct from Haeckel's species *P. buskianum*, *P. temporarium*, and *P. cymbaloideum*. The great variability in the members of this group renders it especially difficult to determine the value of the various species until their hydroid forms are recognized.

Agassiz (2), in speaking of *Oceania languida* (*P. languidum*), remarks on the extraordinary attitudes assumed by this Medusa. One of these attitudes is given in fig. 102, where the animal is rolled up upon itself, the opposite edges of the bell coming together. Many of our examples exhibited this peculiar attitude, while others were folded in a three-cornered manner, something like the attitude in which Brandt (5) pictures his *Staurophora mertensii* (pls. 24 & 25).

The specimens from Prof. Kincaid's collection also exhibited these attitudes. They were taken from a different part of Puget Sound.

IV. *ÆQUORIDÆ* Eschscholtz.

MESONEMA Eschscholtz (Haeckel, 18, p. 225).

1. *MESONEMA VICTORIA*, sp. nov. (Plate XIX. figs. 1, 1 a, & 2, and Plate XXII. fig. 2.)

Specific description.—The bell is hemispherical, 7 cm. broad by 3.5 cm. high, tapering to a thin flexible margin. A well-developed velum is present. Tentacles numerous, over 100, shorter than the diameter of the bell. In the same row with the tentacles are found numerous small papillæ, sometimes between the tentacles, sometimes below them. Otocysts and excretory papillæ are present. The gastric cone is not pedunculated, but is lens-shaped and almost hemispherical. Stomach about the

same depth as the oral peduncle, being very wide at the top, almost half the diameter of the bell. Mouth much lobed, the lobes being narrow, pointed, and finely toothed. There are half as many lobes as there are radial canals. There are about a hundred radial canals; these run from the peripheral canal inwards and upwards to the highest point of the stomach. Each radial canal is covered on its outer surface by a ridge of glandular cells. Sometimes these are continued over the stomach and oral peduncle down to the lobes of the mouth, giving an appearance similar to that presented by the ovaries of *Orchistoma*. The two kinds of umbrellar papillæ are present.

Colour.—Organs and bell-margin white, with a very slight trace of blue in the larger tentacles.

Habitat.—Victoria Harbour, Esquimalt Harbour, collected by Shearer; Pleasant Beach, collected by Kincaid.

Discussion.—On first examination this Medusa was taken to be *Orchistoma*. That it is an undoubted *Alcyonid* is borne out by the presence of marginal vesicles, of which there are one or two between successive tentacles, the absence of eye-spots, and the presence of excretory papillæ under the velum. The papillæ which are in the same row as the tentacle-bells are young tentacles. Brandt describes (6) bodies on the inner side of the bell-margin which Hæckel is probably right in considering to be excretory papillæ. Brandt speaks of them as follows (p. 361):—"An der innern Seite der Basis des Saumes findet sich eine Anzahl kleiner, tassenförmiger, an Gestalt der Cupula einer Eichel nicht unähnlicher Körperchen." No mention is made as to their relation with the circular canal, and Brandt thinks they are the rudiments of a third row of tentacles. Evidently Mortens did not observe whether they were inside the velum, and perhaps his remarks refer to the young tentacle-bells we have described above in *M. victoria*, and not to the true excretory papillæ under the velum. Some slight confusion has arisen over the position of these papillæ. Hæckel (18) and Hertwig (21) describe umbrellar papillæ, which are outside the velum (centrifugal), which are, according to them, blind tentacle-bases, or spurs, possessing no openings. Distinct from these are the subumbrellar papillæ, inside (centripetal) to the velum, arranged one opposite each marginal tentacle-spur on the outside; they are connected by an opening at their apex with the circular canal of the bell-margin, and have been interpreted as excretory in nature. Hæckel (18) expressly states (p. 119) that they are inside the velum, and thus in the subumbrellar cavity; yet in pl. xi. fig. 13 of the same work he shows them as if they were in the same row with the tentacles on the external surface of the bell-edge, and thus outside the velum; from his figure it is impossible to make out their true position under the velum*. Mayer (28) has described centrifugal excretory papillæ on the

* Since the above was written, it has been found that Claus (10, p. 13) makes practically the same comment, although his figures 29 and 30 are not clear.

tentacle-bulbs of *Zygodactyla cyanea*, which are not true excretory papillæ in which an opening is present, but probably simple tentacle-buds or spurs. Agassiz (2) has described similar structures in a number of *Æquorids*, as *Rhagmatodes tenuis*, *Zygodactyla granlandica*, *Æquorea albida*. Possibly in some cases these may be the true excretory papillæ which he has seen but misunderstood, or they may be simple tentacle-spurs, and so entirely different structures; his descriptions and figures do not make this clear: if they are excretory papillæ he does not recognize their structure and proper position. Milne-Edwards (30) speaks of tubercles on the bell-margin of *Æquorea violacea*, "ayant la forme d'un petit mamelon" (pl. i. fig. 1 c, d), which may be these excretory papillæ, but here, again, their structure is not recognised. It is to Metschnikoff (31) that we are indebted for the first correct description of these structures; he was the first to recognise their position under the velum, the opening in the apex, and their connection with the circular canal. His figures are by far the best, although fig. 2, pl. v., is open to the same objection as Haeckel's figure; fig. 7 is, however, very plain.

In *M. victoria* these structures seem to have a very regular arrangement, one opposite each tentacle-bulb and one in the middle of the space between consecutive tentacles. In Plate XXII. fig. 2 is represented a section passing through the bell-margin in the plane of one of these papillæ; the opening in the apex is distinct, being connected with the circular canal by a passage lined with strong cilia. These papillæ do not seem to be present in young specimens, only the larger and older examples appear to possess them. It is doubtful if their function is purely excretory. Brandt (3, pl. v. fig. 4) shows the continuation of the radial canals into the mouth-lobes of his *Mesonema* (*Zygodactyla*) *carulescens*, similar to their continuation into the mouth-lobes of *M. victoria*, as already described. He also shows a peculiar rectangular communication of these canals, on the mouth-lobes, which is not present in our species. While collecting off the inlet of Victoria Harbour early in July, on several occasions lens-shaped masses were picked up, they were about 3 cm. broad; towards the end of the month, when this Medusa was obtained, they proved to be the central gastric peduncle from which the peripheral parts had been worn and macerated away, leaving a hard, smooth, lens-shaped mass. Fewkes has well described these from *M. cyaneum* as "... flat, slightly convex above, rounded convex below." He regards them as probably homologous with the gelatinous peduncle of genera like *Lirope*, *Geryonia*, and *Carmarina*. *M. victoria* frequently contracts the bell when disturbed in a characteristic manner, the thin flexible margin being folded in, the tentacles almost rolled under the velum, the gastric peduncle making a rounded protuberance on the upper surface of the bell. Huxley (23, pl. xxxvii. fig. 11) shows this attitude in his drawing of *Oceania*? Although the

tentacles are not rolled in and contracted, this Medusa is evidently a species of *Mesonema*. Great difficulty was found in preserving our specimens; they seemed to become very brittle on short preservation by the ordinary method in formalin, the slightest shaking of the bottle in which they were preserved causing them to break up into small fragments; the majority of our jars reached home with nothing but a mass of debris at the bottom. This Medusa was quite common about Victoria during July, and is evidently as abundant on the opposite shore of Puget Sound, being represented by numerous examples in Prof. Kincaid's collection from the vicinity of Port Townsend. When kept in captivity they can be readily observed opening the mouth widely right back to the commencement of the radial canals and then rapidly closing it again, wrapping the oral lobes into a corkscrew-shaped mass, as Haeckel (18) has represented the oral lobes in his plate of *Polyoanna fungina* (pl. xiv. fig. 4). This may be repeated rapidly over and over again. Possessing about an equal number of radial canals and tentacles, this species comes under Haeckel's subgenus *Mesonemella*, but is different from either of his two species *M. eurystoma* and *M. cyaneum* (*Zygodaetyla cyaneum* of Agassiz). Nor does it agree with Fewkes's new species (13), *M. bairdii*, because in this there are four times as many radial canals as tentacles.

C. TRACHOMEDUSÆ.

I. PETASIDÆ Haeckel.

GONIONEMUS A. Agassiz.

1. GONIONEMUS VERTEX A. Agassiz.

Specific description.—The bell is described by Agassiz as "an oblate spheroid cut in two by a plane passing through the north and south poles, the plane of intersection containing the circular tube." He also gave other features that will be embodied in this account. Preserved specimens are 1.75 cm. tall and 1.50 cm. broad, being about the same size during life. The bell is considerably taller than a hemisphere, is rather thin, and tinged a yellowish green during life. There is a slight conical depression in the roof of the stomach. The velum is well developed and rather broad stretching almost halfway across the opening of the subumbrellar cavity. The tentacles are twice the longest diameter of the bell in length, and look wiry and somewhat heavy for the size of the animal. They show the ringed welts of nematocyst well developed, standing out very prominently. There are no true tentacle-bulbs, the tapering ends of the tentacles being inserted directly in the bell-margin; but below their insertion there are rather large, oval, brown basal papillæ. Some distance from the outer end of

the tentacles there is a little nodule, the glandular sucker. There appears to be a otocyst between each pair of tentacles. The stomach appears quadrate, but is attached only along the lines of the radial canals. The proboscis is of moderate length, bringing the fringed manubrium near the velum. The four radial canals pass to the highest point in the bell and then dip under the conical depression above mentioned. The gonads are a very closely folded band hanging from the radial canals, their free border being longer than the attached border; they are thrown into folds (sinusoidally) backwards and forwards across the radial canals, like a ruffle or frill*.

Colour.—Gonads deep red, the radial canals as deep brownish lines; bell yellowish green.

Habitat.—Gulf of Georgia, collected by Agassiz; Victoria Harbour, collected by Shearer; Matsmets Bay and Puget Sound, collected by Kincaid.

Discussion.—This is the first notice of this Medusa since its discovery by A. Agassiz in the waters of Puget Sound some forty-three years ago. They were found swimming vigorously in groups of threes and fours in the outer part of Victoria Harbour at McCauley's Point, July 14, 1900. It is hard to convey an idea of the remarkable beauty of this animal as it swims with its dark crimson gonads and dense mass of tentacles thrashing the water at every contraction of the bell. Agassiz (2) also states that he never found them swimming singly, but always in numbers. He says:—"It at once attracted my attention by its peculiar mode of moving. I could see these jelly-fishes, with the tentacles spread out to the fullest extent, sinking slowly to the bottom, the disk turned downward; the moment a blade of kelp touches the disk, they stop, bend their tentacles like knees, and remain attached to the sea-weed by means of their lasso-cells, which are arranged in rings scattered thickly over the surface of the tentacles; after remaining attached in this way a moment, with their tentacles extended and mouth turned upwards, they suddenly let go their hold, turn upside down, contract their tentacles to a third of their former length, and begin their upward movement by means of short, rapid jerks, given by the sudden expanding and contracting of the tentacles as they are violently thrown out from the cavity covered by the veil. They keep up this rapid motion until they reach the surface of the water; at the instant the upper part of the disk touches the top of the water, the Medusa inverts itself,

* Haeckel (18) understood this condition to represent lateral diverticula in the radial canals something like those of *Polyorchis*. For this reason he has placed it near *Polyorchis* under the Cannotidae, whereas its true relationship seems to be under the Trachomedusae, as we have arranged it above, and not under the Leptomedusae, although it has undoubted characters of this class. It would seem to be similar to Medusae, like *Laodice*, which do not find a natural place under any of Haeckel's four orders. For Brooks (7) has shown that *Laodice* possesses the true endodermal sense-clubs of the *Trachylinae*, despite the many features that rank it with the Leptomedusae under the *Leptolinae*.

and sinks, with its tentacles fully expanded, until it reaches the bottom, or another piece of sea-weed where it attaches itself, and after remaining suspended a little while, repeats the same operation." Agassiz has emphasised this habit of turning over in the specific name *vertens*. This power of attachment is not, however, due, as Agassiz states, to the lasso-cells, but to a definite structure—an adhesive pad, an enlarged view of which is shown in Pl. XXII. fig. 3, which is situated near the ends of the tentacles, and acts like a sucker, which is sufficiently strong to tear the tentacles without loosening its hold.

This power of attachment must be of great service to the animal, for it prevents its being carried away by any struggling animal it may capture. It is quite probable this Medusa often captures animals fully as large as itself, as it readily tries to digest pieces of meat, almost twice its size, which are dropped into the bell-jars in which they are kept during captivity. These Medusæ seem remarkably hardy and remain alive in small jars of sea-water without change of water for several days.

2. *GONIONEMUS AGASSIZII*, sp. nov. (Plate XXI. figs. 1, 2, & 3, and Plate XXII. fig. 3.)

Specific description.—The bell is 9 by 17 mm., or a little taller than a hemisphere. The subumbrellar surface dips down in the centre forming a gastral cone.

The velum is rather broad, strong, and well developed.

The tentacles are shorter, more numerous than in any other species of this genus described. They number eighty in specimens of the above size. They are inserted into the bell-margin at different levels, giving the appearance of one row above another. In a moderately contracted condition they are not more than two-thirds the diameter of the bell in length. They are much thicker at the base, and taper more gradually towards the tips, than in any of the species already known. Each is provided with a small glandular attachment-pad some distance from the end (Pl. XXII. fig. 3). As already remarked, the proximal end of the tentacle is slightly enlarged just before entering the margin of the bell as in other species. This end of the tentacle is a tapering root connected with the circular canal. Just at the outer margin of the velum, under the circular canal, is a small ridge or welt of ectoderm filled with urticating-organs. It is reddish-brown in colour, the same as the papillæ below.

There are papillæ under the circular canal on the bell-margin, just below the insertion of the tentacles, containing diverticula of this canal. Their outer layer is composed of the same tissue as that composing the nettle-ridge, and of a similar brown colour. There are not so many otcysts as tentacles, though there is no definite regularity. The pigment-spots at the bases of the tentacles are not visible in the preserved condition.

The stomach is much distorted with food, but is of the usual quadrangular shape, with oral lobes finely crenulated. The four radial canals pass from the circular tube upwards to the gelatinous peduncle, under which they pass downwards to the stomach; their crossing lies deeper on this account than the point where they enter the stomach (Pl. XXI. fig. 3). They are simple.

The gonads have the frill-like arrangement on the course of the radial canals, from side to side, similar to their arrangement in other species of this genus, but they are denser and run closer to the circular canal.

Colour.—This is hard to determine from preserved material, but it is doubtless somewhat similar to the bright colours in other species of this group.

Habitat.—Unalaska, Aleutian Is., collected by Kincaid.

Discussion.—Prof. Kincaid states that this species was collected in a small salt lake in the Aleutian Islands, which was doubtless connected directly with the sea by some underground passage, as its surface rose and fell with the tide. These Medusæ were found clinging to stones by means of their attachment-pads, and when disturbed moved a short distance, then re-attached themselves again. This species probably possesses the same swimming-movements so characteristic of the other species of this genus.

As already stated, the genus *Gonionemus* was founded by A. Agassiz for *G. vertens*, which he procured in the Gulf of Georgia, July 1859. The peculiar angle formed by the tentacles being bent at the adhesive pad or sucker was sufficiently striking to suggest the name *Gonionemus* for the genus. Haeckel (18) subsequently, understanding this name to mean "kneaded threads," changed this to *Gonynema**, under which name it appears in his 'System der Medusen.' The resemblance of *Gonionemus* to *Melicertum* led A. Agassiz to place it with the latter genus in the family Melicertidae, the elder Agassiz (1, p. 348) placing it under the suborder Sertularia.

Haeckel (18) arranges four of Agassiz's genera among the Trachomedusæ, but placed *Gonionemus* in the family Cannotidae, subfamily *Polyorchinae*, believing, from Agassiz's description or drawing, that it possessed lateral diverticula on the radial canals as already mentioned.

No further notice was taken of this Medusa until one of the present writers, Murbach (32) published a short preliminary report of the occurrence of the genus in the Atlantic at Woods

* As Agassiz derived the name *Gonionemus* from *γωνία* and *νήμα*, Haeckel's assumption that the first part of the name is derived from *γωνν* is wrong, only the last part of his name is right. Yerkes, in a recent paper (Am. Journ. of Phys. vol. vii. p. 181), has changed the name to *Gonionema*, in this being followed by Perkins (Johns Hopkins Univ. Cir., June 1902). Since they correctly derive the first part of the name from *γωνία*, why does this become *Gonionema* and not *Goniaema* in the full name? In preference to further change we have retained the original name.

Holl, Mass. Here it was represented by what was thought to be a second species. Two years later Dr. Mayer confirmed this opinion, adding that Prof. Agassiz pronounced the Woods Holl form different from the Pacific form *G. vertens*, and Mayer (29) proposed the name *G. murbachii*.

Agassiz and Mayer (3) described a new species, *G. suavensis*, from Suava Harbour, Fiji Islands. Again, Mayer (28) concluded that his *Cubaia aphrodite* was really a species of *Gonionemus*. The development of *Gonionemus* seems to indicate that it belongs to the lower Trachomedusæ; there are also other features that put it in the lower Trachomedusæ, such as the position of the otocysts, gonads, the marginal welt of netting-organs, and the insertion of the tentacles. Until the life-history of one of the species is better known it is difficult for the present to determine its further position.

Provisionally, Hæckel's family Petasidae, subfamily Petaschninæ, with four radial canals, otocysts either free on the margin or enclosed, tentacles hollow, is best fitted for its reception. It might then be placed between the genera *Aglauropsis* and *Gossea*.

With the exception of the number and position of the tentacles, the above characters are so constant in the four species now known that we can look forward to their being found in all true members of the genus. The position and insertion of the tentacles will vary most.

Only a few Medusæ are recorded, *Bathycodon*, *Pectantis*, &c., in which the ends of some or all of the tentacles are provided with means for clinging to foreign objects. But these are not of the same nature nor in the same position as are the suckorial pads of *Gonionemus*. Recently, Mayer (27) has found a new Medusa, in which every fourth tentacle has an adhesive pad that corresponds somewhat with the position of that in *Gonionemus*, though unlike it in appearance. This Trachomedusa, he thinks, is closely related to *Gonionemus*, and has indicated this in calling it *Gonionemoides*. There is no reason why the presence of these pads, if morphologically the same, may not be one of the marks of relationship. The fact that the young of *Gonionemoides geophila* have pads on every alternate tentacle, not on every fourth as in the adult, may indicate that in the ancestral form they were so arranged. In this case Medusæ having adhesive pads on every alternate tentacle would be more closely related to *Gonionemoides* than to *Gonionemus*, or possibly would be intermediate forms such as *Gonionemus (Cubaia) aphrodite* Mayer, in which every other tentacle possesses an adhesive pad. Behaviour, where it is well marked or there are special habits as in this case, should enter into the characters of the genus or at least the species description. The peculiar habit of swimming to the surface of the water and turning over to float lazily downward is well marked in both *G. vertens* and *G. murbachii*, and we may

expect to find it in the other species when these are closely studied. The four species of *Gonionemus* at present known are as follows:—

1. *Gonionemus vertens* A. Agassiz (2).
2. " *murbachii* Mayer (29).
3. " *suaveusis* Agassiz & Mayer (3).
4. " *agassizii*, sp. nov.

In general appearance and structure the four species differ as follows:—

Gonionemus vertens has much the tallest bell and heaviest tentacles, longest digestive cavity, and oval large marginal papillæ.—Pacific.

Gonionemus murbachii has the bell low, the velum well developed, the tentacles very flexible, the proboscis short.—Atlantic.

Gonionemus suaveusis differs from the other species in the presence of four green spots on the proximal ends of the radial canals, in the absence of subumbrellar papillæ, and the extent and position of the ovaries.—Pacific.

Gonionemus agassizii has the bell lower than in *G. vertens*, yet taller than in either of the other two species. It has a larger number of tentacles (in fully grown specimens probably over a hundred), which are shorter and smaller than in the other species. The depression in the roof of the stomach is more marked in this species than in the others with the exception of *G. suaveusis*.—Pacific.

Species incerta. (Plate XX. fig. 2.)

The following description refers to a peculiar form, a single individual of which was collected by Prof. Kincaid at the St. Paul's Island, Pribyloff Islands. It is very badly preserved, and on this account no definite identification has been attempted.

Description.—The bell is 18 mm. high by 10 mm. broad at its widest part, a little above the region of the velum. The general shape and proportions of the bell are represented in Pl. XX. fig. 2. The bell is drawn in somewhat towards the mouth, and through this the smooth cylindrical proboscis extends a short distance. The proboscis bears four well-marked cylindrical mouth-lobes, one of these being much larger than the others and rolled up on itself, looking like a small contracted tentacle.

Connecting the four radial canals and running in the bell-substance are delicate transverse lines represented in the figure. Some of these are larger than others, and look almost like small connecting canals. The radial canals are thick, and along their

course are numerous irregular masses or enlargements, which may be gonad masses; preservation is not sufficiently good to make certain of this. They are a bright orange-yellow in colour, and become more numerous on the upper part of the radial canals towards the apex of the bell. The four short tentacles are thick and tightly contracted up to their small rounded tentacle-bulbs.

Colour.—Radial canals, and the masses along their course, bright orange-yellow. Proboscis, tentacles, and tentacle-bulbs yellowish brown.

Habitat.—St. Paul's Island, Pribyloff Islands, collected by Kincaid.

D. SIPHONOPHORA.

I. MONOPHYIDÆ Claus.

MUGGIEA Bausch.

1. MUGGIEA KOCHII Chun.

Synonym *Diphyes chamissonis* Huxley.

Specific description.—The single specimen obtained is nearer *M. kochii* than any other Monophyid, although not agreeing with Chun's description in all respects. Only one nectocalyx is present and there is no sign of another being detached. It is more pointed at the apex, and the oil reservoir is larger in proportion than those of *M. kochii*. The wings of the nectocalyx are almost smooth, except that portion below the hydroecium which is wavy in outline. The contracted condition of the hydrosoma will not warrant a more definite determination.

Habitat. Puget Sound, collected by Shearer.

Discussion.—*Muggiea kochii* is of great interest, as it was from the study of this form that Chun (9) found the interesting life-history of the Monophyids to consist of three generations, in this case of *M. kochii*, *Eudoxia eschscholtzii*, and *Monophyes primordialis*.

Chun's statement (9) that the nectocalyx of *Muggiea* is very similar to the anterior swimming-bell of *Diphyes* and *Diphyopsis* is confirmed in this case. The position and shape of the parts correspond almost precisely with Mayer's figure (28) of *Diphyes bipartita*, sp. nov. (fig. 114).

In this connection it may be noted that Fewkes (13, p. 834) in a footnote records that "specimens of a *Diphyes* (?) with but one nectocalyx are very common in the Bermudas and Tortugas." Mayer also says he found a *Diphyopsis* which has no posterior swimming-bell, and suggests the possibility that "no such structure exists." May not both these species be *Muggiea*? The specimen above described differs from Haeckel's (19)

M. pyramidalis in its shorter hydroecium, and from his other species in the toothing.

In addition to the foregoing there are a number of specimens, not in a condition for definite identification or description. So far as can be determined they seem to belong to the following species:—

- Sarsia eximia.* Two specimens
Sarsia rosario. One specimen.
Atollia bairdii. One specimen.
Obelia polystyla. One poorly preserved specimen.

Vanhoeffen (33) gives a good figure of *Atollia bairdii*, with which our specimen seems to closely correspond.

BIBLIOGRAPHY.

1. AGASSIZ, LOUIS.—Contributions to the Nat. Hist. of the U.S.A. Vol. iv. 1862.
2. AGASSIZ, ALEXANDER.—Illustrated Catalogue of the Mus. of Comp. Zool. at Harvard College. No. 2. N. American Acalphæ. 1865.
3. AGASSIZ, A., & MAYER, A. G.—Acalephs from the Fiji Islands. Bull. Mus. of Comp. Zool. at Harvard College, vol. xxxii. no. 9. 1899.
4. BLAINVILLE, DE, H. M. D.—Manuel d'Actinologie. Paris, 1834.
5. BRANDT, J. T.—Prodromus Descriptionis Animalium ab H. Mertensio observatum. Recueil des Actes de l'Académie Impériale des Sciences de St. Pétersbourg, 1833-34.
6. —. Ausführliche Beschreibung d. v. C. H. Mertens a. Siener Weltumsegelung beobacht. Schirmq. Memoirs of the Imperial Acad. of St. Petersburg, ser. 6, Scien. Nat. vol. 2. 1838.
7. BROOKS, W. K.—The Sensory Clubs or Cordyli of *Laodice*. Journal of Morphology, vol. x. pp. 287-304, 1895.
8. BROWN, E. T.—British Hydroids and Medusæ. Proc. Zool. Soc. Lond. 1896.
9. CHUN, CARL.—Ueber die Cyklische Entwl. u. d. Verwandt d. Siph. Sitz. d. kōng. Prus. Akad. d. Wiss. z. Berlin, 1882, p. 1155.
10. CLAUS, C.—Beitr. z. Ktns. d. Geryonospiden u. Eucopiden-Ent. Arbt. d. Zool. Inst. Wien, iv. p. 89, 1882.
11. ESCHSCHOLTZ, FR.—System der Acalephen. Berlin, 1829.
12. EYSENHARDT & CHAMISSE.—De Animalibus quibusdam e Classe Vermium Linneana in circumnavigatione Terræ, auspiciant Comité N. Romanzoff, duce Othone de Kotzebue annis 1815-18 peracta observatis. Acta Akad. Nat. Curiosorum, vol. x. 1821.

13. FEWKES, J. W.—Report on the Medusæ collected by the U.S. F. C. Str. 'Albatross' in the Region of the Gulf Stream. U.S. F. C. Report, 1884, pp. 927-975.
14. ——. On a few Californian Medusæ. Amer. Nat. xxiii. p. 591. 1889.
15. ——. New Invertebrates from the Coast of California. Bull. of Essex Inst. xxi. 1889. Also as separate print for the author. Boston.
16. FORBES, E.—A Monograph of the British Naked-eyed Medusæ. Ray Soc. London, 1848.
17. GRÖNBERG, G. Die Hydroid-Medusen des arktischen Gebiets. Zool. Jahrb. Syst. Abt. Bd. ii. p. 451, 1898.
18. HÆCKEL, E.—System der Medusen. 1879-80.
19. ——. Siphonophoræ. 'Challenger' Reports, xxviii. 1888.
20. HARTLAUB, CH.—Die Hydromedusen Helgoland. Meeresfauna von Helgoland. 1897.
21. HERTWIG, OSCAR & RICHARD.—Nervensystem der Medusen. Leipzig, 1878.
22. HINCKS, T.—British Hydroid Zooph. 1868.
23. HUXLEY, T. H.—On the Anatomy and the Affinities of the Family of the Medusæ. Phil. Trans. 1849, p. 413.
24. LESSON.—Zoology of the Voyage of the 'Coquille' (under Duperrey). 1830.
25. LINKO, A.—Beit. z. Ktns. d. Hydromedusen. Zool. Anz. Bd. xxv. No. 664, 1902.
26. MAAS, O.—Reports on the Explorations of the W. Coast of Mexico by the U.S. F. C. Str. 'Albatross,' during the Year 1891. Mem. of Mus. Comp. Zool. vol. xxiii. no. 1, Die Medusen, pp. 1-92, 1891.
27. MAYER, A. G.—Description of new and little-known Medusæ from the W. Atlantic. Bull. Mus. Comp. Zool. vol. xxxvii. no. 1, 1900.
28. ——. Some Medusæ from the Tortugas, Florida. Bull. Mus. Comp. Zool. vol. xxxvii. no. 2, 1900.
29. ——. The Variation of a newly-arisen Species of Medusa. Sci. Bull. of Brooklyn Inst. Arts & Sci. vol. i. no. 2, 1901.
30. MILNE-EDWARDS, M. H.—Aequorea violacea. Annales des Sciences Naturelles, 2nd ser. t. xvi. p. 196, 1841.
31. METSCHNIKOFF, E.—Medusæ and Siphonophoræ. (In Russian.) Moscow, 1871.
32. MURBACH, L.—Pr. Note on the Life-History of *Gonionemus*. Journ. of Morph. vol. xi. p. 493, 1895.
33. VANHOEFFEN, E.—Die Akalephen d. Plankton-Expedition. 1892.

EXPLANATION OF THE PLATES.

PLATE XVII.

- Fig. 1. *Codonium apiculum*, sp. nov., p. 165.
 2. *Thaumantias cellularia*, p. 172.
 2a. " " oral lobes expanded.
 2b. " " oral lobe contracted.

PLATE XVIII.

- Fig. 1. *Tunis brevicornis*, sp. nov., p. 170.
 2. " " view of oral surface.

PLATE XIX.

- Fig. 1. *Mesonema victoria*, sp. nov., p. 180.
 1a. " " portion of bell-margin.
 2. " " oral surface.
 3. *Polyorchis minuta*, sp. nov., p. 174.

PLATE XX.

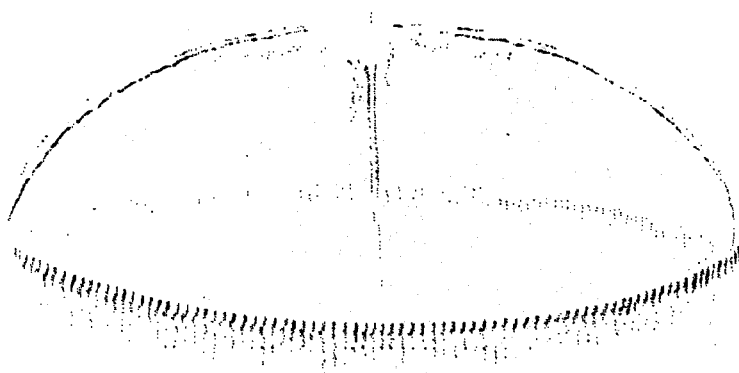
- Fig. 1. *Phialidium gregarium*, p. 179.
 1a. " " crossing of radial canals on stomach-roof.
 2. Species incerta?, p. 188.

PLATE XXI.

- Fig. 1. *Gonionemus agassizii*, sp. nov., p. 185.
 2. " " aboral surface.
 3. " " section of bell.

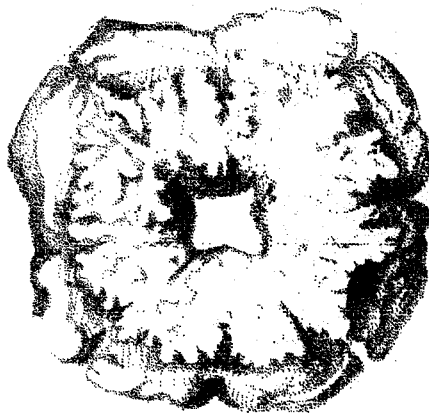
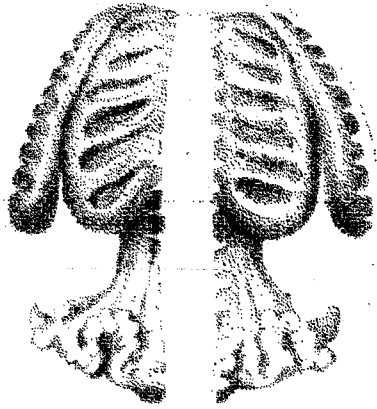
PLATE XXII.

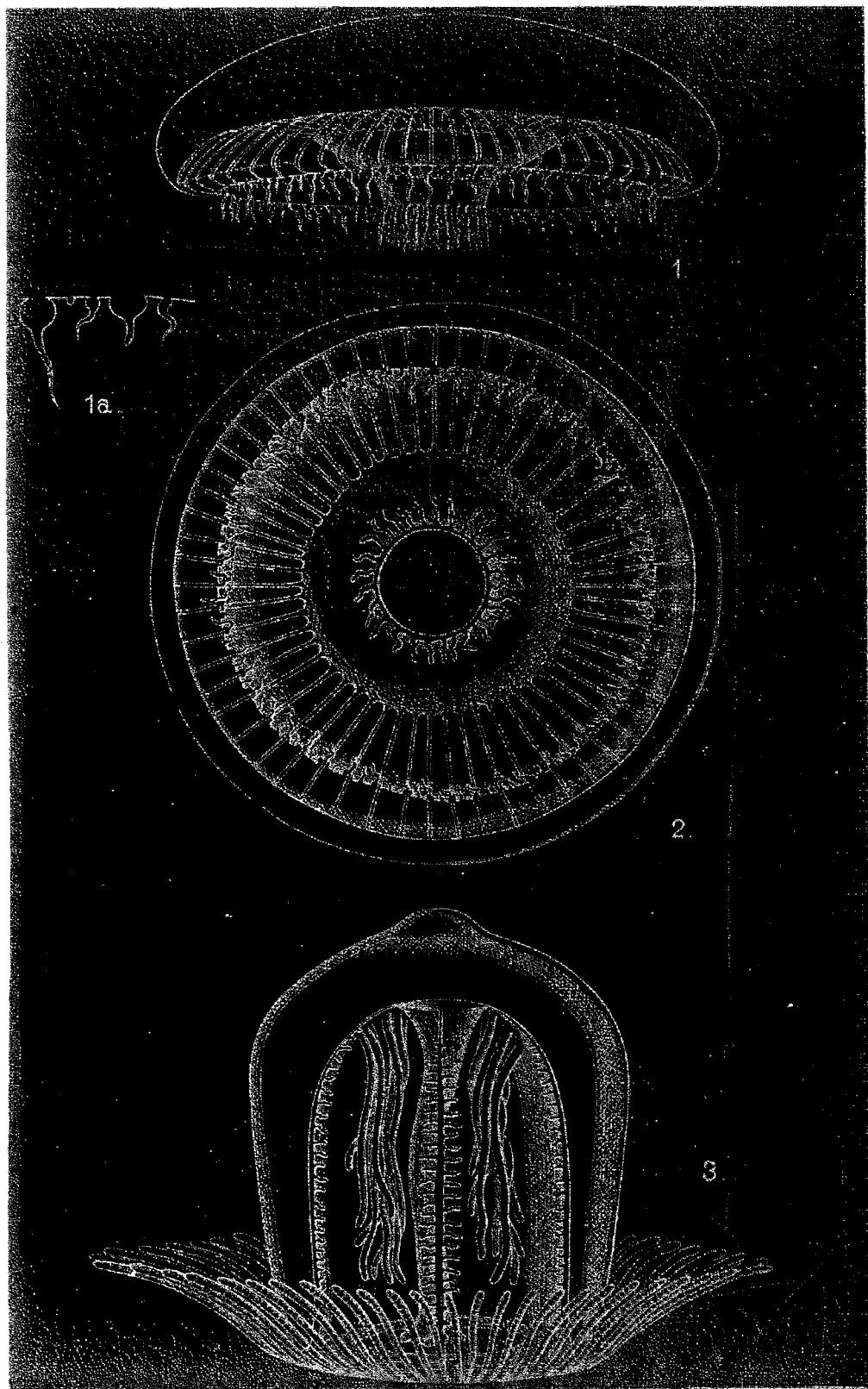
- Fig. 1. *Polyorchis minuta*, sp. nov., p. 174. Transverse section of a gonad showing the continuation of the cavity of the radial canal into the gonad.
 2. *Mesonema victoria*, sp. nov., p. 180. Section of bell-margin.
 cir.can.=circular canal of bell-margin.
 ect.papil.=excretion papilla.
 ve.=velum.
 3. *Gonionemus agassizii*, sp. nov., p. 185. Attachment pad.
 4. *Codonium apiculum*, sp. nov., p. 165. Section of bell-margin.
 cir.can.=circular canal.
 oc.=ocellus.
 ten.ba.=base of tentacle.
 ve.=velum.
 5. *Codonium apiculum*, sp. nov. Section of stomach.



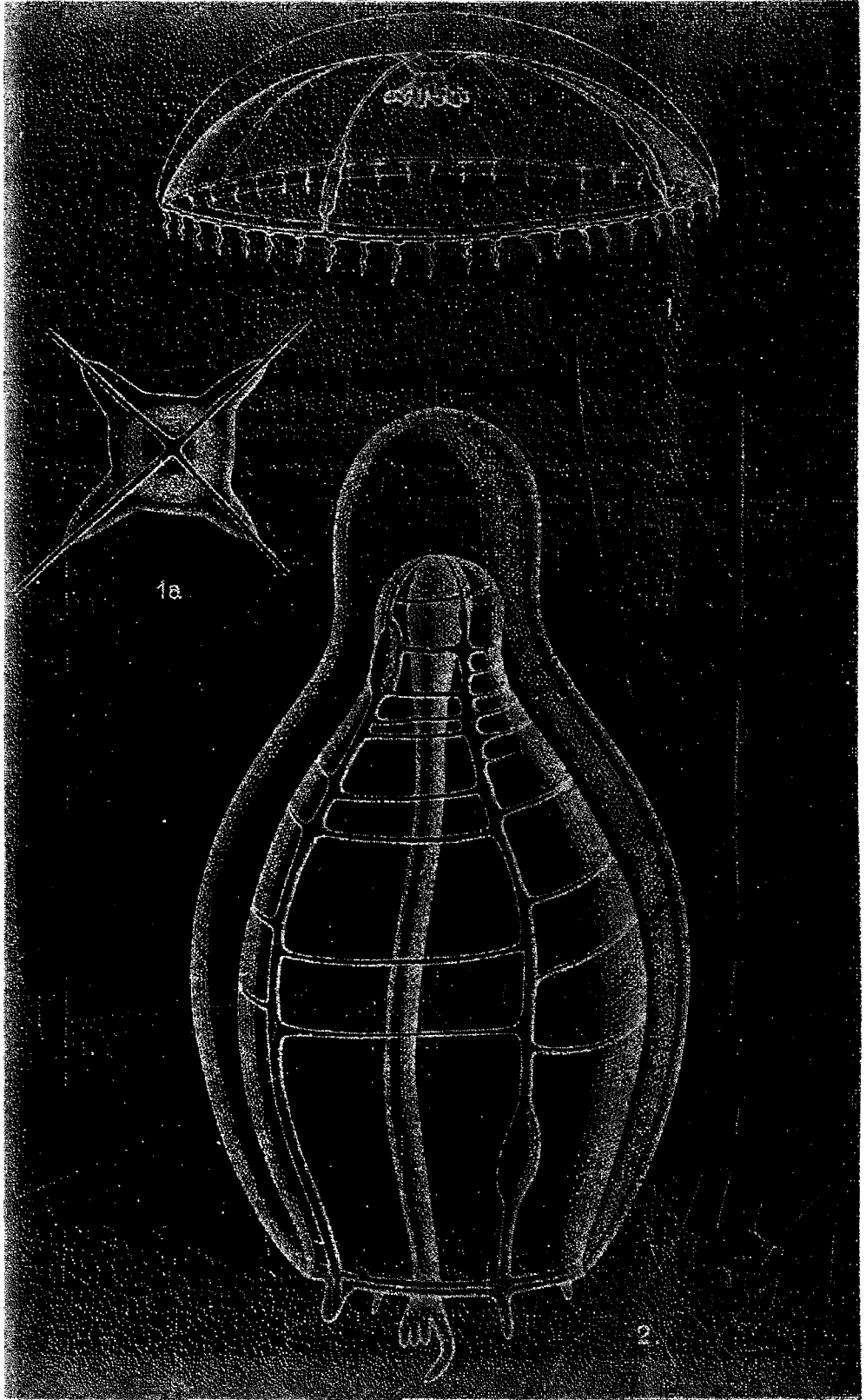
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AND ALASKA.

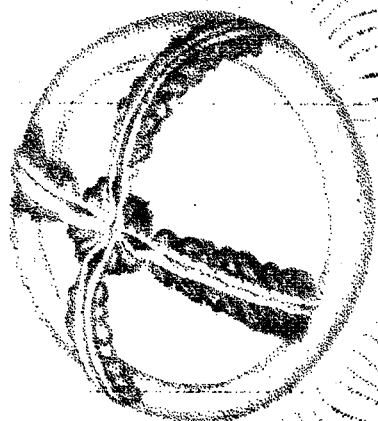
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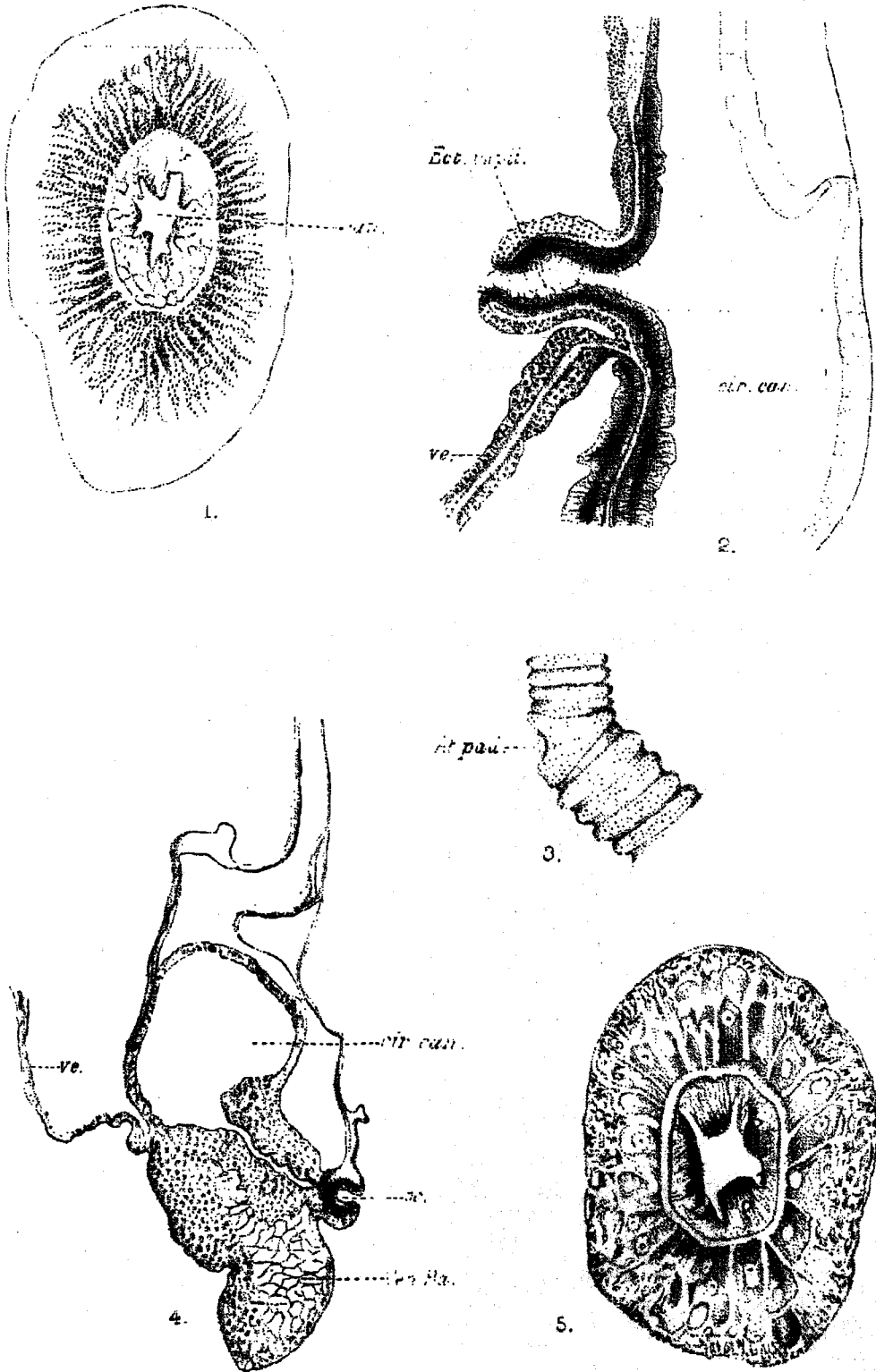




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