REPORT

OF THE

CANADIAN ARCTIC EXPEDITION 1913-18

VOLUME VIII: MOLLUSKS, ECHINODERMS. COELENTERATES, ETC.

PART H: MEDUSÆ AND CTENOPHORA

By HENRY B. BIGELOW

SOUTHERN PARTY, 1913-1916

OTTAWA
THOMAS MULVEY
PRINTER TO THE KING'S MOST EXCELLENT MAJESTY
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Medusæ and Ctenophores from the Canadian Arctic Expedition, 1913-18.

By H. B. Bigelow

Museum of Comparative Zoology, Cambridge, Mass.

The medusæ and ctenophores described in the following pages were collected by Mr. Frits Johansen, in shallow water at various localities along the Alaskan coast, and the arctic coast of North America, between June, 1913, and August, 1916.

The material, in formalin, is in part excellently preserved, but in part so fragmentary as to preclude satisfactory identification. As might be expected of any collection of Medusæ from the Arctic littoral, it consists for the most part of well known and widely distributed arctic species. But it includes one new Anthomedusa, the representives of which are, fortunately, in an excellent state of preservation (p. 7H).

To give an idea of the difficulties under which Mr. Johansen worked, and the credit due him for making the collection at all, I can do no better than quote his own words, from the field notes submitted to me:—

"The difficulties under which I collected Medusæ and Ctenophora during the Canadian Arctic Expedition were great. The opportunities for pelagic collecting were exceedingly few and these had to be devoted to trawlings, etc. Best results were gained by working from the fall ice in bays; but the temperature of the air, at this season, made the water freeze quickly in the specimen jars, so often the Coelenterata collected were spoiled before I could reach the house. The storing and the caring for the specimens collected during the three years in the Arctic was also trying . . . as formalin specimens froze . . . and they thus represent only a part of the Coelenterata actually observed, collected, and preserved."

LIST OF SPECIES.

CRASPEDOTÆ.

ANTHOMEDUSÆ.

Family CODONIDÆ

Sarsia princeps (Haeckel).

Pl. I, Fig. 1.

Codonium princeps Haeckel, 1879, p. 13, pl. 1, fig. 3. For synonymy, see Mayer, 1910, p. 60.

Eleven species of this large, easily recognized, and characteristically arctic species were taken at Collinson point, Arctic Alaska, from September 19 to October 14, 1913 (stations 27*m*, 27*n*, 27*r*, 28*b*), below the sea ice, which had already formed, by that season, to a thickness of 8–10 inches, the temperature of the water, below the ice, 29°–30° F. Also one excellent specimen, about 18 mm. high, from cape Smyth, point Barrow, Alaska, station 57*a*, August 8, 1916.

Except for the geographical records, discussed below (p. 16H), these excellent specimens, ranging in height from 11–19 mm., add nothing to the previous accounts of this species (Haeckel, 1879, Bigelow, 1909*b*). A figure of their general appearance is given, however, to aid students of the Arctic Medusæ in identification. And it is worth noting that in this species, as in *S. mirabilis*, the manubrium is extremely extensible (Pl. I, fig. 1). For, as Mr. Johansen states in his field notes, it "can protrude its long, slender stomach to three times the body length, the four tentacles to five times the body length."

Briefly capitulated, the characteristics of the species are its large size, long, slender manubrium, the jagged margin of the narrow radial canals, the distinct basal tentacular bulbs, usually (but apparently not always) with conspicuous ocelli on their outer faces; and especially the well-developed apical canal, projecting, aborally, into the substance of the bell, from the point of junction of the four radial canals with the base of the manubrium.

Of these characters the most variable (except for the length of the manubrium, which is largely dependent on the state of contraction of the specimen) is the waviness of the margins of the canals. Something of this sort is usually to be seen. But in the present series there are various gradations, independent of the size of the specimens in question, from canals distinctly toothed and jagged to others but slightly wavy. And it is not unlikely that specimens may occur in which their margins are perfectly smooth.

Colour: The value of the series is much enhanced by a beautiful coloured drawing of a specimen from station 27*r* by Mr. Frits Johansen, naturalist on the expedition, which shows the entodermal core of the manubrium of a violet tint, radial canals and tentacles pale pink, and the ocelli carmine.

Sarsia flammea Linko.

Plate II, Fig. 5.

Sarsia flammea Linko, 1905; p. 212. For synonymy, see Hartlaub, 1907, p. 12.

Two specimens, about 19 mm. high, Collinson point, stations 27*r* and 28*b*, October 2 and 14, 1913, when Mr. Johansen notes the species as common under the sea-ice. Two specimens, about 8 mm. high, station 57*a*, Cape Smyth, point Barrow, Alaska, August 8, 1916.

The most characteristic feature of this species, a negative one, is the absence of ocelli. And this, coupled with its short manubrium, short, stout tentacles with large basal bulbs, absence of apical canal, and large size, make it easy to recognize. The present series adds nothing to the good account by Hartlaub (1907), with which they closely agree.

A colour sketch, taken from life by Mr. Johansen (station 27*r*) shows manubrium and tentacle bulbs reddish orange, which agrees with the earlier accounts (Mayer, 1910, p. 64), the tentacles themselves pale bluish.

Sarsia flammea has previously been recorded from various localities in Spitzbergen, from Greenland (Hartlaub, 1907), and from Barents sea (Linko, 1905).

The species is so closely allied to *S. japponica* (Maas, 1909, Bigelow, 1913) that it may finally be nceessary to unite them. The only character which has been invoked to separate them (*japponica* like *flammea* lacks ocelli) is the fact that in the specimens of *japponica* so far examined by Maas and by me (1913) the sexual products are irregularly massed, while in *flammea* they occupy the whole gastric wall except for its proximal and distal extremities. But inasmuch as the specimens of *japponica* which I have seen (1913, p. 4) were not in the best of condition, the question may be left open for the present.

Family **BOUGAINVILLEIDÆ** Gegenbaur.

? **Bougainvillea britannica** (Forbes)

Hippocrene britanica Forbes, 1848, p. 84, fig. 2. For synonymy, see Mayer, 1910, p. 161; Hartlaub, 1911, p. 162.

Station 6*b*; lat. 56° 26′ N., long. 133° W. (off southern Alaska); June 24, 1913, surface, 1 specimen, 6½mm. high, in formalin, in fragmentary condition; also coloured sketch of same, from life, by Mr. Johansen.

Our knowledge of the Medusæ of this genus from the Pacific coast of America is so scanty that it is much to be regretted that the collection contains only a single specimen, and that one in such poor condition that it can only be provisionally identified. Its large number of marginal tentacles (27 in one bundle) class it with either *B. brittanica*, *B. principis*, *B. bougainvillei*, *B. macloviana*, or *B. superciliaris*. But as it has no trace of peduncle, it cannot be associated with either of the last three. As between *britannica* and *principis*, it is best referred to *britanica*, for the following reasons.

Although apparently sexually mature (to judge from the large gonads), the labial tentacles branch at most four times, as is usually the case in *britanica* (Hartlaub, 1911, p. 163), whereas in *principis*, according to Hartlaub (1911, p. 177) they are much more complex. The gelatinous substance is not especially thick: there are about as many marginal tentacles as in *britannica;* the small axial ocelli are similarly situated on the bases of the free tentacles; and the marginal tentacular pads are shorter than the spaces between them, whereas in *principis* they are longer. On the other hand, in their rather linear outlines they more nearly approach *principis;* and this is also true of the short-stalked condition of the labial tentacles. The gonads, so far as can be seen in their present state, are adradial, which is true of both *britannica* and *principis*.

In colour, this specimen agrees fairly well with *britannica*, its manubrium, as sketched by Mr. Johansen, being dark reddish brown, tentacular pads grey, ocelli black.

In *britannica* the gonads are described by Hartlaub (1911) as brown with reddish tint; the manubrium having a yellow stripe in each interradius. According to Forbes (1848) the manubrium is reddish orange, while Mayer (1910) describes the endoderm of the stomach as golden yellow.

Considering how many collections of Medusæ have now been made along the northwest coast of America, and in Bering sea, it is surprising that the Medusæ of Bougainvillea have so seldom been taken or described thence. So far as I can learn, the complete list of records is as follows:—*B. bougainvillei*, probably identical with *B. superciliaris* (1913, p. 9), by Mertens in Bering sea in 1829, many specimens (Brandt, 1838). Probably identical with it is the *B. mertensii* of

L. Agassiz and A. Agassiz (1865), common in the gulf of Georgia; but of this no full description or figure has ever been published, nor is it sure that the hydroid described as *mertensii* by A. Agassiz (1865) and by Fraser (1914) belongs to the Medusa in question. Finally a *Bougainvillea* from Victoria harbour, British Columbia, has been recorded by Murbach and Shearer (1903) as *B. mertensii*, which apparently belongs to *superciliaris*. Torrey (1904, p. 7), has described the hydroid stage of a new *Bougainvillea, B. glorietta*, from San Diego, California, but its free Medusa is still unknown. And my own account of a typical *B. superciliaris* from Attu island, Aleutian islands (1913, p. 9) completes the list.

Considering how wide an area is covered by these few records, and how many species or races of *Bougainvillea* are known from both sides of the North Atlantic, probably the present record of *B. britannica* is but a forerunner of others to come from the Pacific.

B. britannica was previously known from both sides of the North Atlantic (Mayer, 1910; Hartlaub, 1911), *B. principis* from North European waters and from Barents sea (Hartlaub, 1911).

Rathkea blumenbachii (Rathke).

Oceania blumenbachii Rathke, 1835, p. 321. For synonymy, see Mayer, 1910, p. 177, 179, and Hartlaub, 1911, p. 229.

Stations 25 *b*, *c*. Arctic ocean, off Cooper island, near point Barrow, Alaska, August 27–28, 1913, eleven very fragmentary specimens. Station 18d, lat. 62°N., long. 167° 30′W; July 7, 1913, one specimen, 2mm. high, in fair condition.

The number (8) of marginal tentacle-bundles and the structure of the lip and oral appendages make identity with the larger series from New England, Newfoundland, and Bering sea, with which I have been able to compare them, certain (1909*b*, 1913). All the specimens show budding phases; but they are in such poor condition that they add nothing to the numerous existing accounts and figures of this well-known species.

From its wide distribution in Arctic waters, this species was to be expected off the northern coast of Alaska (1913, p. 11).

Family **PANDEIDÆ** Haeckel.

Halitholus cirratus Hartlaub.

Pl. 1, Figs. 2, 3.

Halitholus cirratus Hartlaub, 1913, p. 274.

This species has several times been recorded from arctic waters, as "*Tiara conifera* Haeckel." But Hartlaub, who has seen the original specimen of *conifera* (1913, p. 284), found that it was really probably a *Catablema vesicaria*. Therefore to the specimens recently recorded as *conifera* and to others he himself has studied, he has given the name *Halitholus cirratus*.

The species has been fully described by him, and he has given in detail the grounds for considering *Halitholus* a genus distinct from other Pandeids, chief of these being the combination of gonads of the *Leuckartiara* type, with folded lip, and lack of mesenteries; the latter separating it from its closest relatives, *Leuckartiara* and *Catablema*. So far, two species have been described, both by Hartlaub (1913), *H. pauper and H. cirratus* (both had previously masqueraded as *Tiara conifera*); the two separable by absence of peduncle and few tentacles in the former, its presence, with many tentacles, in the latter.

H. cirratus is represented in the collection by twelve specimens, two in excellent condition, 13 and 14 mm. high, respectively; the others fragmentary, from Collinson point, Camden bay, north coast of Alaska, September 15 to October 14, 1913 (stations 27*b* to 28*b*), under the sea-ice.

This material adds little, except in the way of confirmation, to Hartlaub's account of large series. But inasmuch as the species has not been recorded previously from American waters, a figure and a brief statement of the most diagnostic features are given here.

The general form of the bell is, itself, characteristic, there being, as Hartlaub has pointed out, a thick rounded apical gelatinous projection, with shallow bell cavity (Pl. I, fig. 2), this agreeing with *Catablema vesicaria*, which *Halitholus* much resembles in its general appearance, but from which it is easily separable by such important structural characters as absence of mesenteries and structure of the gonads.

In the better preserved specimens there are, respectively, thirty-five and thirty-six large tentacles, and in each a few rudimentary ones in the various stages of development.

The shape of the tentacles, with laterally flattened basal bulbs, is much as described by Hartlaub. All specimens show the low, broad, peduncle, which is one of the characteristics of this genus, and the four much crenulated lips (Pl. I, fig. 3; Hartlaub, 1913). The primarily horseshoe-shaped gonads, with transverse folds directed toward the perradii (Pl. I, fig. 3) recall his figure, as well as the related genus *Leuckartiara* (Maas, 1904).

But, while this gonad-type is fundamentally characteristic, the surface plications of the gonads cannot always be relied on as a systematic character; for while in one of the specimens it is well exemplified, in the other, an adult female, the entire interradial zones of the gastric wall are so packed with large eggs, easily visible even with the hand lens, that the genital folds are obscured.

There are no diverticula from the margins of the canals, either radial or circular; but the edges of the former are slightly wavy (Hartlaub, 1913).

There are no ocelli.

The only Medusæ with which *H. cirratus* is likely to be confused are *Catablema vesicaria* and the species of *Leuckartiara* and *Neoturris*. But from the first of these it is easily distinguished by the lack of mesenteries, by the smooth-walled canals, and especially by the structure of the gonads; from *Leuckartiara* by the absence of mesenteries and ocelli; from *Neoturris* by lack of mesenteries and structure of gonads.

H. cirratus has previously been recorded, as listed by Hartlaub, from various localities in the Baltic, Barents sea and Spitzbergen (for list of localities see Hartlaub, 1913, p. 274).

The present captures show that it actually has a circumpolar distribution. But its occurrence as far south as Kiel bay shows that it is not distinctively arctic in its occurrence, but may be expected as far south as Cape Cod on the eastern, as well as in Bering sea on the western coast of America.

Colour: An excellent coloured sketch, from life, by Mr. Frits Johansen, of the specimen from station 27*u*, shows the manubrium of a deep pinkish violet, tentacles pale pink.

Family **BYTHOTIARIDÆ** Maas.

Eumedusa similis, gen. nov., sp. nov.

Pl. I, Figs. 4, 5; Pl. II, Figs. 1, 2.

One specimen, 13 mm. high by 10 mm. broad (type); station 27*v*, off Collinson point, Alaska, October 7, 1913; surface temperature, 30° F.; ice, 10 inches thick. Catalogue No. 26, Victoria Memorial Museum, Ottawa.

Station 27*o*: One specimen, contracted, of about the same size, from lagoon inside Collinson point, Alaska, September 20, 1913; surface temperature, 30° F.; ice, 5 inches thick. Catalogue No. 3292, Museum of Comparative Zoology.

The type is in excellent condition, fully expanded except for the manubrium and tentacles. In general outline it is high, bell-shaped, the subumbrella two-thirds as deep as the bell is high; the gelatinous substance of the bell thick at apex, thin at sides with smoothly rounded apex and no suggestion of an apical projection (Pl. I, fig. 4). The surface of the bell is slightly wrinkled in the type; in the other specimen it is furrowed in the radii of the radial canals; but these furrows are obviously contraction phenomena.

The most interesting features of this new Medusa are the radial canals and the tentacles. There are eight radial canals in each specimen, broad and flat, all arising independently at the center of the apex of the manubrium (Pl. I, fig. 5). The four primary perradial canals are easily distinguished, by their larger size, from the four of the second series which alternate with them. But as all are equidistant, there is no evidence that the latter originate as branches of the former, as occurs in the related genus *Bythotiara*. The edges of all the radial canals in the contracted specimen are smooth, with no traces of lateral spurs or branches, and though they are slightly wavy in the type, this is apparently the result of muscular relaxation, at least there are no definite lateral deverticula or spurs. And in both specimens the edge of the circular canal is smooth, with no trace of even such rudimentary centripetal spurs as occur occasionally in *Heterotiara* (Maas, 1905; Bigelow, 1909*a*, 1913; Hartlaub, 1913).

Tentacles: The tentacles, best illustrated by the type owing to its relaxed condition, are of two sorts, large and small, arranged as follows: opposite each canal, and in each inter-radius, is a large tentacle; between these, a varying number of small ones, of various stages in growth, from mere knobs to fully developed ones (Pl. II, fig. 2). In four successive sixteenths of the margin of the type these number 7, 7, 6, 6. The large tentacles, though agreeing with the usual Calycopsid tentacle in the presence of terminal nematocyst knobs, differ from those of *Calycopsis*, *Heterotiara*, etc., in being armed with ectodermic nematocysts, arranged in rings, irregularly scattered, particularly over the middle third of the tentacle. The large tentacles are, however, strongly contracted, now (in the preserved state) being only 3–5 mm. long; hence, when expanded, these nematocyst structures probably are less apparent, if visible at all other than as scattered cells

The large tentacles are hollow (Pl. II, fig. 1), as usual among Pandeidæ and Bythotiaridæ but owing to their contracted state the lumen is very small. Their relationship to the bell margin is the same here as in *Calycopsis*, the basal part of each lying in a groove with the gelatinous substance of the exumbrella projecting downward between them (Pl. II, fig. 1). And it is also worth noting that the marginal nematocyst ring is unusually thick, as compared with that of related genera.

The small tentacles differ from the large ones not only in size (being about 1.5 mm. long, and apparently not contracted), but also in structure, being solid instead of hollow, with an endodermic core of large irregular chordate cells (Pl. II, fig. 1). But, like the primary tentacles, they too bear terminal nematocyst knobs, though otherwise without nematocysts. The small tentacles exhibit every stage of growth, from mere bosses of the marginal ring to fully formed tentacles, showing that their final number is not attained till a late stage in growth, if, indeed, new ones are not developed as long as the Medusa lives. But the largest ones are all of about the same size, and there is no evidence that they ever develop further. That is to say, so far as the actual evidence goes, it is safe to conclude that there is no intergradation between the twt classes of tentacles. Small do not develop into large, but represent a distinco series, really more cirrus-like than tentacle-like.

There are no ocelli, or even any visible pigment granules, on the bases of either class of tentacles.

In the type specimen the manubrium (Pl. I. fig 4) is almost two-thirds as long as the bell cavity is deep, flask shaped, with a simple quadrate lip, in the contracted state tightly closed, its margin smooth, without nematocyst knobs or swellings.

Gonads: The arrangement of the genital swellings is always an important character in this family; but in the present case it is impossible to determine how much they owe to contraction, and in the type (apparently sexually mature) the genital products apparently occupy the whole interradial walls of the manubrium, except for its labial portion (there are no " mesenteries," the manubrium being quite separate from the subumbrella except at its narrow base), just as is the case in *Heterotiara*. Along the four perradii (as revealed by the four corners of the quadrate lip and the four primary radial canals), there is a narrow band free from sexual products. In each of the interradii there is a double series of 2–4 oblique folds, better seen in the figure than described: a very simple type of gonad. But, as noted above, it is a question how far even these folds owe their existence to contraction. In the other specimen, a female with large eggs visible, the manubrium is even more contracted, so much so that it is thrown into a series of irregular folds, and it is impossible to reconstruct its appearance in life.

Colour: In the preserved state both specimens are colourless except for the manubrium, which, as is often the case, is pale opaque ochre yellow, a tint which very probably is no index to its colour in life, but merely the result of preservation.

This new genus agrees so well with the Bythotiaridæ in the structure of its primary tentacles, and their relation to the bell margin, in its manubrium, and in the departure of its canals from the fundamental Anthomedusan number, that I have no hesitation in referring it to that family, though in the presence of two series of tentacles differing structurally as well as in size, it recalls several typical Pandeids, e.g., *Halitiara formosa* (Fewkes, 1882, p. 276, Mayer, 1910, p. 107, pl. 13, fig. 1), *Dissonema turrida* (1909*a*, p. 200), *Dissonema gaussi* (Vanhöffen 1912, p. 361, Pl. I, fig. 2), and *Cirrhitiara superba* (Mayer, 1910, p. 126, Pl. 28, fig. 3; Hartlaub, 1913, p. 284, fig. 237). But it is sufficiently distinguished from all Bythotiarids yet known by the presence of eight unbranched canals.

Trachomedusæ.

Family **Olindiidæ** Browne.

(?) **Eperetmus typus** Bigelow.

Eperetmus typus Bigelow, 1915, p. 401, pl. 59, figs. 1–8.

Station 20*g*, Port Clarence, Alaska, August 4, 1913, two specimens, about 9 and 7 mm. in diameter, both in poor condition.

These two specimens are only provisionally referred to this species, their poor condition precluding absolute identification.

In the general appearance of the saucer-shaped bell, with rather long manubrium hanging about to the level of the bell opening, they almost exactly reproduce the type specimen of this species (1915, pl. 59, fig. 1). And while the small exumbral papillæ of the latter are not to be seen here, their apparent absence may well be due to the fact that they are, apparently, more or less macerated. The margin of the lip, too, is studded with small sessile nematocyst knobs, exactly as I have figured it for *Eperetmus* (1915, pl. 59, fig. 5), especially evident in the larger specimen, in which the mouth is widely open; and the gonads, from their large size apparently fully developed in the large specimen,

are of the simple, wavy, leaf-like form characterizing that genus, extending practically the whole length of the radial canals.

The arrangement and structure of the marginal organs in *Eperetmus* is characteristic. And in spite of the poor condition of the present material, enough tentacles and otocysts are still intact to show the same main features. Thus the tentacles are all of one kind, corresponding to the primary tentacles of *Olindias*, neither the marginal papillæ characteristic of *Gonionemus*, nor the secondary (velar) tentacles of *Olindias* occurring. Tentacles are present in all stages of growth, from mere knobs to the fully developed state. And while the youngest stand free on the margin, with progressive development they turn upward against the exumbrella, and finally come to lie in deep furrows in the latter, from which they project at various heights, corresponding to their ages. One of the most diagnostic features is the presence of a thick opaque kidney-shaped nematocyst pad associated with each large tentacle, lining the distal end of the exumbrellar groove in which it lies (1915). And these pads, being tough and resistant, are sufficiently preserved to show that in this respect the present specimens agree exactly with the type. Nor is there any difference in the structure of the tentacles, which are smooth distally, their outer parts ringed with nematocyst ridges, without suckers, but terminating in nematocyst knobs. It is not possible to count the tentacles in either specimen, but to judge from their number in such small segments of the margin as are intact, there must have been 80–100, i.e., about the same number as in the type specimen.

Only a few otocysts are still to be seen. But fortunately such as remain are large enough to show that they lie in capsules, the various elements of which are visible even in optical section, and imbedded and entirely enclosed in the exumbrella, exactly as in the original specimen of *Eperetmus*. In fact the figures of the margin of the latter (1915, pl. 59) would equally apply to the present material. The sense organs themselves are spherical, with central otocyst mass, borne on a stalk.

In all this our specimens agree perfectly with *Eperetmus typus*. But it is impossible to determine whether one of the most important characters of the latter, the presence of centripetal canals, recurs here. In their present state the specimens show no clear evidence of them, though in the case of the smaller one the circular canal in one interradius is apparently dilated centripetally. But, considering the macerated and rubbed state of the subumbrella, it is an open question whether such canals were really absent, or whether their apparent lack is merely the result of mutilation, as so often occurs with these structures in *Liriope*. And it is the necessary uncertainty on this point which makes their identity with *Eperetmus typus* doubtful, a doubt which cannot be cleared up till larger and better preserved series are available.

So close is the resemblance between the Port Clarence specimens and the one known specimen of *Eperetmus*, even to the most minute details of structure of the marginal organs, that such divergence as lack of centripetal canals in the former, would be a somewhat surprising phenomenon. And should it prove that they are really absent in fact, as well as in present appearance, the generally accepted classification of the family would demand for them not only a new species but a new genus.

Family **TRACHYNEMIDÆ** Gegenbaur.

Aglantha digitale (Fabricius).

Medusa digitale Fabricius, 1780, p. 366. For Synonymy, see Mayer, 1910, p. 402.

Specimens of this well-known species, all rather fragmentary, were taken at:
Stations 21 *a*, *b*, c, lat. 68° 30′ N., long. 166° 32′ W., August 15, 1913.
Stations 25*b*, *c*, off Cooper island, Alaska, surface, August 27-28, 1913.

Station 41*s*, Bernard harbour, Dolphin and Union strait, Northwest territories, August 24, 1915.

Station 40*d* (crack in ice), Dolphin and Union strait, Northwest territories, June 8, 1915.

Station 29g^3, 50–150 fathoms, crack in ice, lat. 70° 20′ N., long. 140° 30′ W., April 6, 1914. One very fragmentary.

Station 29g^2, 0–150 fathoms, crack in ice, lat. 70° 20′ N., long. 140° 30′ W., April 6, 1914. One very fragmentary.

Station 57*a*, cape Smyth, point Barrow, Alaska, August 8, 1916. One very fragmentary.

In all there are perhaps thirty specimens. But for the most part they are mere shells, minus margin, gonads or manubrium; identified as *Aglantha* chiefly on the strength of their rather characteristic outline. In height, such of the specimens as can be approximately measured range from about 5 to about 15 mm.

Such poor material could not be expected to add anything to our knowledge of a species as well known anatomically as is *Aglantha digitale*, while, owing to the total destruction of the marginal organs in all the specimens, they throw no light on varietal differences which have been the subject of much discussion in this genus. In no case is an otocyst intact.

The records, however, are of interest, geographically, as bridging a gap in the known distribution of *Aglantha*, the genus being previously known from Labrador to the east, Bering sea and off point Barrow (Fewkes, 1885) to the west of the region in question.

Narcomedusæ.

Family AEGINIDÆ Gegenbaur.

Aeginopsis laurentii Brandt.

Plate II, Fig. 3.

Aeginopsis laurentii Brandt, 1838, p. 363, pl. 6, fig. 1–6. For synonymy, see Mayer, 1910, p. 472, 498.

Station 27*q*, 1 fathom, September 26, 1913, off Collinson point, Alaska; ice, 8 inches; 2 specimens.

Station 27*r*, 1 fathom, October, 2, 1913, off Collinson point, Alaska; 30° F. temperature; ice, 10 inches; 1 specimen.

Station 30*a*; 3 fathoms; May 4, 1914; 69° 41′ N., 141° 11′ W. Hole made in ice 6 feet thick; 1 specimen.

Station 27*m*, September 19, 1913, off Collinson point, Alaska; ice, 8 inches; 3 specimens.

Station 27*n*, September 20, 1913, off Collinson point, Alaska; 30° F.; ice, 8 inches; 2 specimens.

The specimens range from 3 to 12 mm. in diameter.

This characteristically arctic, and easily recognized Narcomedusa has been fully described within recent years by Maas (1916), by Hartlaub (1909), and by me (1909[b]). Indeed, since the first account of it, by Brandt (1838), there has been no doubt of its identity. Its most diagnostic features are the presence of only four tentacles, but 8 peronii, and the total absence of a peripheral canal system, contrasted with the presence of 8 bifid, i.e., 16, gastric pouches, the wrinkled oral surfaces of which bear the genital products, particularly next their outer margins, which are more or less lobed. There are no otoporpæ, but the otocysts are of the usual Aeginid type, 3 or 4 per octant in the largest specimens, as I have already pointed out (1909*b*, p. 315). All these features are

exhibited by the present series, which, however, add nothing, except by way of confirmation, to the more extensive series already described and figured by me from the coasts of Labrador and Newfoundland.

Having been recorded from Bering straits on the one hand (Brandt, 1838), from Labrador and Greenland (Maas, 1906, Bigelow, 1909*b*, Hartlaub, 1909), on the other, as well as from Barents sea (Linko, 1904*b*; the White sea (Birula, 1896) and from Spitzbergen (Grönberg, 1898, Maas, 1906), its occurrence off the arctic coast of North America was to be expected. In fact, it is apparently one of the most characteristic and widespread of Arctic Medusæ.

SCYPHOMEDUSÆ.

STAUROMEDUSÆ.

Family **LUCERNARIDÆ** Johnston.

Haliclystus stejnegeri Kishinouye.

Plate II, Fig. 4.

Haliclystus stejnegeri Kishinouye, 1899, p. 126, fig. 1–3, Mayer, 1910, p. 535.

Station 20*g*, port Clarence, Alaska, August 4, 1913; 2–3 fathoms; 2 specimens, both about 12 mm. broad, with well-developed gonads.

Although this genus has been the subject of a great deal of study, not only from the morphological (Clark, 1863, 1878; Gross, 1900), but also from the varietal standpoint (Browne, 1895), it is still impossible to draw any sharp lines between the several species generally recognized.[1] This is partly due to the fact that the various studies on its variations were not undertaken with this end in view; partly to the homogeneity of the genus as a whole, but chiefly to the intergrading nature of the characters which have been used to delimit "species," and to the changes which take place in them with growth during the normal life of the Medusa, as well as after preservation.

Among the four northern species recognized by Mayer (1910, p. 53), *H. auricula*, so fully described by Clark (1878), is recognizable chiefly by the fact that its eight adradial tentacle-arms are associated in pairs, whereas in *H. octoradiatus*, *H. salpinx*, and *H. stejnegeri* they stand 45° apart, with the interradial marginal notches as deep and broad as the perradial. Furthermore, *auricula* has more tentacles per arm (100–120) than either *octoradiatus* or *salpinx*. But, like them, the sexual saccules borne by its gonads are arranged in radial rows, irregular, it is true, but still discernible, there being two rows per gonad in *octoradiatus*, 4 in *salpinx*, 6–8 in *auricula*. In *stejnegeri*, on the contrary, the sexual swellings are in the form of round sacs, of varying sizes, irregularly arranged over the surfaces of the leaf-like gonads.

The present specimens are identified as *stejnegeri*, chiefly because they exhibit the gonad structure supposed to be typical of that species. That is, each of the eight long leaf-like gonads, which extend from the base of the disc to the extremities of the arms, is closely studded with a series of globular swellings varying in size and irregularly arranged (pl. II, fig. 4). Of these there may be from three or four to nine or ten abreast, and there is no trace of any radial arrangement in rows, such as characterizes the gonad swellings of *H. octoradiatus* and H. *auricula* (Clark, 1878; Mayer, 1910).

I may also note (as a character separating *stejnegeri* from *auricula*) that the arms in our specimens are 45° apart, the radial and interradial notches being equally deep and broad.

[1] For summary of our present knowledge of this genus, see Mayer, 1910.

On the other hand the peduncle in both specimens is round, instead of showing the four longitudinal grooves observed by Kishinouye. In other respects they so closely agree with his description that no further account is needed here.

The original records of this species being from Bering island, Commander group (Kishinouye, 1899; Mayer, 1910), the present captures extend its known range across the breadth of Bering sea. But in this there is nothing surprising, the Medusa fauna of the latter, so far as known, being decidedly uniform across its whole breadth (1913).

Discophora.

Family **PELAGIDÆ** Gegenbaur.

Chrysaora sp.?

Station 42*a*, Bernard harbour, Dolphin and Union strait (washed up on beach); September 1, 1915; 1 fragmentary specimen.

Unfortunately this large specimen is now merely a mass of broken fragments, only the central part of the disc, with the mouth arms, being reasonably intact. It is impossible to identify it further than that it is certainly a pelagid, and probably a *Chrysaora*. Its diameter, when taken, is given in Mr. Johansen's field notes as 11 inches (about 280 mm.), with mouth arms about 300 mm. and tentacles about 75 mm. long. The colour is described as follows: "The sixteen radial stripes and the marginal tentacles were dark brown (the former darkest); gonads and filaments on the four mouth tentacles (arms) light brown; otherwise the Medusa was pale yellow transparent."

The specimen is now so thoroughly stained with iron rust that no trace of its normal colouration is to be seen.

Unfortunately this does not suffice to identify the specimen specifically, for not only are the relationships of the various described members of this genus still a puzzle, but the colouration of all those of which any considerable number have been studied, is extremely variable (Mayer, 1910, p. 580). *Chrysaora*, though primarily at home in temperate seas, is already known from the sea of Okhotsk (Kishinouye, 1910, p. 12). And in the North Pacific one or other "species" of the genus is known from Saghalin island; from Kamtschatka, the Aleutians, and thence southward to San Francisco bay in California. It is recorded (*C. melanaster*) from the neighbourhood of point Barrow (Fewkes, 1885, Murdoch, 1885). It is also recorded from Greenland (Aurivillius, 1896, *fide* Mörch, 1857). But it is by no means certain that this early record can be relied on, and it has not been accepted by Kramp (1914).

Family **CYANEIDÆ** L. Agassiz.

Cyanea capillata var. **capillata** (Linnæus), Eschscholtz.

Medusa capillata Linnæus, 1758, vol. 1, p. 660. For synonymy and synopsis of varieties, see Mayer, 1910, pp. 596, 597.

Station 20*f*, Grantley harbour, port Clarence, Alaska; August 3, 1913; 2 juv. specimens, both about 40 mm. in diameter.

Station 57*a*, cape Smyth, point Barrow, Alaska, August 8, 1916; 4 young specimens, 8–20 mm. in diameter, somewhat fragmentary, but yet well enough preserved to show their identity. At this same locality, according to Mr. Johansen's notes, many *Cyanea*, large (1–2 feet in diameter) and small were seen, drifting northward with the strong current.

Both of the larger (but still immature) specimens have lost most of their mouth parts and tentacles, and are otherwise in poor condition. They are recorded as belonging to the var. *capillata* of this widespread and well-known species, because of their close resemblance to the specimens of *C. capillata* var. *capillata*, which I have previously described from Bering sea (1913, p. 92). Particularly important, as locating them in this section of the species, are the facts that the sixteen muscular trapezia of the subumbrella are practically continuous, one with another, hardly separated at all; and that the clefts limiting the rhopalar lappets are shallow and the interradial marginal clefts broad (1913, pl. 4, fig. 8). The arrangement of the lappet canals is likewise the same as in the Bering sea examples. But they are not in good enough condition to throw any light on the varietal relationships in this variable genus. Whatever colour they may have exhibited in life has now disappeared.

Family **AURELIIDÆ** L. Agassiz.

Aurelia limbata Brandt.

Aurelia limbata Brandt, 1834, p. 26, Vanhöffen, 1902, p. 43; Maas, 1906, p. 507; Bigelow 1913, p. 99, pl. 5, figs. 1–4. *Diplocraspedon limbata* Brandt, 1838, p. 372, pl. 10.

Station 20*f*, Grantley harbour, port Clarence, Alaska, August 3, 1913; surface; 3 specimens about 75, 50, and 36 mm. in diameter. Also, many noted as " seen in the water."

These three specimens, the largest of which bears well-developed gonads, are crumpled and partly decomposed. But the canal system is sufficiently preserved to show that they are the same form as the specimens from the Aleutian islands and northern Japan, which I have referred to the *A. limbata* of Brandt (1913, p. 99). As I have pointed out, this species (if indeed it deserves so dignified a rank) is separable from the more widely occurring *A. aurita* chiefly by the very complex anastomosis of its canals. And though this character is a trivial one and not sharply defined, thanks to it *A. limbata* is decidedly different from A. *aurita* in general appearance. In the present specimens, as in the much better ones which I have already described from the Kurile islands, from the sea of Okhotsk, and from northern Japan (1913, p. 99), the perradial and interradial groups of canals divide, subdivide, and anastomose so complexly that the entire subumbrella surface is occupied by a close-meshed canal net. And even the adradial canals, which are straight and unbranched over their inner halves, take part in the general anastomosis for the outer half of their length.

A second character which has been used to separate *limbata* from *aurita* is the marginal pigmentation of the former; and this was a striking feature of the Bering sea series collected by the *Albatross* (1913, p. 100). In the present case this pigmentation, if once present, has been lost—probably the result of very poor preservation. But the Aurelia seen off cape Smyth, point Barrow, Alaska, station 57*a*, August 8, 1916 (none preserved) are described by Mr. Johansen as having the tentacles yellow brown (these, however, may not have been *limbata*). Because of their poor condition the specimens add nothing to previous accounts of the anatomy of the species. Their principal interest is geographic.

This same variety, or species, of *Aurelia*, whichever it finally proves to be, was apparently taken by the *Tjalfe* expedition in Greenland waters (Kramp, 1913, p. 281), for Kramp's series show the same complex anastomis of the canals as is characteristic of Aleutian and Bering Strait specimens. Kramp, it is true, believes that they cannot be referred to *limbata*, because differing from it in the degree of pigmentation and outline of the bell. But the structure of the canals is so much more important than either of these characters that they are

certainly more closely allied to it than to *A. aurita*. From this it follows that the arctic *Aurelia* is not only distinguishable from the Aurelia (*A. aurita*) of boreal and temperate seas, but, like other Arctic Medusæ, is circumpolar.

CTENOPHORÆ.

CYDIPPIDA.

Family **PLEUROBRACHIIDÆ** Chun.

Mertensia ovum (Fabricius).

Beroe ovum Fabricius, 1780, p. 362. For synonymy, see Mayer, 1912, p. 8.

No specimens of this species (at least none recognizable as such) were to be found in the collection. But it is recorded in Mr. Johansen's field notes as being common at Camden bay, Arctic coast of Alaska, during September and October, 1913.

BEROIDA.

Family **BEROIDÆ** Eschscholtz.

Beroe cucumis Fabricius.

Beroe cucumis Fabricius, 1780, p. 361. For synonymy, see Mortensen, 1912, p. 83.

Station 57*a*, cape Smyth, point Barrow, Alaska, August 8, 1916; 1 small specimen, about 14 mm. high, and numerous fragments.

The material is not in sufficiently good condition to add anything to the earlier accounts of this well-known species. For a discussion of its systematic relationship to the various other "species" of *Beroe*, I refer the reader to Mortensen (1912).

LOBATA.

Family **BOLINOPSIDÆ** Bigelow.

Bolinopsis sp.?

Bolinopsis (as "*Bolina*") is recorded in Mr. Johansen's field notes as common during September and October, 1913, at Camden bay, Arctic coast of Alaska. But no specimens were successfully preserved.

GEOGRAPHICAL DISTRIBUTION.

The interest of the present collection is much enhanced by the fact that it is only the second ever made on the Arctic coast of North America. In fact, although collections have been made in Bering sea on the one hand (Brandt, 1838; Bigelow, 1913), along the Labrador coast and at various fjords and harbours in Greenland on the other, there is not a single record of any Medusa, so far as I have been able to learn, between Hudson straits on the east, and Bering straits on the west, except for a few records from the neighbourhood of point Barrow (Fewkes, 1885; Murdoch, 1885).

The Medusa fauna of the Arctic coasts of Europe, and of Spitzbergen has, on the other hand, been the subject of such exhaustive study at so many hands that in its general characteristics it may be regarded as fully as well known as that of more temperate coasts And the Medusæ of the northern coasts of eastern

America are fairly well known, thanks to the southward extension of subarctic temperatures to New England.

Judging from what is known of the distribution of Medusæ in arctic waters and, indeed, of most other marine organisms, no great faunal peculiarities, distinguishing the regions studied by the Canadian Arctic Expedition from Bering sea on the one hand, or from the coasts of Labrador, Greenland, or Spitzbergen on the other, were to be expected, the general thesis of the circumpolarity of most littoral arctic organisms being well established. And, as a matter of fact, none is shown by the collection, all the Medusæ and Ctenophores taken by the Canadian Arctic Expedition north of Bering straits belonging to species well known either from some part of the North Atlantic or from its arctic tributaries, except for the one new species (p. 7H). Such are *Sarsia princeps*, *Sarsia flammea*, *Rathkea blumenbachii*, *Halitholus cirratus*, *Aglantha digitale*, *Aeginopsis laurentii*, *Chrysaora* sp., *Cyanea capillata*, *Mertensia ovum*, *Beroe cucumis*, and *Bolinopsis* sp. All of them were living under purely Arctic conditions of temperature, often, as noted by Mr. Johansen, in the leads and openings in the ice and under it. And judging from the geographical location of capture, there is no reason to suppose that any of them are other than endemic to the Arctic ocean, something which cannot always be said of collections from Spitzbergen, or from Barents sea. Thus, to take an example, for *Chrysaora* to have reached Dolphin and Union strait as an involuntary immigrant from either North Atlantic or North Pacific waters would require a drift of not less than 1,000 miles; necessarily carried out since the Medusa was set free (*Chrysaora* passes through a fixed stage), which, to judge by what is known of the rate of growth of the large Scyphomedusæ in cold waters, probably took place not more than three months prior to its capture. Similarly, it is perfectly safe to conclude that the several Hydroid Medusæ which are evidently common at Collinson point, are normally at home there. It does not follow, however, that all of them are restricted to waters of arctic temperature, in their normal distribution. On the contrary, it is well established that *Cyanea capillata* among Scyphomedusæ, *Halitholus cirratus*, *Rathkea blumenbachii*, and one or another variety of *Aglantha digitale* are equally endemic in the boreal waters of the North Atlantic.

It is of great importance, not only to the students of the group, but especially to the oceanographer, to establish definitely which of the Arctic Medusæ are certainly the products of arctic seas, and of them alone, for such natural buoys are often of the greatest assistance in indicating the origin, northern or southern, of the constituent waters of ocean currents. And they have the advantage over the arctic diatoms, of large size and easy identification. Fortunately there is at least one Anthomedusa, *Sarsia princeps*, which has been recorded from so many parts of the arctic and from the currents flowing from it, e.g., the Labrador current, but no where else, that it can safely be taken as a sure indication of arctic water. Wherever it may drift, it can be as surely retraced to an arctic home as can a Nova Scotia coast buoy which has strayed out into the Gulf Stream, to coastal moorings. And no better natural buoy could be found for not only is its arctic origin certain, and its drift period limited (by the fixed hydroid stage), but it is so large and its specific features so characteristic that the veriest tyro could be trusted to recognise it from a good drawing. *S. flammea* would perhaps be an equally safe index to arctic waters, except that it is less distinguishable from its relatives.

Among Leptomedusæ I may mention, as an arctic index, *Ptychogena lactea* (not, however, represented in the present collection). Typically arctic Trachomedusæ are *Ptychogastria polaris* (1909b, 1913.) and *Botrynema elinoræ* (Hartlaub, 1909; Bigelow, 1913, p. 52).[1]

[1]Since *Ptychogastria polaris* lives, as a rule, on or close to the bottom, and often in enclosed waters, it is less apt to be of service to the oceanographer than the surface forms.

One Narcomedusa, *Aeginopsis laurentii*, is likewise typically arctic. And, like *Sarsai princeps*, it is not only large but very easily recognized; and it is now known from so many records, so widely distributed over the Arctic seas, that its presence can be considered a sure indication of arctic water.

This is equally true of the Ctenophore *Mertensia ovum*, which is not only a true arctic form, but is so sensitive to changes of temperature that it does not long survive any considerable warming of the water in which it floats (1917, p. 249).

If further confirmation of the affinities of *Sarsia princeps*, *Sarsia flammea*, *Aeginopsis*, and *Mertensia* be needed, it is furnished by the collection of the Canadian Arctic Expedition, as it is for their circumpolarity. Indeed, to find any shallow-water arctic Medusa not circumpolar would be surprising, there being no barrier, either in the physical conditions of the sea water or in the presence of a land mass, to such distribution.

So far as the present collection goes, it may be considered a typical representative of the endemic littoral Medusa fauna of the Arctic.

POSTSCRIPT

List of Medusæ collected by the Canadian Exploring Steamer "Neptune" 1903–1904.

The few Medusæ taken during this expedition are in poor condition, and, as all belong to well-known species, a simple list of the records is given.

Catablema vesicaria (A. Agassiz).

One specimen, 20 mm. in diameter, with thirty large tentacles (all broken off short) and about as many knobs, from Black Tickle, Labrador, September, 1903.

Aglantha digitale (Fabricius).

Three specimens, very fragmentary, 20–25 mm. high, port Burwell, Ungava, September, 1903.

Cyanea sp.?

One specimen, about 35 mm. in diameter, too fragmentary for more than generic determination, Fullerton, west side of Hudson bay, Northwest Territories, September, 1903.

Aurelia limbata Brandt (?)

Seven small specimens of *Aurelia*, 20–30 mm. in diameter, probably belonging to this species, because of the anastomosis of the canals (p. 14H), from Black Tickle, Labrador, September, 1903. One specimen of about the same size from North Somerset, Northwest Territories, August, 1904.

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EXPLANATION OF PLATES.

All figures drawn from photographs by E. N. Fischer.

PLATE I.

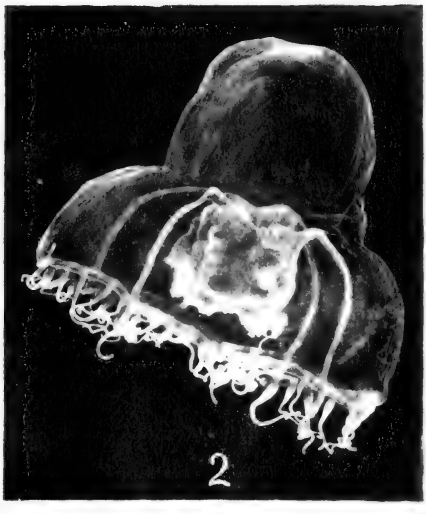
Fig. 1. *Sarsia princeps* Haeckel. Side view of specimen 18 mm. high. It has swallowed a Schizopod.

Fig. 2. *Halitholus cirratus* Hartlaub. Side view of specimen 13 mm. high.

Fig. 3. *Halitholus cirratus* Hartlaub. Side view of specimen 14 mm. high with bell cavity opened, and upper wall turned back, to show manubrium and gonads.

Fig. 4. *Eumedusa similis*, gen. et sp. nov. Side view of type specimen, with half the bell wall cut away, to show manubrium and gonads. Four radial canals are intact, and the base of a fifth.

Fig. 5. *Eumedusa similis*, gen. et sp. nov. Apical view of contracted specimen (p. 8H.) to show the 8 radial canals.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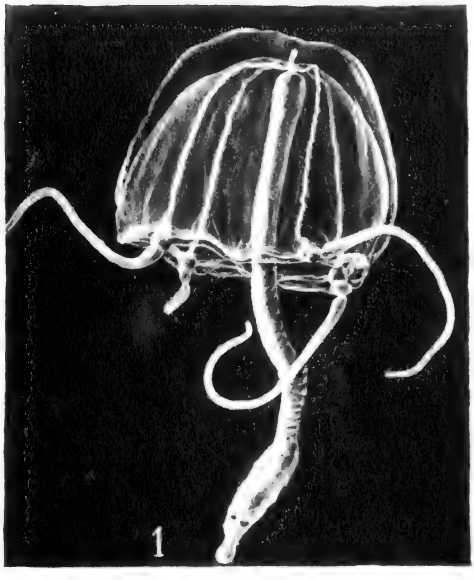
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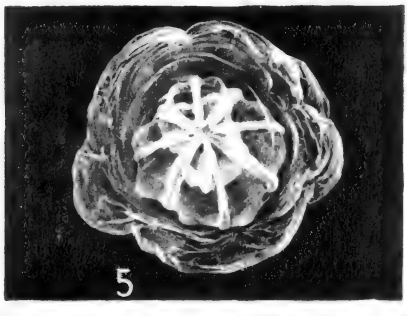
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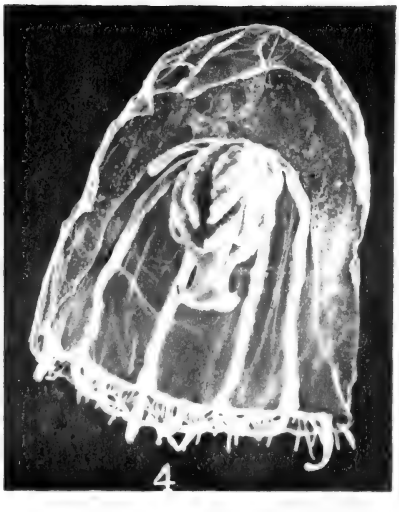
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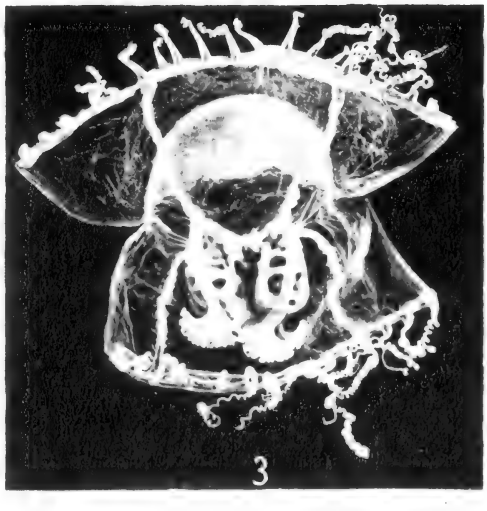
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PLATE II.

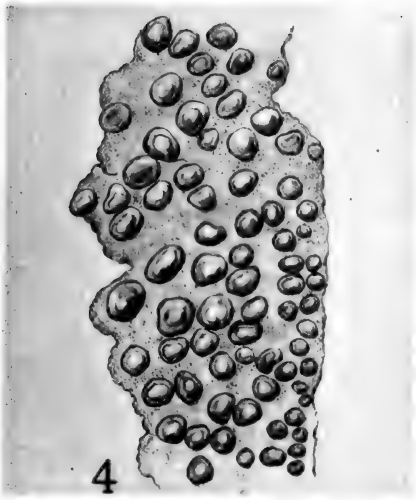
Fig. 1. *Eumedusa similis*, gen. et sp. nov. Oral view of segment of margin of type specimen, to show the two classes of tentacles, large hollow and small solid.

Fig. 2. *Eumedusa similis*, gen. et sp. nov. Side view of segment of margin of type specimen showing relation of large and small tentacles to margin and ex-umbrella.

Fig. 3. *Aeginopsis laurentii* Brandt. Oblique side view of specimen 12 mm. in diameter.

Fig. 4. *Haliclystus stejnegeri* Kishinouye. Segment of gonad, to show arrangement of genital swellings.

Fig. 5. *Sarsia flammea* Linko. Side view of specimen 8 mm. high. From a photograph.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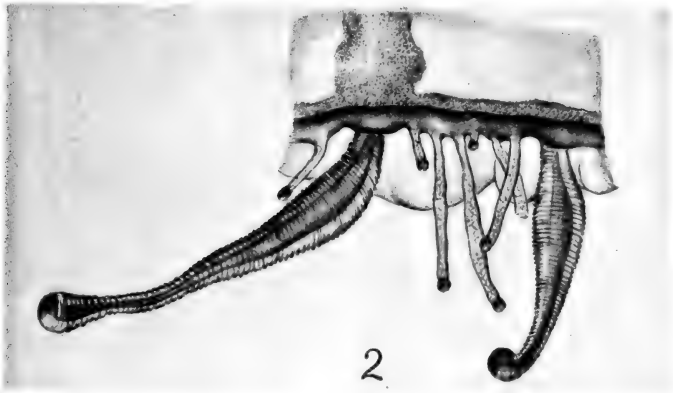
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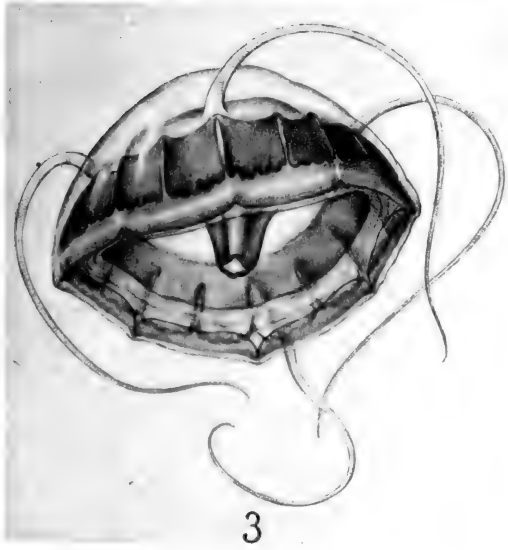
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