THE DANISH INGOLF-EXPEDITION

VOLUME V

14

MEDUSÆ

PART III.

TRACHYLINA AND SCYPHOZOA

WITH ZOOGEOGRAPHICAL REMARKS ON ALL THE MEDUSÆ OF THE NORTHERN ATLANTIC

BY

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WITH 6 PLATES AND 20 FIGURES IN THE TEXT

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Contents.

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Introduction.

Many years have elapsed, since I published the first two parts of the medusæ of the northern Atlantic in the "Ingolf" publications (Leptomedusæ 1919, Anthomedusæ 1926). For various reasons the treatment of the Trachylina and the Scyphomedusæ was repeatedly postponed; other work, particularly on animals from Greenland waters, occupied much of my time available for scientific work; moreover I wanted the final treatment of the North-Atlantic medusæ to be as complete as possible by including new collections (mainly from the "Dana" expeditions), and also to be better aquainted with the distribution of the oceanic species in other parts of the Atlantic Ocean. In this respect the working out of the extensive collections of Hydromedusæ from the "Dana" expeditions in 1921–22 and 1930 and from the "Discovery" expeditions has given valuable information.

In the meantime it was decided to restrict the "Ingolf" papers still awaiting publication to comprise deep-sea animals only, hoping at last to come to an end with this series. The majority of the Trachylina and some of the Scyphomedusæ are decidedly bathypelagic, and they might therefore be treated to about the same extent as the Leptolina, but in accordance with the new plan the few neritic forms will only be briefly mentioned.

To conclude the present volume a short survey is given of all the medusæ occurring in the areas under consideration, i. e. the Atlantic Ocean north of about 50° N. and adjacent waters, paying regard to new information on the Leptolina.

One new species is described: *Haliscera bigelowi* n. sp.

If nothing else is stated, the material dealt with in the present paper belongs to the Zoological Museum of Copenhagen.

I. Trachymedusæ.

Fam. Ptychogastridæ.

Ptychogastria polaris Allman.

Pl. I figs. 1–4, Pl. VI figs. 1–2.

North-Atlantic records:

Ptychogastria polaris Allman 1878 p. 290, figs. 1–3.
Pectyllis arctica Haeckel 1879 p. 266.
– – 1881 p. 10, Pl. III–IV.
– Levinsen 1893 p. 146.
– Aurivillius 1896 p. 194.
– Maas 1893 p. 20.
– Gromberg 1898 p. 165.
– Aurivillius 1899 p. 56.
– Linko 1900 p. 117.
Ptychogastria polaris Browne 1903 p. 24, Pl. IV figs. 1–2, Pl. V figs. 6–8.
Ptychogastria polaris Maas 1906a pp. 482, 492, 509.
– Broch 1907 p. 8.
– Bigelow 1909 b p. 310.
– – Kramp 1914 p. 427.
– Kramp & Damas 1925 p. 316.
– Tanasijčuk 1927.
– Runnström 1932 p. 30.
– Bernstein 1931 pp. 9, 25.
– – Jaschnov 1939 p. 112.
– – Dunbar 1942 p. 74.
– – Kramp 1942 p. 69.
– – 1943 p. 6.

Material (see the map, textfig. 1):

West Greenland (chart in Kramp 1942 p. 71, fig. 21):

Smith Sound, 78°15′N., 73°29′W., $^{8}/_{8}$1928, depth 290 m, dredge at the bottom. "Godthaab" St. 97. 8 specimens.

Inglefield Bay, 77°17′N., 69°59′W., $^{5}/_{8}$1928, depth 930 m, otter-trawl. "Godthaab" St. 90. 8 specimens.

Proven, about 72°20′N. Olrik 1860. 5 specimens (the original specimens of *Pectyllis arctica* Haeckel).

Rinksbank, about 69°45′N., 51°20′W. Bergendal 1890. 1 specimen.

Jakobshavn, about 69°12′N., 51°00′W. Traustedt 1892. 1 spec.

Off Sikkertoppen, 65°31′N., 54°31′W., $^{5}/_{7}$1895, depth 128 m, bottom haul 95–0 m. "Ingolf" St. 29. 3 specimens.

Broughton Island, about 61°N., four localities, depth 55–190 m, dredge & otter-trawl. K. Stephensen 1912 (see Kramp 1914).

East Greenland:

Franz Joseph Fjord, 76°19′N., 22°18′W., $^{17}/_{9}$1928, depth 75–200 m, Sandel Grund. "Godthaab" St. 156. 6 specimens.

North of Iceland, 67°19′N., 15°52′W., $^{29}/_{7}$1896, depth 552 m, trawl. "Ingolf" St. 126. 2 specimens.

South-east of Iceland, 65°00′N., 11°16′W., $^{28}/_{5}$1896, depth 584 m, trawl. "Ingolf" St. 59. 1 specimen.

Kara Sea, without further details. "Dijmphna" 1882–83. Numerous specimens.

Norway, off Toskoen in Mangerfjord, near Bergen, July 1932, depth about 300 m, near the bottom. Th. Mortensen. 2 specimens.

Remarks on the morphology:

A thorough description of this interesting medusa was given by E. T. Browne (1903), who had seen Allman's type specimens and also a number of specimens from the Norwegian coast; his description differed in several respects from those given by Allman and Haeckel. Maas (1906) further discussed the morphology of the medusa. Bigelow (1909 and 1913) examined some specimens from Labrador and from the Aleutian Islands; he fully confirmed the correctness of the description given by Browne, and I have very little to add.

As pointed out by Mayer (1910 p. 372), Browne does not mention the number of radiating ridges on the exumbrella of the medusa; but we know from Haeckel that the number is 16. Maas (1906 p. 183) likewise found 16 principal ridges and between them sometimes a number of less prominent folds which partly might be due to contraction. As a matter of fact, the appearance of the exumbrella is much dependent on the state of contraction. I have seen specimens preserved in an expanded state, the umbrella being considerably flatter than a hemisphere; in such specimens the surface of the exumbrella is almost smooth and the ridges hardly to be discerned. In contracted specimens, which have obtained a high and conical umbrella, the ridges are very prominent, with sharp edges; their number is 16, and eight of them, which follow the eight radial canals, are more prominent than the others. In specimens especially strongly contracted a varying number of short accessory ridges appear in the spaces between the sixteen principal ridges.

In the tentacles provided with an adhesive disk the endoderm consists of large cylindrical cells, and the ectodermal epithelium is extremely thin, with only very few scattered nematocysts (Pl. I figs. 1–3). The filiform tentacles, without suckers, likewise have a solid endoderm, but these tentacles are very contractile, and in the contracted state the endoderm cells are very flat, and the ectodermal epithelium is fairly thick and contains several nematocysts scattered throughout the length of the tentacle, though the more dense towards the distal end (Pl. I fig. 4).

The size of the medusa is usually given as 10–15 mm in diameter, but several of the specimens examined by me are larger, 18–22 mm in diameter.

In adult specimens there are 48 clusters of tentacles; I have however seen some young individuals, 4–8 mm wide, with only

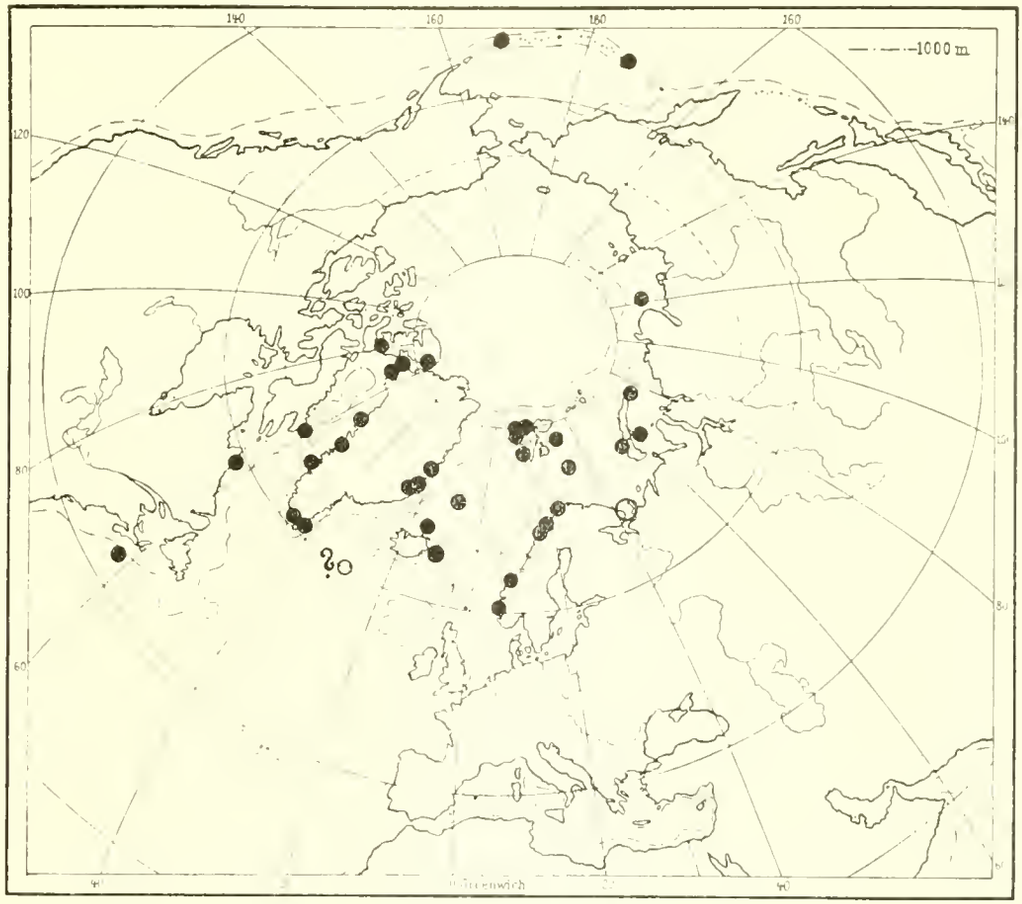


Fig. 1. Distribution of *Ptychogastria polaris*. ? exact locality unknown.

16 clusters; in all other respects these young specimens resemble the adult, and the gonads are already visible on the eight stomachal lobes which are all of equal size.

Colour: According to sketches, made on board the "Ingolf", St. 126, the colour of the subumbrella is a light pink, the gonads are scarlet, the stomach a deep red (Pl. VI figs. 1–2).

Comparison with other species. – I quite agree with Vanhöffen (1912a p. 386) that *Ptychogastria antarctica* (Haeckel) differs too much from *P. polaris* to be placed in the same genus, or even in the same family. The genus is, however, really represented in the Antarctic by *P. opposita* Vanhöffen (1902 b), a species greatly resembling the arctic *P. polaris*. *P. asteroides* (Haeckel) from the Adriatic Sea and the Straits of Gibraltar likewise seems to be a true *Ptychogastria*, though there is one feature which (provided that the description is correct) presents a serious obstacle against its affinities to this genus: the adhesive tentacles are said to be hollow, and in Haeckel's figure of a transverse section (1881, Pl. 7 fig. 1) the central canal is seen to be surrounded by an epithelium of endoderm cells with cilia waving into the hollow space, and the ectoderm is remarkably thick; these tentacles are, accordingly, fundamentally different from those of *P. polaris*, and from the tentacles of any other Trachymedusa as well.

Systematic position. – As far as the systematic position of *Ptychogastria* is concerned, I absolutely disagree with the supposition put forth by Maas (1906a p. 181) and provisionally followed by Bigelow (1909 b p. 311) that *Ptychogastria* should be associated with *Crossota* on account of "the arrangement of the several rows of tentacles". In *Ptychogastria* the tentacles are placed in distinct clusters, whereas in *Crossota* they make an uninterrupted whorl; and as previously pointed out by me (1942 p. 80) the tentacles of *Crossota* are not arranged in several rows or series. Thus the only point of connection supposed to exist between these two genera does not hold good, and in all other respects they are highly different. The species of *Ptychogastria* constitute a distinct family with an isolated position within the Trachymedusæ.

Occurrence:

Almost all the specimens in our collections were collected at the bottom of the sea, with dredge or trawl, at very different depths, varying from about 10 m (in East Greenland) to 930 m (Inglefield Bay, West Greenland); most of the records in the literature are from depths of less than 200 m. Haeckel (1881) records it from off Halifax, Nova Scotia, at a depth of 2200 m, but the specimen in question may possibly have been caught pelagically in a higher level. In all parts of the area of distribution the medusa has most frequently been collected at the bottom, where it most likely attaches itself to solid objects by means of the adhesive disks of its tentacles. It appears to Browne (1903 p. 29) that "a medusa, which has exceptionally powerful circular muscles lining the whole sub-umbrella and a strong muscular velum of exceptional width, would be a strong and active swimmer and not likely to spend much of its time crawling about the bottom of the sea". As a matter of fact, the vast majority of the specimens hitherto observed have actually been stationed on or near the bottom; but occasionally the medusa is met with swimming in the upper strata, sometimes even very near the surface of the water. It seems most likely, therefore, that the habit of the medusa is to spend some of its time attached to the bottom, usually at rather considerable depths, but occasionally to ascend to higher levels, and for such a habit of living the possession of strong muscles is highly required. Very likely Maas (1906 a p. 185)

[illegible] in comparing the habits of *Ptychogastria* with that of [illegible]. The latter, however, does not descend to great depths and, therefore, does not need such strong muscles in order to [illegible] to the surface again.

Geographical distribution (see the map, textfig. 1): *[illegible]* is an arctic, circumpolar species penetrating [illegible] boreal regions. The locality in deep water south-[illegible] of Iceland (marked with a query in the map) seems to me [illegible]; the record (by MAAS 1893 p. 20) was based upon [illegible] badly preserved specimens, and I feel sure that the identification must have been erroneous.

Fam. Halicreasidæ Fewkes 1896.

Trachylinæ with broad radial canals; with numerous tentacles of different sizes, but all structurally alike and arranged in a single series, each tentacle divisible into a soft flexible proximal and a stiff spine-like distal region, with free sensory clubs; with neither peduncle nor proboscis. (BIGELOW 1919 p. 321, slightly altered).

I fully agree with BIGELOW that the medusæ which agree with this definition constitute a separate family, and also that the rudimentary, flattened manubrium is the most characteristic feature of the group. It is to be deplored, therefore, that another able student of the medusæ (UCHIDA 1928 p. 80) not only reduces the family to the rank of a subfamily (Halicreasinæ), but will include into it the genus *Homoeonema* in which a proper manubrium with four lips is present.

Very different opinions have been advanced concerning the extension of this family and the limitation of its genera and species, and many difficulties have arisen on account of too vague descriptions of the species. I hope before long to be able to enter into a thorough discussion of these problems, based upon examination of very extensive collections from various parts of the world; some provisional remarks must, however, be forwarded on the present occasion.

One of the difficulties is due to MAAS's varying conceptions of the genus *Homoeonema* erected by himself in 1893. I shall abstain from a historical account of the fate of that genus in the present place and shall only remark that it seems to me highly probable that the Norwegian medusæ described and figured by BROWNE (1903 p. 21) under the name of *Homoeonema platygonon* Maas really belonged to that species, which is the type species of the genus; as its mouth is distinctly provided with four lips, it cannot be closely related to the Halicreasidæ. Some further remarks on *Homoeonema* will be found below under the discussion of some of the genera of Trachynemidæ.

The difficulties of the limitation of genera and species of the Halicreasidæ are mainly due to the incompleteness of the descriptions given by VANHÖFFEN in his paper on the "Valdivia" medusæ (1902). I shall first give the facts which seem to me beyond doubt. The family as defined above comprises four genera, the first genus, *Halicreas*, from which the name of the family has been derived, [illegible] by FEWKES (1882) for the species *Halicreas minimum*; [illegible] *Halicreas papillosum*, which was thoroughly described and [illegible] by VANHÖFFEN (1902), was proved by BIGELOW [illegible] *H. minimum*. The four other new [illegible] VANHÖFFEN (1902) and divided into two genera, *[illegible]* and *Haliscera*, have given occasion to endless discussion. [illegible] *Halicreas glabrum*, may safely be placed in the genus *Botrynema* Browne (1908) and is perhaps identical with the type species of this genus, *Botrynema brucei* Browne [illegible] *[illegible] ellinorae* Hartlaub (1909) like [illegible] *Haliscera*. [illegible] *Halitrephes* BIGELOW (1909a) [illegible] *H. [illegible]* Bigelow (1909) and *H. valdiviae* Vanhöffen (1902) [illegible] by the large number of radial canals. *[illegible]* *H[illegible]* Maas (1906b), of which I have seen a few specimens, is certainly a distinct species, probably of *Haliscera*.

The specific value of VANHÖFFEN's several species has been doubted by various authors, but none of them have come to definite conclusions. THIEL (1936) certainly went much too far in reducing the number of species to only two: 1) *Halicreas album* Vanhöffen (with only one kind of tentacles) also comprising *H. conicum* (Vanhöffen) and *H. racovitzai* (Maas). 2) *Halicreas papillosum* Vanhöffen (with eight long and numerous short tentacles), also comprising *Halicreas glabrum* Vanhöffen and *Halicreas rotundatum* Vanhöffen. RANSON (1936) maintains the genera *Halicreas* (with more than 15 tentacles in each octant) and *Haliscera* (with 12 or less tentacles in each octant), and he also observed a characteristic difference in the conformation of the umbrella in these two genera; he retains all VANHÖFFEN's species of *Halicreas*, and refers *Homoeonema platygonon* Maas to *Haliscera*. According to BIGELOW (1938 p. 121) it is obvious that "the five named representatives of the smooth-belled subdivision of the genus (*conicum*, *album*, *glabrum* and *rotundatum* Vanhöffen 1902; *racovitzai* Maas, 1906) stand in need of drastic reduction, successive studies (Bigelow 1909; Ranson 1936) having proved that the features on which Vanhöffen (1902) laid chief stress (degree of doming of the exumbrella, and precise location of the gonads on the radial canals), are too variable to be of taxonomic significance."

I am however not quite sure that the number of species may be much reduced; my own studies have convinced me that a number of distinct species exist, but I find it difficult to bring them into concordance with VANHÖFFEN's descriptions. As a matter of fact, no proper descriptions were given, except of *H. papillosum*, but only scattered remarks on certain distinguishing features, and the beautiful coloured figures are more artistic than elucidating. After I wrote my paper on the medusæ in the waters west of Greenland (KRAMP 1912) I have seen numerous specimens of *Botrynema brucei* Browne from almost every part of the Atlantic Ocean, which further confirmed my supposition that *Halicreas glabrum* Vanhöffen belongs to the same genus, and probably even to the same species; the peculiar structure and position of the tentacles thus entirely escaped the attention of VANHÖFFEN; in the uncoloured figure of *Halicreas papillosum*, seen from the exumbrella (Pl. IX fig. 8), the difference in size of the eight perradial and the other tentacles is clearly shown, but in the lateral view (fig. 7) nothing of the kind is indicated. One might be inclined to think that the artist has taken similar liberties in his delineation of some of the other figures.

Halicreas rotundatum is expressly stated to have 20 tentacles in each octant when 18 mm in diameter; it also has an evenly rounded, dome-shaped umbrella; I have not seen any medusa corresponding to this species; none of the dome-shaped specimens which I have seen had more than about 12 tentacles in each octant; nor has any other author. (Cfr. *Haliscera bigelowi*, p. 9).

The most characteristic feature of *Haliscera conica* is the conical shape of the umbrella; it was taken in one or two localities, south of Africa and in the Indian Ocean, one of the specimens was 18 mm in diameter, and according to fig. 33 on Pl. 11 it had 9 tentacles and two statocysts in each octant (fig. 6 on Pl. 9 shows 11 tentacles). Various authors have doubted the specific value of the shape of the umbrella; it should be pointed out, however, that the jelly of the Halicreasidæ is rather firm and resistent and apparently not very liable to alter its shape by preservation. As a matter of fact, all the numerous specimens of *Haliscera* which I have seen in the "Discovery" collections from the southern Atlantic and the Antarctic Ocean have the conical shape characteristic of *H. conica* and agree very well with that species, with the exception that the number of tentacles rarely exceeds 8 in each octant. It is the same species which occurs in the Mediterranean.

On the other hand, all the numerous specimens of *Haliscera*

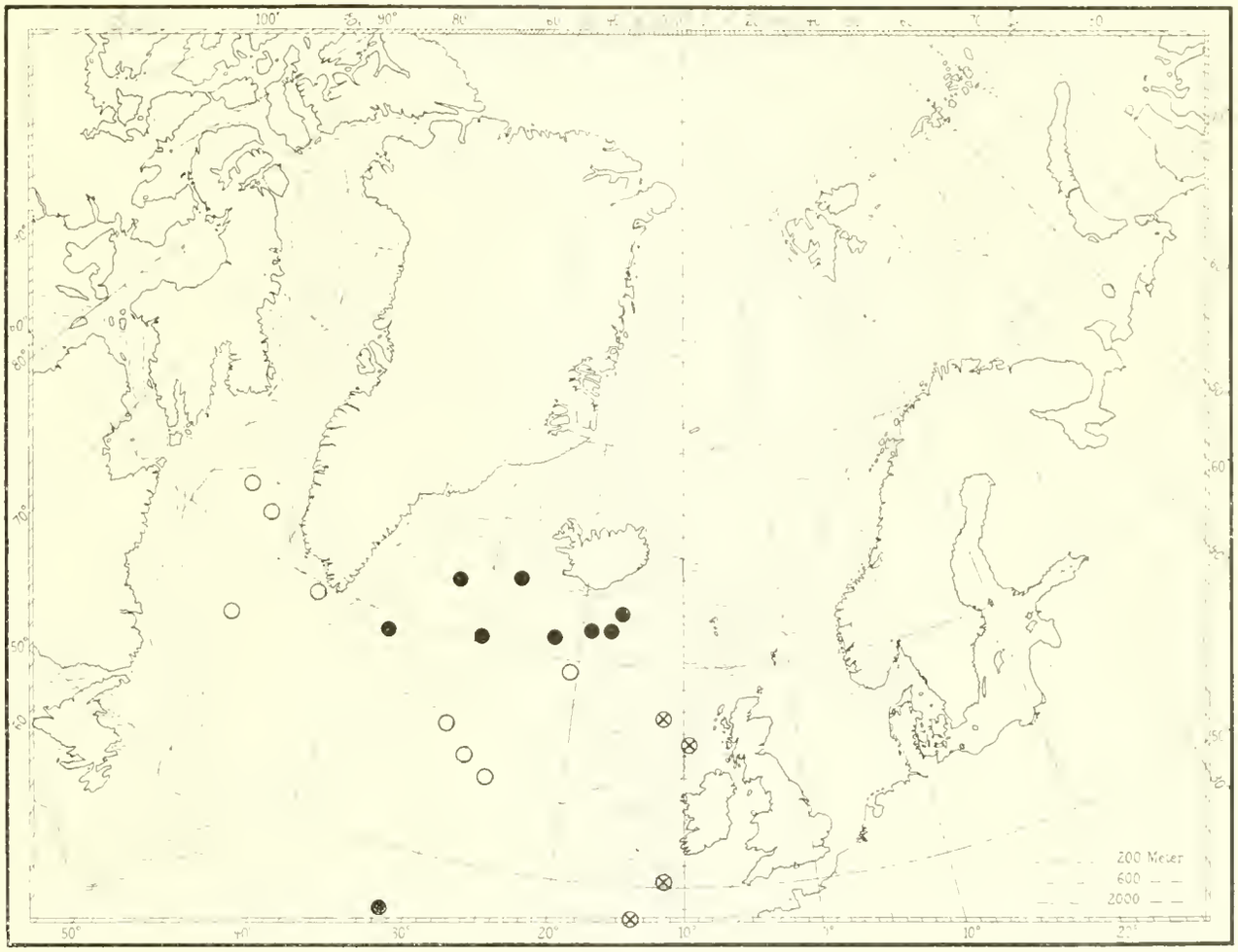


Fig. 2. Distribution in the northern Atlantic of *Halicreas minimum*. ● new records, ○ previous records, ⊗ records not yet published.

from the northern Atlantic examined by me, and further mentioned below, have an evenly rounded, dome-shaped umbrella with a thick jelly. They are about 17 mm in diameter, with about 12 tentacles in each octant. They agree fairly well with the specimens from the eastern tropical Pacific described and figured by Bigelow (1909 a p. 142) under the name of *Homoconema alba* (Vanhöffen); but it seems to me doubtful to refer them to that species. Vanhöffen's description of *Haliscera alba* was based on one specimen from the South Atlantic, a large medusa 35 mm in diameter, yet with only 8-10 tentacles in each octant. Moreover its gonads are described and figured as lancet-shaped, occupying a rather considerable portion of the radial canals, whereas in the Pacific as well as in the North-Atlantic specimens the gonads are short and broadly oval or nearly circular in outline. I prefer, therefore, to describe this form as a new species and name it in honour of professor H. B. Bigelow, *Haliscera bigelowi* n. sp.

Genus **Halicreas** Fewkes 1882.

Halicreasidæ with eight radial canals; with a continuous row of tentacles; with perradial, gelatinous papillæ on the exumbrella.

Halicreas minimum Fewkes.

Pl. VI fig. 3.

Principal references:

Halicreas minimum Fewkes 1882 p. 306.
– papillosum Vanhöffen 1902 b p. 68, Pl. IX figs. 7–8, Pl. X1 fig. 30.
Halicreas papillosum Bigelow 1909a p. 138, Pl. 3 fig. 3, Pl. 33 figs. 8, 9, Pl. 31 figs. 1–3, 5, 8, 10, 11.
Halicreas minimum Bigelow 1938 p. 122.

North-Atlantic records:

Halicreas minimum Fewkes 1882 p. 306; 1886 p. 953.
– papillosum Kramp 1920 p. 5.
– – Bigelow 1926 p. 67.
– – Ranson 1936 p. 161.
– minimum Kramp 1942 p. 70.

Material (see the map, textfig. 2):

61°31′N. 19°05′W.,	$\frac{10}{7}$1901.	"Thor" St.	180.	2 specimens.
61°30′N. 17°08′W.,	$\frac{11}{7}$1901.		183.	6 –
63°19′N. 26°50′W.,	$\frac{24}{5}$1928.	"Godthaab" St.	1.	1000 m wire, 2 spec.
59°30′N. 45°23′W.,	$\frac{29}{5}$1928.	–	5.	300 m 1 –
56°56′N. 51°17′W.,	$\frac{3}{6}$1928.	–	10.	3000 m 7 –
62°19′N. 56°00′W.,	$\frac{14}{6}$1928.	–	21.	1000 m 6 –
–		–	21.	2500 m 1 –
60°59′N. 22°29′W.,	$\frac{29}{5}$1925.	"Dana" St.	2306.	3000 m wire, 9 –
60°20′N. 29°21′W.,	$\frac{31}{5}$1925.		2307.	1500 m 1 –
59°21′N. 37°56′W.,	$\frac{1\ 2}{6}$1925.		2308.	3000 m 115 –
–			2308.	1000 m 58 –
61°17′N. 52°55′W.,	$\frac{9}{7}$1925.		2101.	1900 m 2 –
62°35′N. 32°53′W.,	$\frac{27}{7}$1925.		2137.	1900 m 1 –
17°02′N. 31°15′W.,	$\frac{27\ 28}{6}$1931.		1201.	2000 m 7 –
–			1201.	3000 m 70 –
–			1201.	1000 m 10 –
–			1201.	5000 m 33 –
–			1201.	6000 m 25 –
62°23′N. 16°05′W.,	$\frac{25}{6}$1932.		1102.	3000 m 13 –
–			1102.	1000 m 17 –
62°36′N. 32°18′W.,	$\frac{16}{8}$1933		1687.	2000 m 7 –

In the map (textfig. 2) are included four localities in which this species was collected by the "Michael Sars" North Atlantic Deep-Sea Expedition 1910. I have seen these specimens, but they are not yet recorded in the literature. They were taken in hauls with 1000–3000 m wire out.

The species was well described by VANHÖFFEN (1902 b); moreover PETERSEN (1909 a) has given some excellent figures illustrating the peculiar structure of the tentacles. The majority of the numerous specimens examined by me are in a poor state of preservation, but some few are in good condition, even with some of the tentacles and statocysts completely retained; they fully agree with the descriptions already given. A discussion on the individual variation and the frequent abnormalities is better postponed for another occasion, in connection with the extensive collections from other geographical regions which have been placed at my disposal.

The colours of the medusa are not quite as given by VANHÖFFEN (1902 b, Pl. IX fig. 7): the gonads are a pure scarlet, the stomach and radial canals pink, the tentacle stumps carmine (Pl. VI fig. 3, from a coloured sketch made by me on board the "Godthaab").

Halicreas minimum is a bathypelagic medusa with a world-wide distribution. The map (textfig. 2) clearly shows that its horizontal distribution in the northern Atlantic is limited by the continental shelves and the submarine ridges connecting Scotland, Iceland, Greenland, and Baffin Land. With one exception ("Godthaab" St. 5) the North-Atlantic localities are all outside the 1000 m line. "Godthaab" St. 5 was near the south point of Greenland at a depth of only 294 m, and one single specimen was taken about 200 m below the surface in water with a salinity of 31.94 ‰, same as in the deep strata outside the shelf, where the medusa was common. It is also the only instance of the medusa occurring so near the surface in this geographical region: all other North-Atlantic specimens were taken in hauls with at least 1000 m wire out, about 650 m below the surface. The species was nowhere abundant in depths of less than about 2000 m below the surface, whereas most of the hauls taken with 3000–6000 m wire out (about 2000–4000 m below the surface) brought forward a large number of specimens. The vertical distribution is particularly well illustrated by the catches at "Dana" St. 1201: the ring-trawl with bag of stramin and with an opening diameter of 150 cm, towed horizontally during 4 hours and with 2000 m wire out, caught only 7 specimens, whereas a considerable number were taken in the same kind of net towed simultaneously with 3000 m wire (70 specimens), 4000 m wire (40), and 5000 m wire (33); the deepest haul in this locality was made with a larger net, diameter 300 cm, and with a bag of coarser net; it took 25 specimens during the four hours. The medusa was taken in still greater numbers in a locality further north, "Dana" St. 2308, where 115 specimens were caught by the 2 m ring-trawl during a haul of 2 hours' duration with 3000 m wire out, and 58 specimens in the haul with 4000 m wire, whereas none were taken in the hauls made on higher levels.

In the warmer regions of the Atlantic Ocean the occurrence of *H. minimum* does not seem to be restricted to the deep strata. According to THIEL (1935 p. 48) its vertical distribution in the central part of the ocean ranges from about 75 m to about 800 m below the surface with two maxima, one between 50 and 100 m, another between 200 and 400 m down (it should be borne in mind, however, that the material identified by THIEL as *H. papillosum* probably comprises three different species: the true *H. minimum* as well as *H. sedatum* and *H. rotundatum* which, in his opinion, are synonyms). In the Sargasso Sea, south-east of the Bermuda Islands, *H. minimum* "may occasionally come right up to the surface" (BIGELOW 1938 p. 124), though its principal occurrence is in deeper strata, "at least as deep as 1,000 [600] meters".

THIEL (1935 p. 46) found an increase of the average size of the specimens from the upper strata downwards, and he concluded that the eggs or young larvæ rise towards the surface, whereas the medusæ, while growing larger, gradually sink back into the deep-sea (the specimens at his disposal were all young ones, less than 10 mm in diameter). A tendency in the same direction is indicated by the North-Atlantic collections examined by me, as seen from the accompanying table showing the size limits of the individuals taken at different depths. I would, however, not attach too much importance to these figures which may prove to be entirely casual; but I shall return to the question, when my studies on the collections from the central and southern parts of the Atlantic Ocean are finished.

m wire out	Diameter of specimens, mm
1000	22–29
2000	9–26
3000	9–35
4000	12–35
5000	20–30
6000	22–30

Geographical distribution: *Halicreas minimum* occurs in the deep parts of all the oceans, except in the arctic seas. There are regions of the Indian and Pacific Oceans, from which it has not yet been recorded, but there is every reason to believe that its distribution in these oceans really comprises the entire deep-sea areas. In the Atlantic Ocean it is generally distributed in the deep basins from the submarine ridges in the North Atlantic to the shelf of the Antarctic Continent. In the Pacific its area of distribution comprises the Bering Sea; the deep-sea of that water is in direct connection with the deep-sea of the Pacific Ocean and forms a continuous part of it, in the same manner as the deep-sea areas west and east of the southern part of Greenland are continuous portions of the Atlantic deep-sea basin.

Genus **Haliscera** Vanhöffen 1902.

Halicreasidæ with eight radial canals; with a continuous row of tentacles; without exumbral papillæ.

Haliscera bigelowi n. sp.

Pl. I figs. 5–8, Pl. II figs. 1–2.

Homoconema alba Bigelow 1909 a p. 142, Pl. 3 figs. 1, 2, Pl. 33 figs. 6, 11, Pl. 31 fig. 9.

Material (see the map, textfig. 3):

57°03′N. 11°20′W.,	$^{28}/_{5}$1908.	"Thor" St. 12.	300 m wire.	2 specim.
63°19′N. 26°50′W.,	$^{21}/_{5}$1928.	"Godthaab" St. 1.	1000 m wire.	1 spec.
63°32′N. 26°23′W.,	$^{28}/_{7}$1925.	"Dana" St. 2438.	1500 m wire.	75 –
62°23′N. 16°05′W.,	$^{25}/_{6}$1932.	– –	1402. 3000 m	– 6 –
62°23′N. 16°05′W.,	$^{25}/_{6}$1932.	– –	1402. 3000 m	– 6 –
		–	1402. 4000 m	– 4 –
62°36′N. 32°48′W.,	$^{16}/_{8}$1933.	– –	1687. 1000 m	– 5 –
62°45′N. 16°01′W.,	$^{7}/_{5}$1934.	– –	5083. 1000 m	– 1 –
–	–	– –	5083. 1500 m	– 30 –
–	–	– –	5083. 2000 m	– 20 –

Moreover taken by the "Michael Sars" in the following localities:

17°31′N. 13°11′W.,	$^{11}/_{7}$1910.	"Michael Sars" St. 80.	950–525 m	
48°02′N. 39°55′W.,	$^{12}/_{7}$1910.	– –	81. 2000 m	wire
16°18′N. 27°46′W.,	$^{17}/_{7}$1910.	–	87. 1900–0 m	
15°26′N. 25°15′W.,	$^{18}/_{7}$1910.	–	88. 1000 m	wire
48°29′N. 13°55′W.,	$^{23\ 24}/_{7}$10.	–	92. 600 m	–
50°13′N. 11°23′W.,	$^{26}/_{7}$1910.	–	91. 600 m	–
56°33′N. 9°30′W.,	$^{5}/_{8}$1910.	–	98. 1000 m	–
–	–	–	98. 1500 m	–
57°11′N. 11°48′W.,	$^{6\ 7}/_{8}$1910.	–	101. 1000 m	–
		–	101. 2000 m	–

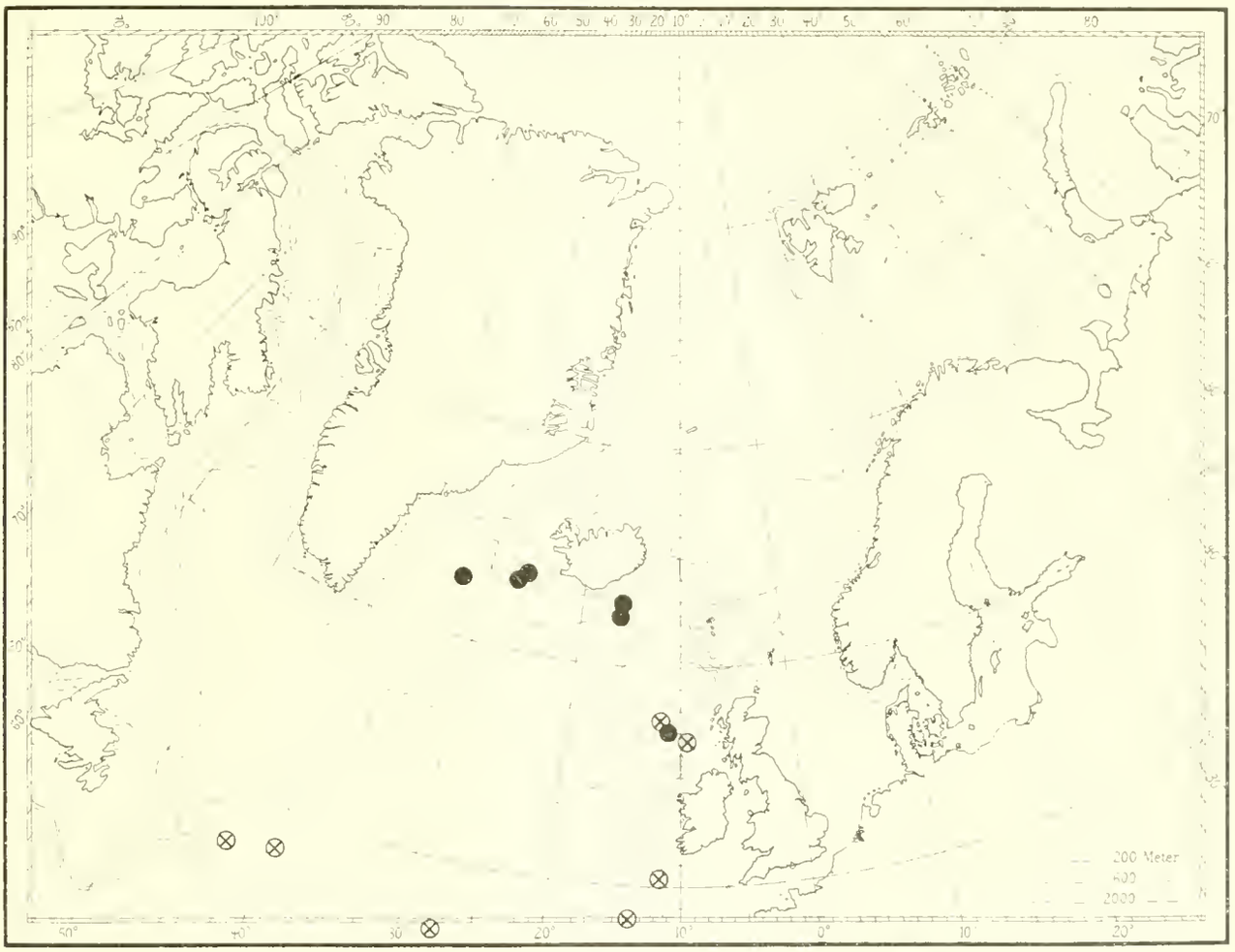


Fig. 3. Distribution in the northern Atlantic of *Haliscera bigelowi*. ● new records; ⊗ records not yet published.

Description: (Pl. I fig. 5) Umbrella almost hemispherical, its central portion consisting of a thick, hemispherical mass of jelly, by a slight constriction separated from the marginal portion which has fairly thin walls; the apical gelatinous portion comprises nearly two thirds of the entire height of the medusa.

The stomach (Pl. I fig. 6) is very broad and flat, slightly conical in shape; it has a circular outline, and the mouth is a circular opening varying in width according to the state of contraction. There are eight broad radial canals and a broad circular vessel. The gonads (Pl. I fig. 6) are broadly oval, comprising about two fifths of the length of the radial canals and placed somewhat nearer to the stomach than to the circular vessel; in female specimens each gonad contains about seven large eggs in one layer. The gonad is usually rather flat, but in certain states of contraction it is doubled up after a longitudinal line and thereby attains a laterally compressed appearance.

In the specimens examined almost all the tentacles are broken off, leaving only the basal stumps (Pl. I fig. 7); a few small tentacles are retained, showing that they have the same structure as in other species of Halicreasidæ (Pl. I fig. 8). The number of tentacles is usually about 96 (12 in each octant); in some of the octants there may be 11 or 13; the full number of tentacles is attained at an early stage of development; in the smallest specimen examined, which is 5 mm in diameter, there are about 80 tentacles; another small specimen, 6 mm wide, has about 96, and in the largest specimen, 19 mm in diameter, the number does not exceed 100. The tentacles are all of the same structure, but varying in size; the eight perradial tentacles are not distinctly larger than the others. The distribution of large and small tentacles between the perradials is rather irregular; two small ones or two fairly large ones are frequently placed side by side.

The statocysts (Pl. II figs. 1–2) are elongated club-shaped, as in other species of Halicreasidæ; the endoderm core consists of about 10 cells each with a large nucleus except the two or three distal cells, in which no nuclei are seen; as all the specimens are preserved in formalin, the statoliths have completely disappeared. The ectoderm consists of two different kinds of cells; in the distal half or two thirds of the club there are two lateral rows of rectangular cells, rather high and rich in protoplasm; they have most probably carried sensory hairs; in the proximal portion of the club and on the abaxial and adaxial sides of the distal portion the epithelium consists of large, flattened cells with irregular outlines, usually somewhat elongated in the longitudinal direction of the club.

There are three statocysts in each octant, and their position among the tentacles is very characteristic and rather constant (Pl. I fig. 7); when the number of tentacles in an octant is 12, we shall almost always find the statocysts placed as follows (the medusa seen from the exumbral side, the bell margin downwards): to the right hand side of a perradial tentacle we first see another tentacle and then a statocyst followed by 3 tentacles, one statocyst, 3 more tentacles, and again one statocyst, but between this third statocyst and the first one in the next octant there are 6 tentacles! A statocyst in the middle of this group of six tentacles would result in a completely symmetrical and regular position of statocysts round the umbrella margin, with three tentacles between each successive pair of statocysts, but I have never seen a statocyst on the left hand side of a perradius. I do not think that

the absence of it entirely in this place is due to its being broken off. Since the statocysts are small and delicate organs, they are sometimes missing, and even in badly preserved specimens most of them are retained and always as described here; variations are only observed when the number of tentacles in an octant is smaller than twelve. The statocysts are thus asymmetrically placed within one octant, but they are placed in the same manner in all the octants.

The velum is extraordinarily broad, but with a weak musculature.

Diameter of umbrella usually about 15–17 mm, height 9–10 mm.

The only specimen which I have seen alive ("Godthaab" St. 1) was colourless.

The specimen from "Godthaab" St. 1 is chosen as the **type specimen**. It is a male individual, fairly well preserved, with the exception that the stomach is damaged. The above description of the stomach and the female gonads is based on other specimens, especially from "Michael Sars" St. 98.

Comparison with other species. The North-Atlantic specimens described here agree in almost all respects with the description given by Bigelow (1909 a) of the medusa from the eastern Pacific referred by him to *Halicreas alba* Vanhöffen; the differences are so slight that I feel almost sure they belong to the same species. According to Bigelow the female gonads contain "many large eggs" (number not stated), whereas in the North-Atlantic specimens there are rarely more than seven eggs in each gonad, nine being the largest number observed. Bigelow describes the gonads as "rounded and deep", not flat; as stated above, the gonads as I have seen them are sometimes flat, sometimes laterally compressed. The most serious obstacle against uniting the Pacific and the Atlantic forms into one species, is the relative size of the tentacle stumps, according to Bigelow "the radial ones are much stouter and longer than those between the canals," whereas I have found that if there is a difference, it is not distinctly pronounced. In one and the same specimen the eight perradial tentacle stumps may, however, be of somewhat varying size, and the same seems to be possible in the Pacific specimens, as seen from Bigelow's figure of the bell margin, Pl. 33 fig. 11, in which the two perradial tentacle stumps are of very different size, and one of them is hardly larger than some of those between the two canals. It should also be remarked that apparently the tentacles are not always broken off exactly at their point of issue from the bell margin, so that we cannot be sure that the size of the remaining, basal part of the endodermal core gives a true impression of the size of the tentacle which in the living specimen issued from that point. This difference in the descriptions by Bigelow and by me, therefore, does not seem to me to be of such decisive importance as to involve a specific difference between the Atlantic and the Pacific forms. As mentioned above (p. 7) I do not think that any of them belongs to *Halicreas alba* Vanhöffen, and both of them are quite distinct from *Halicreas conica*, which has a conical umbrella and only 61 tentacles and 16 statocysts, and from *Halicreas rotundatum* Vanhoffen which has 160 tentacles.

Distribution. *Halicreas bigelowi* is a bathypelagic medusa, apparently to be generally distributed in the North-Atlantic [illegible] at least as far south as Lat. 15° N. It was taken in the Faroe Channel and the Davis Strait in five localities south and [illegible] partly in considerable numbers; in 1908 a [illegible] was taken east of Rockall by the "Thor", and in the "Michael Sars" North-Atlantic deep-sea expedition in 1910 [illegible] several localities west and south-west of the British Isles, north of the Azores, and east of the New Foundland Banks. The records by Bigelow (1909 a) are from eight localities in the eastern tropical Pacific between about 0° and 25° S., where it was taken in vertical hauls from 300 fathoms to the surface. If the medusæ found in these two widely separated areas really belong to one species, it is to be expected that this species will prove in future to have an extensive distribution in the deep-sea areas of the oceans.

Genus **Botrynema** Browne 1908.

Halicreasidæ with eight radial canals; with sixteen groups of tentacles (two groups containing many tentacles in a single row in each octant) and eight solitary perradial tentacles.

In a previous paper (Kramp 1942 p. 73) I have discussed this genus and its species. Numerous specimens had been collected in the deep-sea areas west of Greenland, and I pointed out that all specimens from the Baffin Bay had an evenly rounded umbrella, whereas in all specimens taken in the Atlantic water south of the submarine ridge across Davis Strait the apical jelly had an enormous thickness and was provided with a very distinct and sharply defined apical knob (Pl. VI fig. 4). Though the two forms were alike in all other respects, I concluded that they belonged to two different species; the northern form, from the arctic basin of the Baffin Bay, certainly belongs to *Botrynema ellinora* (Hartlaub), the southern form agrees perfectly with *B. brucei* Browne, originally described from the Antarctic Ocean. Later on I have examined extensive collections of *Botrynema brucei* from almost all parts of the Atlantic Ocean, and all these numerous specimens, except very young ones, possess the remarkably thick jelly and the distinct apical knob, which I had observed in the specimens from Davis Strait. They confirm, therefore, my supposition that the arctic *B. ellinora* and the Atlantic *B. brucei* are two distinct species, though they differ from each other only in colour and in the shape of the umbrella, this difference however being remarkably constant.

In the paper quoted above I also called attention to the possibility that *Halicreas glabrum* Vanhöffen might be identical with *Botrynema brucei* Browne. The name *Halicreas glabrum* was given by Vanhöffen (1902 b) to a medusa taken by the "Valdivia" expedition in the tropical and southern parts of the Atlantic; the species was not properly described, and if the figure (Pl. 9 fig. 3) really has been drawn after a specimen of *Botrynema*, it gives an altogether wrong conception of the bell margin. I am therefore still of the opinion, expressed in my former paper (1942 p. 77) that "the name of the cosmopolitan species must remain *Botrynema brucei* Browne and should not be replaced by *glabrum*, because the description of that species is really beyond recognition."

The identity of the genera *Botrynema* Browne 1908 and *Alloiocnema* Hartlaub 1909 was pointed out by Bigelow (1913 p. 52); he examined some specimens taken in the northern Pacific and referred them to *B. ellinora* (Hartlaub), but they most certainly belong to *B. brucei* (see Kramp 1942 p. 76).

Both species are now so well known that I have very little to say about their morphology. I am able to state, however, that the tentacles have the same structure as in other species of Halicreasidæ; in all specimens hitherto observed the tentacles are all broken off near their base, but in some of the specimens at my disposal I have found a few very young tentacles fully preserved (Pl. I fig. 9). The statocysts are likewise very similar to those of *Halicreas* and *Halisecra* (Pl. II fig. 3). They are placed in the 16 spaces between the groups of tentacles; in both species there are usually 3 statocysts in each of the interradial spaces and one or two on either side of the perradial tentacles, but in a few specimens of *B. brucei* I have found a perradial tentacle flanked by 3 statocysts on either side.

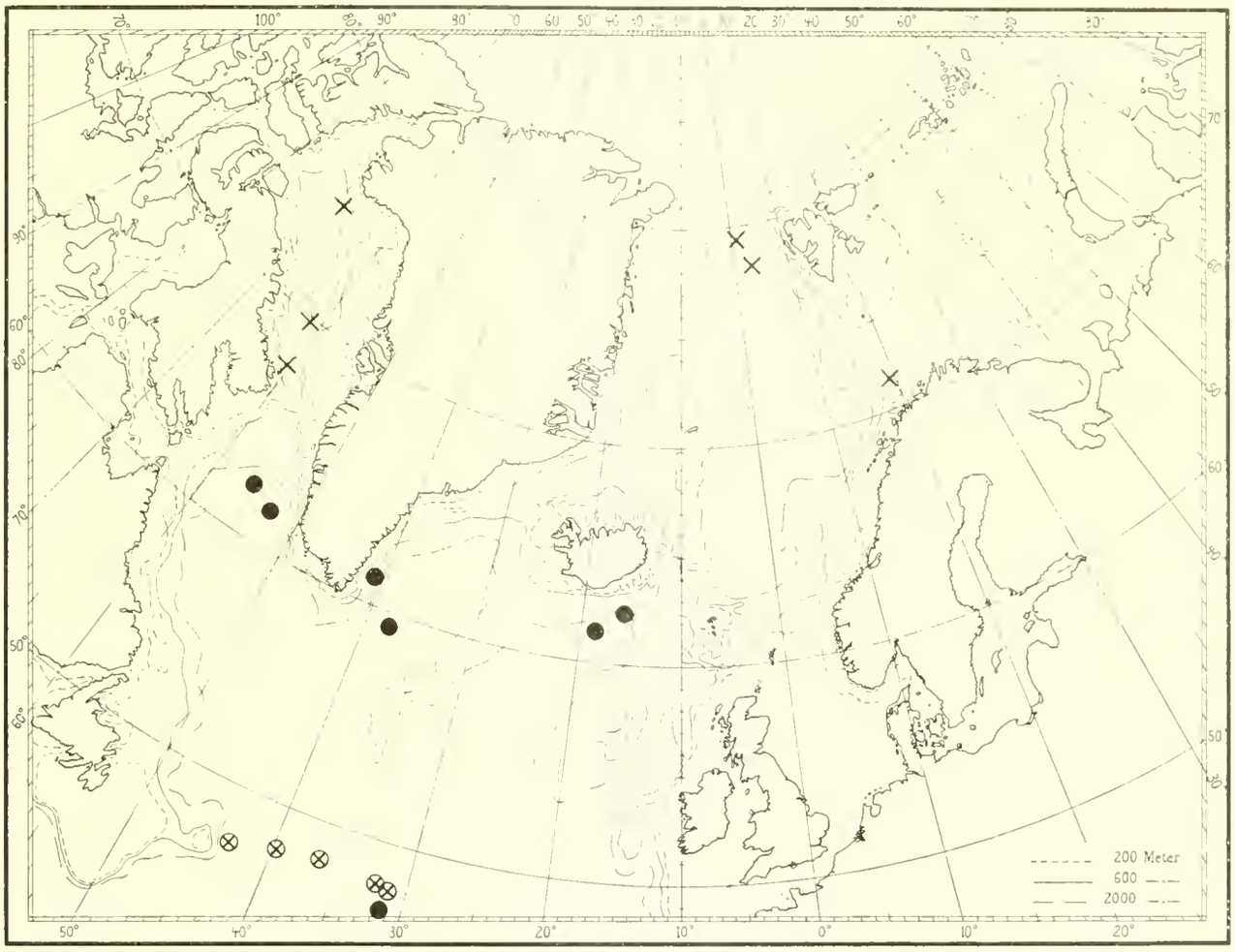


Fig. 4. Distribution in the northern Atlantic of: ● *Botrynema brucei*, new records; ⊗ do., records not yet published; × *Botrynema ellinoræ*.

Botrynema ellinoræ (Hartlaub).

Alloionema ellinoræ Hartlaub 1909 p. 8, Pl. 76 figs. 3, 4, 6.
Botrynema ellinoræ Kramp 1942 p. 77.

I have seen no other specimens of this species than those taken by the "Godthaab" expedition 1928 and mentioned by me in 1942; they were taken in three localities in the deep basin of Baffin Bay, about 1000–1800 m below the surface at temperatures between 0° and + 0.4°.

Further distribution (see the map, textfig. 1): Between East Greenland and Spitzbergen and north of Norway, in deep water (Hartlaub).

Botrynema brucei Browne.

Pl. I fig. 9, Pl. II fig. 3, Pl. VI fig. 4.

? Halicreas glabrum Vanhöffen 1902 b p. 70, Pl. 9 fig. 3.
Botrynema brucei Browne 1908 p. 239, Pl. 1 figs. 8–9, Pl. 2 fig. 1.
– – Vanhöffen 1912a p. 382, textfigs. 18–19, Pl. 25 fig. 5.
Botrynema ellinoræ Bigelow 1913 p. 53, Pl. 1 figs. 1–4.
? Halicreas glabrum Ranson 1936 p. 167.
– Bigelow 1938 p. 124.
Botrynema brucei Kramp 1942 p. 77.

North-Atlantic record:
Botrynema brucei Kramp 1942 p. 77.

Material (see the map, textfig. 4):

61°34′N. 19°05′W., $^{10}_{7}$1904.	"Thor" St. 180.	1 specimen.		
62°19′N. 56°00′W., $^{14}_{6}$1928.	"Godthaab" St. 24.	1000 a. 2500 m wire		
59°21′N. 37°56′W., $^{1\ 2}_{6}$1925.	"Dana" St. 2308.	3000 m wire.	70 spec.	
– – –	–	2308. 4000 m	–	24
61°47′N. 52°55′W., $^{9}_{7}$1925.	–	2401. 1900 m	–	8
61°13′N. 40°57′W., $^{25}_{7}$1925.	–	2436. 1700 m	–	1
47°02′N. 31°45′W., $^{27\ 28}_{6}$31.	–	1201. 4000 m	–	85
– –	–	1201. 5000 m		235
–	–	1201. 6000 m		12
62°23′N. 16°05′W., $^{25}_{6}$1932.	–	1102. 4000 m	–	20

In the map, textfig. 4, are included the localities in which this species was collected by the "Michael Sars" North Atlantic Deep-Sea Expedition 1910.

This species is easily recognizable, even if badly preserved. The gelatinous substance is very resistent, and the medusa is, therefore, at once conspicuous by the characteristic shape of the umbrella. Moreover, in all the numerous specimens I have seen, traces of the sixteen groups of tentacles are always distinguishable, even in specimens in a very poor condition. The female gonads have never been properly described, and unfortunately none of the female specimens at my disposal are sufficiently well preserved to allow a closer examination of their gonads; I am, therefore, unable to state whether they have contained many small eggs or few large ones. The male gonads are shield-shaped, with the apex pointing towards the bell margin, and rather flat.

Colour: The stomach and the radial canals are bright scarlet, the circular vessel somewhat lighter, the tentacle stumps likewise

[illegible] (Pl. VI fig. 4, from a coloured sketch made by [illegible] Godthaab.)

Occurrence. *Botrynema brucei* evidently belongs to the deep-[illegible] fauna, and seems to be fairly abundant in the deep strata in the northern Atlantic. East of the south point of Greenland ("Dana" St. 2908) the ring trawl, 2 m in opening diameter and with bag of [illegible] towed horizontally during 2 hours with 3000 m wire out, brought forward 70 specimens, and 24 specimens with 4000 m wire out at "Dana" St. 1201, about midway between Newfoundland and the Bay of Biscay, hauls were made in several different strata, but no specimens of *Botrynema* were taken with less than 1000 m wire out. 85 specimens were taken by the $1^1/_2$ m ring-trawl in a haul of 4 hours' duration with 1000 m wire out, and no less than 235 with 5000 m wire, the deepest haul at this station, with 6000 m wire out, was made with a larger net, 3 m in diameter, with a bag of rather coarse net, and it captured only 12 specimens during the four hours. Other records of this species likewise show that it is an inhabitant of the deep strata of the oceans.

Geographical distribution. Most of the localities mentioned above are in the northernmost part of the Atlantic deep-sea basin, west and east of southern Greenland and south of Iceland. Moreover the species was taken by the "Michael Sars" North Atlantic Expedition in 1910 at a series of stations east of the Newfoundland Bank in horizontal hauls with 1500–3000 m wire out. The original specimen, described by Browne (1908) was found near the south point of South America, and Vanhöffen (1912 a) records it from the Antarctic Ocean N.W. of the Gauss-station, about 80° E. In the "Discovery" collections I have seen numerous specimens from the southern Atlantic, south of about 31° S., and from the Antarctic Ocean as far as about 110° E., south of Australia. If "*Halicreas glabrum*" Vanhoffen is identical with *Botrynema brucei*, the North-Atlantic and South-Atlantic areas of distribution are connected by several finds: off the west coast of Africa between about 12° S. and 25° N. (Vanhöffen 1902 b), near the Azores (Ranson 1936), and near the Bermudas (Bigelow 1938). The "Valdivia" also took it in the Indian Ocean. As the *Botrynema* recorded by Bigelow (1913) from the Bering Sea and northern Pacific undoubtedly belongs to *B. brucei*, it seems probable that this species also occurs in other parts of the Pacific Ocean, so that presumably it has a world-wide distribution in the deep fauna of the oceans, except in the arctic seas, where it is replaced by *Botrynema ellinora*.

Fam. Trachynemidæ Gegenbaur 1856.

Whereas, in my opinion, the Halicreasidæ constitute a well-defined family, the limit between the Trachynemidæ s. str. and the Aglauridæ is not sharp and I does not justify a division into two families. Bigelow (1909 a) simply included the Aglauridæ in the family Trachynemidæ (but excluded the Halicreasidæ as a separate family). Mayer (1910) subdivided the Trachynemidæ into two sub-families, Rhopalonememinæ (including the Halicreasidæ) in which the stomach lacks a peduncle, and Aglaurinæ, in which the stomach is mounted upon a peduncle. Uchida (1928) separates the Halicreasinæ as a third sub-family, and apparently on account of the indistinctness of the two others, since his definitions are very vague. Rhopalonememinæ: Statocysts [illegible]. Gonads linear or oval. (The manubrium is [illegible]). Aglaurinæ: Statocysts generally [illegible] or pendant. Thiel (1936) follows Uchida in retaining the three old families, Trachynemidæ, Halicreasidæ and Aglauridæ.

I am unable to see how to group and divide the other genera [illegible] according to the absence or presence of a peduncle, the limit between these latter is fairly sharp, in so far as the Aglaurinæ all possess a well developed peduncle, whereas only one species of the Rhopalonememinæ (*Crossota pedunculata* Bigelow) has a short peduncle. There are, however, other characters which might seem to be of no less taxonomic importance than the peduncle, particularly the shape of the gonads. In the majority of the Rhopalonememinæ the gonads are linear along the radial canals, in most of the Aglaurinæ they are sausage-shaped, pendent, hanging free in the bell cavity; but within both groups we also find globular gonads (*Sminthea* and *Arctapodema*: *Amphogona* and *Stauroglaura*): in *Homoconema* the gonads form a continuous band around the base of the manubrium with outgrowths along the radial canals, and in two genera usually placed among the Rhopalonememinæ (*Tetrorchis* and *Crossota*) they are pendent and very similar to the gonads of *Aglantha*. Finally in the peculiar species *Aglantha krampi* Ranson the gonads are linear, discontinuous, and placed along that part of the radial canals running down the stomachal peduncle.[1]) Uchida (1928) was probably not altogether wrong in referring *Crossota* to the Aglaurinæ, though most of the species of that genus are destitute of a peduncle: in the shape of the gonads, however, *Crossota* resembles Aglantha.

A subdivision of the Trachynemidæ into two sub-families, with or without a peduncle, thus seems somewhat artificial, but with our present imperfect knowledge of the minor structure of the various organs it is premature to attempt a natural classification of the several genera. At present I, therefore, follow Bigelow (1909 a pp. 101 and 117) and simply include the genera, formerly divided into two families or sub-families, into the one family Trachynemidæ with the following definition, proposed by Bigelow and only slightly altered:

Trachymedusæ with eight or more radial canals; without blind centripetal canals; with well-developed manubrium; with numerous tentacles, of either one or two kinds, but arranged in a single series; with or without a gelatinous peduncle; gonads either linear, globular, or pendent.

In the northern Atlantic the following genera are represented: *Rhopalonema*, *Homoconema*, *Colobonema*, *Pantachogon*, *Crossota*, and *Aglantha*. – An altogether uncertain species was described by Hartlaub (1909 p. 6) as *Trachynema arctica* from the arctic sea between Spitzbergen and Greenland; it was referred, with doubt, to the genus *Smithea* by Brocu (1929 p. 499) and Thiel (1932 a p. 152).

Genus **Rhopalonema** Gegenbaur 1856.

Trachynemidæ with 32 tentacles, of two kinds, *i. e.* radial clubs, and inter- and adradial cirri; with enclosed statocysts; without a stomachal peduncle.

This is the definition as expressed by Bigelow (1909 a p. 127) in accordance with Vanhöffen's conception of the genus (1902 b p. 59).

I still believe that *Rhopalonema funerarium* Vanhöffen is a proper species distinct from *R. velatum* Gegenbaur, whereas *R. coeruleum* Haeckel is most probably identic with this latter.

[1]) *Aglantha krampi* was described by Ranson (1932 pp. 1–19, figs. p. 6), and I appreciate the honour he bestowed upon me in naming it after me. Before publishing his description Mr. Ranson sent the specimens to me, and I can state that it really is a most peculiar species; in general appearance it is very like *Aglantha digitale*, but the gonads are entirely different in structure and position from those of *Aglantha*; moreover it differs from *Aglantha* in lacking the characteristic bands along the sides of the radial canals (Ranson calls them radial muscular bands, but I cannot see any muscle fibres in them). It therefore seems unavoidable to erect a new genus for this species, and I propose the generic name **Ransonia** nov. gens. The species should accordingly be named *Ransonia krampi* (Ranson).

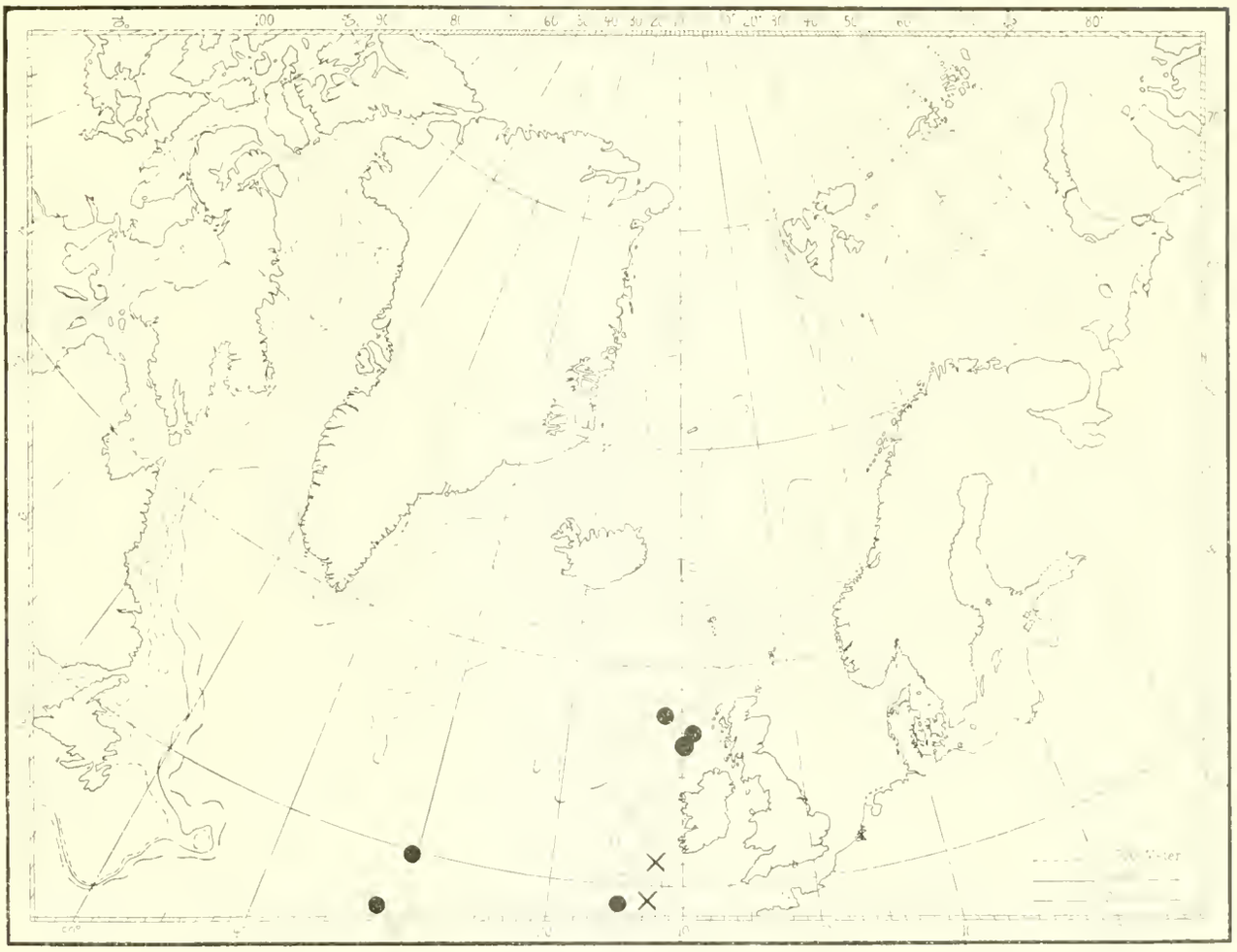


Fig. 5. Distribution in the northern Atlantic of: ● *Rhopalonema velatum*; × *Rhopalonema funerarium*.

Rhopalonema velatum Gegenbaur.

North-Atlantic records:

Rhopalonema coeruleum Browne 1906 p. 172.
– velatum Vanhöffen 1912a p. 371.
– – Bigelow 1914 p. 20.
– – – 1918 pp. 388, 133.
– – – 1926 p. 54.
– – Ranson 1936 p. 137.

Material (see the map, textfig. 5):

57°47′N. 11°43′W., $^{7}/_{6}$1905. "Thor" St. 71. 1 specimen
49°04′N. 14°52′W., $^{6}/_{6}$1906. – – 65. 300 m wire. 4 spec.
56°56′N. 9°01′W., $^{28}/_{5}$1908. – – 11. 65 m – 1 –
47°02′N. 31°15′W., $^{27\ 28}/_{6}$31. "Dana" St. 4201. 50–6000 m wire
49°49′N. 30°22′W., $^{30}/_{6}$1931. – – 4203. 50–600 m –

In the two last-mentioned localities the species was taken at different depths, from very near the surface to about 1000 m down, though it is possible that some of the specimens taken in the deepest hauls were actually captured during the hauling in of the nets. At both stations the four uppermost hauls, with 50–600 m wire out, were made with the 2 m ringtrawl (S 200) with bag of stramin; at stat. 4201 four deeper hauls, with 2000–5000 m wire out, were made with a somewhat smaller net, 1½ m in opening diameter; in the deepest haul at each station the appliance (E 300) was much larger, 3 m in diameter, but with a bag of coarser net, not suitable to catch this small medusa. The duration of the hauls was also different. For the sake of comparison between the catches it is necessary, therefore, to re-calculate the number of specimens to a certain standard. In the table below are given: the appliance used at each haul, the duration of the haul, the actual number of specimens caught, and the number of specimens reduced to number per one hour's haul with S 200.

Stat.	m wire out	Appliance used	Duration of haul	Actual number of specimens	Reduced number	Diameter of specimens
4201	50	S 200	60 min.	115	115	1–8 mm
	100			500	500	1–8
	300			20	20	
	600			10	10	1–8
	2000	S 150	240 min.	35	15	6–8
	3000			35	15	5–8
	4000			60	25	5–8
	5000			60	25	4–9
	6000	E 300		1	(1)	7
4203	50	S 200	120 min.	8	4	6–8
	100			9	4.5	6–9
	300			13	6.5	6–8
	600			10	5	7–9
	1000	E 300		0	(0)	

principal occurrence in the upper strata of the warmer parts of the oceans, and its distribution in the Atlantic seems to be evidently restricted to the areas of the Gulf Stream. The collections of the "Thor" and the "Dana" show that also in these comparatively high latitudes it mainly occurs in the upper strata. It is interesting that the medusa was very abundant at "Dana" St. 1201 in the middle of the Gulf Stream, but rather scarce at the same depths at St. 1203 which was near the northern frontier of the Gulf Stream; at St. 1205, still further north, 51° 18' N. 30° 30' W., it was not taken at all.

Though *Rhopalonema velatum* mainly belongs to the upper strata, it is also rather frequently found in deeper water layers, sometimes even very far below the surface. At "Dana" St. 1201 it was particularly common in the haul with 100 m wire out (about 50 m below the surface), but several specimens were also taken even in the deepest hauls, and it is not likely that all of these were captured in the upper strata during the hauling in of the nets.

The measurements of the specimens do not show any remarkable vertical distribution of the various size classes.

Geographical distribution: *Rhopalonema velatum* is a common medusa in the warmer parts of all the oceans, including the Mediterranean. In the western Atlantic its northern limit of distribution is off Georges Bank, about 40° N. On the European side it is known from the Bay of Biscay, and, as appears from the present collections, it follows the Gulf Stream towards the western coasts of the British Isles, where it has been found as far north as 57° 17' N., west of Scotland.

Rhopalonema funerarium Vanhöffen.
Pl. II figs. 1–5.

non Diana funeraria Quoy & Gaimard 1827.
Rhopalonema funerarium Vanhoffen 1902 b p. 61. Pl. 9 fig. 2, Pl. 10 fig. 17. Pl. 11 fig. 31.
? Rhopalonema funerarium Maas 1904 p. 28.
Rhopalonema coeruleum Maas 1905 p. 51. Pl. 10 figs. 67, 68.
funerarium Bigelow 1909 a p. 132.
? p. coeruleum Mayer 1910 p. 380.
funerarium Vanhöffen 1912 a p. 372.
Bigelow 1917 p. 306.
Kramp 1921 p. 22.
Broch 1929 p. 196.
Ranson 1936 p. 141.
? p. velatum Thiel 1936 p. 10.

North Atlantic record.
Rhopalonema funerarium Kramp 1921 p. 22.

Material (see the map, textfig. 5):

51° 09' N. 11° 13' W. 1905 Thor St. 82(05). 2 specimens.
49° 22' N. 12° 52' W. 1906 181(06) 1800 m wire. 7 spec.

The seven specimens from "Thor" St. 181 S.W. of Ireland are briefly mentioned by me in a previous paper (Kramp 1924); examination of the specimens confirms my former opinion that *R. funerarium* is a proper species quite distinct from *R. velatum*.

The specimens were originally preserved in formalin, but later on they have been transferred to alcohol; they are not in very good condition, but they may without any doubt be referred to the species described and figured by Vanhöffen (1902 b) as *Rhopalonema funerarium* and by Maas (1905) as *R. coeruleum*. In spirit preparations this species may resemble a young *Colobonema* sericeum, particularly in the elongated shape of the gonads, which nearly reach to the circular vessel, and by the configuration of the subumbrellar musculature in its upper parts around the manubrium, forming a star-shaped figure, as neatly represented in Vanhöffen's figures and similar to that found in *Colobonema*. In four of the specimens examined by me the manubrium is very short, only about one fourth as long as the height of the subumbrella cavity; but in one specimen it is more than half the height of the bell cavity, and the distal half part of the manubrium is narrowed and terminates in four distinct mouth lips (Pl. II fig. 4). The eight perradial tentacles have a broad and bulbous base, but are all broken off short. Most of the adradial cirri have disappeared leaving only a tiny protuberance on the bell margin, but some of the interradial cirri are present (Pl. II fig. 5): they are club-shaped with an almost spherical distal knob and a thin pedicel, in which the endoderm consists of one row of elongated, cylindrical cells surrounded by an ectodermal epithelium of large, flat cells. Several of the statocysts are preserved, and they are placed in the middle of the spaces between the other marginal organs (tentacles and cirri); they are not in such a condition that I can give a description of their minor structure, but I can state that they are enclosed in the same manner as in *R. velatum*. The diameter of the specimens is 9–17 mm, the height 7–12 mm (see Kramp 1921).

This species clearly differs from *R. velatum* by the much greater length of the gonads, by the greater number of statocysts, and particularly by the position of these latter: the 8 or 16 statocysts in *R. velatum* are placed close by the base of the perradial tentacles and interradial cirri, whereas the 32 statocysts in *R. funerarium* alternate with the tentacles and cirri and are situated in the middle of the spaces between them. In the apex of the umbrella the mesogloea may be somewhat thickened in *R. funerarium*, but it never has a distinct apical knob as in *R. velatum*. *R. funerarium* also differs from the various species of *Rhopalonema* described by Haeckel (*clavigerum*, *coeruleum*, and *polydactylum*) all of which are most probably identic with *R. velatum* Gegenbaur. It also seems to me improbable that, as indicated by Bigelow (1909 a), *R. funerarium* should be identic with *R. striatum* Maas 1905; in *R. striatum* the gonads are broadly oval and situated in the proximal parts of the radial canals.

I cannot agree with Thiel (1936) in uniting all species of *Rhopalonema*, including *R. funerarium*, into one species, *velatum*, and when Thiel remarks (p. 15): "Nur Kramp (1924) hat noch einmal *Rh. funerarium* als gute Art erwähnt," I may refer to Bigelow (1909 and 1917) and Broch (1929) who likewise retain *R. funerarium* as a distinct species.

Geographical distribution: *Rhopalonema funerarium* occurs in the deep and intermediate strata, and it seems to have its principal distribution in the tropical parts of the oceans. It is recorded from the eastern tropical Pacific (Bigelow 1909 a), the Malayan Archipelago (Maas 1905), the warm parts of the Indian Ocean (Vanhöffen 1902 b), the tropical Atlantic from the Cape Verde Islands southwards (Vanhöffen 1902 b and 1912 a), near Monaco in the Mediterranean (Ranson 1936), the surroundings of the Azores (Ranson 1936); in the western Atlantic it has been taken in one locality, off Georges Bank, 40°06' N. 68°06' W., at a comparatively high level, *viz.* in a vertical haul from 300 m (Bigelow 1917). The localities south-west of Ireland mentioned above are the northernmost localities in which this species has been taken up to now.

Genus Homoeonema (Maas 1893) Browne 1903.

The genus *Homoeonema*, erected by O. Maas in 1893, has a very sad history, which is rather difficult to unravel, and the confusion is partly due do Maas himself who, in some subsequent papers (1897 and, especially, in 1906 b) referred a number of quite

different species to the same genus and thoroughly altered its definition. Several authors have attempted to solve the intricate taxonomic problems which have arisen around this genus, and their opinions are very different. As the genotype, *Homoeonema platygonon* Maas, belongs to the fauna of the North-Atlantic area, I take this opportunity to make a new attempt to settle the question as to what generic names ought to be applied to the several species which from time to time have been provided with the name of *Homoeonema*. I am quite aware that I cannot reach a final result, because some of the species are still unknown to me, so that I must rely on the descriptions in the literature. Nevertheless, the attempt must be made, and I hope that the following considerations may serve to elucidate the matter.

In MAAS' original description (1893) *Homoeonema* was a genus of the family Trachynemidæ, and his definition is as follows: "Tentakel alle unter sich gleich, aber nicht in bestimmter, an die Zahl der Radiärkanäle gebundener Anzahl (8 oder 16) vorhanden, sondern zahlreich, 32 bis 64 und mehr."

The actual number of tentacles is usually not a character of generic value, but in connection with other features it is certainly of considerable importance whether the number is fixed or varying. The above definition excludes the genera *Rhopalonema* and *Sminthea* Gegenbaur 1856 and *Pantachogon* Maas 1893, as also the subsequently described *Colobonema* Vanhöffen 1902. On the other hand, if *Halicreas* and *Aglantha* and their allies are reckoned among the Trachynemidæ, as actually done by various authors, these are all covered by the definition of *Homoeonema*.

The genus originally comprised three species: *platygonon* nov., *militare* nov., and *elongatum* which was proposed as a new name for *Rhopalonema polydactylum* Haeckel; this latter is, however, most certainly a *Rhopalonema*, probably identic with *R. velatum*. *H. militare* is evidently a Trachynemid, as it has a distinct prismatic manubrium with four mouth-lips; it has broad, oval gonads in the distal half of the radial canals which, in the description, are said to be broad, though in the figure (Pl. 1 fig. 1) they appear to be fairly narrow. VANHÖFFEN (1902 b p. 56), BIGELOW (1913 p. 11), and THIEL (1936 p. 24) refer this species to *Pantachogon*, because they regard this genus in a wide sense as comprising all Trachynemidæ with numerous tentacles, in one row, and all alike, without a stomachal peduncle (BIGELOW 1913). MAAS (1905 p. 54) is opposed to the transmission of *H. militare* to *Pantachogon*, because, in his opinion, *Pantachogon* is mainly characterized by discontinuous gonads which, however, is not correct (see below, p. 19). Considering that the number of tentacles in *H. militare*, according to the figure, is 48 as in *P. haeckeli*, I am inclined to think that the said authors are right in transferring it to *Pantachogon*, but I would not go so far as THIEL and identify it with the species *P. haeckeli*.

Homoeonema platygonon was a small medusa with broad gonads on the proximal portions of the radial canals, which likewise are remarkably broad; the species therefore bears a great resemblance to a Halicreasid, and several authors, including MAAS himself in some of his later papers, really refer it to the Halicreasidæ.

A small Norwegian medusa was described by E. T. BROWNE (1903 p. 21, Pl. 2 figs. 2, 3) and by him referred to *H. platygonon* Maas; one of the difficulties in the forthcoming discussions is due to the uncertainty of this identification. The specimens were taken in Skjerstadfjord and Byfjord in Norway; I myself have seen 19 specimens from Herlöfjord exactly agreeing with BROWNE's description (KRAMP & DAMAS 1925 p. 318); two of them are now in the Zoological Museum of Copenhagen, and I have been able to re-examine them. This Norwegian medusa certainly belongs to the Trachynemidæ, because it possesses a prismatic manubrium and a mouth opening provided with four short lips, whereas the Halicreasidæ all have a large, circular stomach and a wide, circular mouth opening without indication of lips. But it differs from all other Trachynemidæ in the shape of the gonads, which are remarkably broad, occupying the proximal halves of the radial canals and connected with each other around the base of the stomach; it therefore cannot be included in any of the known genera of Trachynemidæ, except perhaps in *Homoeonema* sensu Maas 1893.

The stomach and its surroundings are not seen in MAAS' figure of *H. platygonon*, but in the text he expressly states that the stomach is "gleich dem der typischen Formen," i. e. the species of *Rhopalonema* described on the preceding pages. It seems to me, therefore, that in spite of the deficiency of the figure we must regard *Homoeonema platygonon* Maas as belonging to the Trachynemidæ sensu strictu. When further comparing it with BROWNE's Norwegian medusa we will find that both of them have a small but distinct apical knob, numerous tentacles, and only four statocysts which, in both of them, are described as vesicular. The only difference is that the circular canal and the distal halves of the radial canals, beyond the broad gonads, in BROWNE's medusa "are not so broad and conspicuous as those figured by MAAS." If MAAS' medusa were a Halicreasid, it would be the only member of that family with vesicular statocysts; it is also much smaller than any known species of Halicreasidæ, and owing to the advanced development of the gonads it cannot be a young individual.

It therefore seems to me very likely that the medusæ described by MAAS and by BROWNE really belong to the same species, *Homoeonema platygonon*; and if this is agreed upon, it becomes the only species which can bear the generic name *Homoeonema*, because no other known medusa can be congeneric with it such as we know it from BROWNE's description. Their identity, it is true, cannot be decided with certainty; but even if the supposed identity of the two medusæ be denied, it seems to me that the generic name ought never to be attached to any other species either of Trachynemidæ or of Halicreasidæ (see below). In such case *Homoeonema platygonon* Maas must be regarded as an obsolete species, and, if the rules of nomenclature were to be strictly followed, the medusa described by BROWNE should be provided with a new name; but as the Norwegian medusa, which was well described by BROWNE, has ever since been known under the name of *Homoeonema platygonon* and has repeatedly been recorded from new localities (KRAMP & DAMAS 1925, RUNNSTRÖM 1932, BERNSTEIN 1934, JASCHNOV 1939), it seems wise to retain this name and designate BROWNE as its author, adding *Homoeonema platygonon* Maas as a doubtful synonym.

In his paper on the "Albatross" medusæ, MAAS (1897 p. 22) described a new species, *Homoeonema typicum*; he referred it to *Homoeonema* because it was a "Trachynemide mit zahlreichen und gleichartigen kurzen Tentakeln," but it is entirely different from *H. platygonon*, and in 1905 MAAS himself transferred it to *Colobonema* Vanhöffen 1902 together with a number of specimens taken by the "Siboga" and presumably belonging to the same species; this view has been accepted by the majority of subsequent authors, who only differ as to the question of whether the two species, *typicum* Maas and *sericeum* Vanhöffen, are identic or not.

In his "Valdivia" paper (1902 b) VANHÖFFEN gives a new definition of *Homoeonema*: »Trachynemide mit 8 perkanalen und 72 oder mehr interkanalen Tentakeln, mit am proximalen Ende der Radiärkanäle dem Magen anliegenden Gonaden," in contradistinction to *Pantachogon*, in which the number of intercanal tentacles does not exceed 56, and the oval or spindle-shaped gonads are placed along the radial canals. He transfers *Homoeonema militare* Maas to *Pantachogon*, and describes two new species of *Homoeonema*: *H. amplum* and *H. macrogaster*; both of them have club-shaped statocysts and numerous (more than 80) tentacles, and the gonads are almost spherical swellings on the eight radial canals close by the stomach. They differ so considerably from *Homoeonema platygonon* (sensu Maas as well as sensu Browne) that they cannot belong to the same genus, and it is also impossible to place them within any other of the genera known by then. It was fully justified, therefore, when MAAS (1906 b) erected a new genus, *Isonema* (by RANSON 1936 altered to *Arctapodema*

with *I. amplum* as the genotype. Maas also included some of the Haliscera-like new genus and that is where the history of "*Homoeonema*" begins to intricate.

After some preliminary remarks in his "Siboga" paper (1905 p. 2–3), Maas entered upon a further discussion of the matter in his papers on the medusæ from the "Belgica" Antarctic Expedition (Maas 1906b pl. 3–11) and in "Fauna Arctica" (1906a p. 149–150). After the establishment of the new genus *Isonema* (see above), Maas now gives an entirely new definition of *Homoeonema*: Mit proximalen schildförmigen Gonaden, mit breiten trichterförmigen Radialcanälen, mit weitem ringförmigem Magen. Tentakel mässig zahlreich (3–7 im Octant) von gleicher Structur, einige mit Grossenunterschieden. Mit freien Sinneskolben." *Homoeonema* as here defined is completely identic with *Haliscera* Vanhöffen 1902, and it comprises: Vanhöffen's species of that genus, a new species "*Homoeonema* (*Haliscera*) *ravaritzae*" (which certainly is a *Haliscera*, see above p. 6), and also *Homoeonema platygonon*. What induced Maas to unite these species into one genus was that he had compared the original specimen of *Haliscera alba* Vanhöffen with supposed new specimens of *Homoeonema platygonon*, partly collected in the subtropical Atlantic by the Prince of Monaco (no further information of these specimens is given), partly sent to him by E. T. Browne. These latter specimens, four in number, which were collected in the Bay of Biscay, are thoroughly described by Browne (1906 p. 171), and I have not the slightest doubt that they were small specimens of a Halicreasid, most probably of the same species which I have described above as *Haliscera bigelowi* n. sp. They are very different from the Norwegian specimens of *Homoeonema platygonon* previously described by Browne (1903); as he was uncertain as to their identification he sent them to Maas, and on his authority they are mentioned as *H. platygonon* in Browne's paper on the medusæ of the Biscayan plankton. Maas was certainly right in referring these specimens to the same genus as *Haliscera alba* and the new species *H. ravaritzæ*, but he must have forgotten the exact appearance of his own original specimen of *Homoeonema platygonon*; it is the more astonishing that he now refers that species to the Halicreasidæ, as he expressly states (1906a p. 190) that in Browne's description and figures of the Norwegian medusa he recognizes "die von der gemeinte Art," and as emphasized above the Norwegian medusa is absolutely no Halicreasid, but belongs to the Trachynemidæ s. str.

We then again have to face the two alternatives: 1) If *Homoeonema platygonon* Browne 1903 is the same as *Homoeonema platygonon* Maas 1893, *Homoeonema* is a genus of the Trachynemidæ, and the Halicreasid genus *Haliscera* Vanhöffen 1902 must retain its name. 2) If Browne's Norwegian medusa is something else, we must regard *Homoeonema* Maas 1893 as an obsolete genus, as it is unreasonable to let its name replace that of *Haliscera*.

We can further state that the specimens from the subtropical Atlantic and from the Bay of Biscay, which in 1906 were referred to *H. platygonon*, were some undetermined specimens of Halicreasidæ, probably *Haliscera bigelowi* n. sp.

In his important paper on the medusæ from the central tropical Pacific (1909a) Agassiz approved of Maas' new conception of *Homoeonema* and adopted that name for the species of *Haliscera*, apparently because on one point he had misunderstood Maas. Browne (1910 p. 671–672) Maas has demonstrated the identity of *Homoeonema* and *Haliscera* "by a fresh examination of the type specimen of *Homoeonema platygonon*", but, as mentioned above, Maas examined the type specimen of *Haliscera alba* Vanh. and considered it to belong to *Homoeonema platygonon*, but not to be identical with the type specimen of this latter.

Browne (1910 p. 672) further remarks as to the affinities of *Homoeonema platygonon* Maas:

One thing is clear, that is that the name *Homoeonema* has

In Mayer's Medusæ of the World (1910 pp. 383 ff.) *Homoeonema* comprises the species *platygonon* Maas, *militare* Maas, *typicum* Maas (including *Colobonema sericeum* Vanh.), *amplum* Vanhöffen, and *macrogaster* Vanhöffen. Mayer thus does not accept *Isonema*. Vanhöffen, on the other hand, in his paper on the craspedote medusæ of the German South-Polar Expedition (Vanhöffen 1912a p. 371) approves of *Isonema* as the generic name of *I. amplum* and describes three new species which he refers to the same genus: *antarcticum*, *australe*, and *tetragonium*; the affinities of these three species seem to me very doubtful, but will not be discussed in this place.

Uchida (1928 p. 76) places *Homoeonema* in the subfamily Halicreasinæ, but includes *H. typicum* Maas in the genus. – Broch, in the "Nordisches Plankton" (1929) follows Mayer, and Thiel (1931) provisionally takes the same position. Thiel also records *Homoeonema platygonon* and *militare* from localities in the Antarctic Ocean, but the specimens were so badly preserved that the identification seems to me open to doubt. – In his papers on the Hydromedusæ of the "Meteor" Expedition (1935 and 1936) Thiel has yielded to a most deplorable tendency to unite as many different species as possible. He recognizes only two species of *Halicreas* (including *Haliscera*): *Homoeonema militare* Maas, *H. typicum* Maas, and *Colobonema sericeum* Vanhöffen are united with *Pantachogon rubrum*; and *Isonema amplum*, *macrogaster*, *tetragonium*, *antarcticum*, and *australe* are regarded as synonyms of *Homoeonema platygonon* sensu Browne together with *Pantachogon scotti* Browne (pars). On the present occasion I shall not enter upon the critical remarks which involuntarily are called forth by this astonishing assertion.

Ranson (1936) has treated in detail the difficulties of *Homoeonema* and put forth some well chosen remarks, with which I fully agree, though I cannot follow him in his final conclusion. He deplores the confusion brought into the nomenclature of *Homoeonema* and says (p. 137): "Les synonymies sont devenues incompréhensible," and he deplores (p. 170) that "O. Maas (1906) n'a pas voulu accepter le nom *Haliscera* Vanhöffen dont il a fait un synonyme de *Homoeonema*. Cet auteur a eu tort de vouloir conserver, à tout prix, un nom de genre créé par lui, mal défini d'après de mauvais échantillons, et dont il a changé complètement le sens plusieurs fois." Ranson thus retains the name *Haliscera* sensu Vanhöffen, and he will regard *Homoeonema* as a synonym of *Haliscera*: he has seen the specimen from the subtropical Atlantic (near the Azores) mentioned by Maas (1906) as *Homoeonema platygonon*, and he states that it belongs to *Haliscera*. But then he takes it for granted that the original specimen of *H. platygonon* was the same species, and he therefore records the specimen from the Azores under the name of *Haliscera platygonon*. In this respect I cannot agree with Ranson. I have no doubt that the specimen from the Azores is a *Haliscera*, but as stated above, various details in Maas' description (1893) make it probable that the original specimen was a Trachynemid: at any rate, its supposed affinity to the Halicreasidæ is far from being established and cannot justify a decisive reference of the species into the genus *Haliscera*.

Ranson's list of synonyms (p. 173) also seems to me objectionable; it includes *Homoeonema platygonon* Browne 1903 which certainly is no *Haliscera*, and Thiel 1931 which is a doubtful record.

The above considerations on the synonymy of "*Homoeonema*" may be summarized as follows:

Species belonging to the Family **Trachynemidæ.**

Homoeonema platygonon Browne 1903. **Genotype.**

? Hoemoeonema platygonon Maas 1893.
Homoeonema platygonon Browne 1903.

non Homoeonema platygonon Maas 1906b.

non Homoeonema platygonon Browne 1906.
non Haliscera platygonon Ranson 1936.

Pantachogon militare (Maas 1893).

Homoeonema militare Maas 1893.
Pantachogon militare Vanhöffen 1902 b.

Colobonema typicum (Maas 1897).

Homoeonema typicum Maas 1897.
Colobonema typicum Maas 1905.

Arctapodema amplum (Vanhöffen 1902). Genotype.

Homoeonema amplum Vanhöffen 1902 b.
Isonema amplum Maas 1906 b.
Isonema amplum Vanhöffen 1912 a.
Pantachogon amplum Bigelow 1913.
Arctapodema amplum Ranson 1936.

Arctapodema macrogaster (Vanhöffen 1902).

Homoeonema macrogaster Vanhöffen 1902 b.
Isonema amplum Maas 1906 b.
Pantachogon macrogaster Bigelow 1913.
Arctapodema? amplum Ranson 1936.

Isonema antarcticum, *australe*, and *tetragonium* Vanhöffen 1912 a are Trachynemidæ of doubtful systematic position.

Species belonging to the family **Halicreasidæ.**

Haliscera alba Vanhöffen 1902. Genotype.

Haliscera alba Vanhöffen 1902 b.
Homoeonema album Maas 1906 a.
Halicreas alba Mayer 1910.
Haliscera alba Vanhöffen 1912 a.

non Homoeonema album Bigelow 1909 a.

Haliscera racovitzæ (Maas 1906).

Homoeonema (Haliscera) racovitzæ Maas 1906 b.
Homoeonema recovitzæ Bigelow 1909 a.
Halicreas racovitzæ Mayer 1910.
Haliscera racovitzæ Vanhöffen 1912 a.

Haliscera bigelowi Kramp 1946.

Homoeonema album Bigelow 1909 a.
Haliscera bigelowi Kramp 1947.

? Homoeonema platygonon Maas 1906 a.
? Homoeonema platygonon Browne 1906.
? Haliscera platygonon Ranson 1936.

The genus *Homoeonema* may now be defined as follows: Trachynemidæ with eight radial canals; with numerous tentacles structurally alike; with gonads forming a continuous band around the base of the stomach extending outwards along the radial canals; without a stomachal peduncle. – Only species: *platygonon* Browne 1903.

Homoeonema platygonon Browne.
Pl. 11 fig. 6.

North-Atlantic records:
? Homoeonema platygonon Maas 1893 p. 15, Pl. 1 fig. 8.
Homoeonema platygonon Browne 1903 p. 21, Pl. 2 figs. 2, 3.
– – Kramp & Damas 1925 p. 318.
– – Runnström 1932 p. 30.
Homoeonema platygonon Bernstein 1934 pp. 26, 53.
– – Jaschnov 1939 p. 111.

Material:
Herlofjord, Norway, October 1908, 300 m.

Herlofjord is in the neighbourhood of Bergen, where professor D. Damas collected 19 small specimens (1–2 mm in diameter) of this medusa. I saw these specimens, when I stayed with prof. Damas at Liége in 1920; later on they were sent to Bergens Museum, except two specimens which I secured for our museum at Copenhagen. The shape of the umbrella is not quite as high as shown in the figure by Browne, somewhat more like Maas' figure. The gonads (Pl. 11 fig. 6) have a somewhat wavy outline and are attached to the subumbrella along fairly narrow lines. on the subumbrella side of the radial canals the gonads are continuous, as also seen in Browne's figure, and the gonads are likewise confluent in the interradii. As a matter of fact, therefore, the gonads form one uninterrupted band around the base of the stomach with outgrowths along the eight radial canals, about halfway to the bell margin. In the specimens examined by me there are about 10–11 tentacles in each octant, thus altogether 80 or more.

The specimens described by Browne were taken in Skjerstadfjord (about 67¹ ₄° N.) in April and in Byfjord (near Bergen) in November; the present specimens were found in Herlofjord (Herdlafjord) in October; Runnström (1932) also found it in the neighbouring Hjeltefjord, and he gives valuable information on its occurrence in Herdlafjord, where he has taken it throughout the year, with maximal occurrence in the autumn and minimum in spring: the largest specimens (2–3 mm) occur in the autumn, but in March only very small specimens (about ¹ ₂ mm) are found. Runnström further states that it belongs to the deep strata in the fjord, mainly between 200 and 400 m, but during the autumn young specimens may be found at higher levels, 50–100 m below the surface. This species thus is quite common in the fjords in the surroundings of Bergen.

It is very interesting that *Homoeonema platygonon* also has been found in some localities in the northern part of the Kara Sea, partly in fairly deep water (155–100 m), partly in the upper strata, 17·0 and 10·0 m (Bernstein 1931). This Russian author takes it for granted that the specimen taken by the German "Plankton-Expedition" between Iceland and the south point of Greenland (Maas 1893) belongs to the same species as the Norwegian specimens, and he discusses its geographical distribution. "The zoogeographical character of this form remains uncertain. Our knowledge is not sufficient to explain its appearance in the Kara Sea. It is possible that this small medusa . . . has escaped the attention of the planktonists, and that it has a greater distribution in the arctic seas. If between Iceland and Greenland it lives in a region of cold currents, it is even possible that *Homoeonema platygonon* is an arctic medusa. Future investigations may probably bring this information. So far it thus seems probable that the connection between the western distribution of this medusa and its occurrence in the Kara Sea may be accomplished as well through the Barents Sea as through the Polar Basin."

In the intermediate and deep strata in Hjeltefjord, Herdlafjord, and Byfjord in Norway the temperature of the water is about 7° C. with only slight variations during the year (rarely below 6° and rarely above 8°), and the plankton consists of a mixture of boreal and arctic species. The zoogeographical character of *Homoeonema platygonon*, therefore, is not determined by its occurrence in these fjords; its occurrence in the Kara Sea, however, seems to indicate that it is an arctic species. Its presence in the Atlantic between Iceland and the south point of Greenland is not very elucidating, partly because we are not sure of the identity of the medusa found there, partly because the locality is in a mixed area with water masses of different origin. Bernstein is right, therefore, that the zoogeographical character of this species

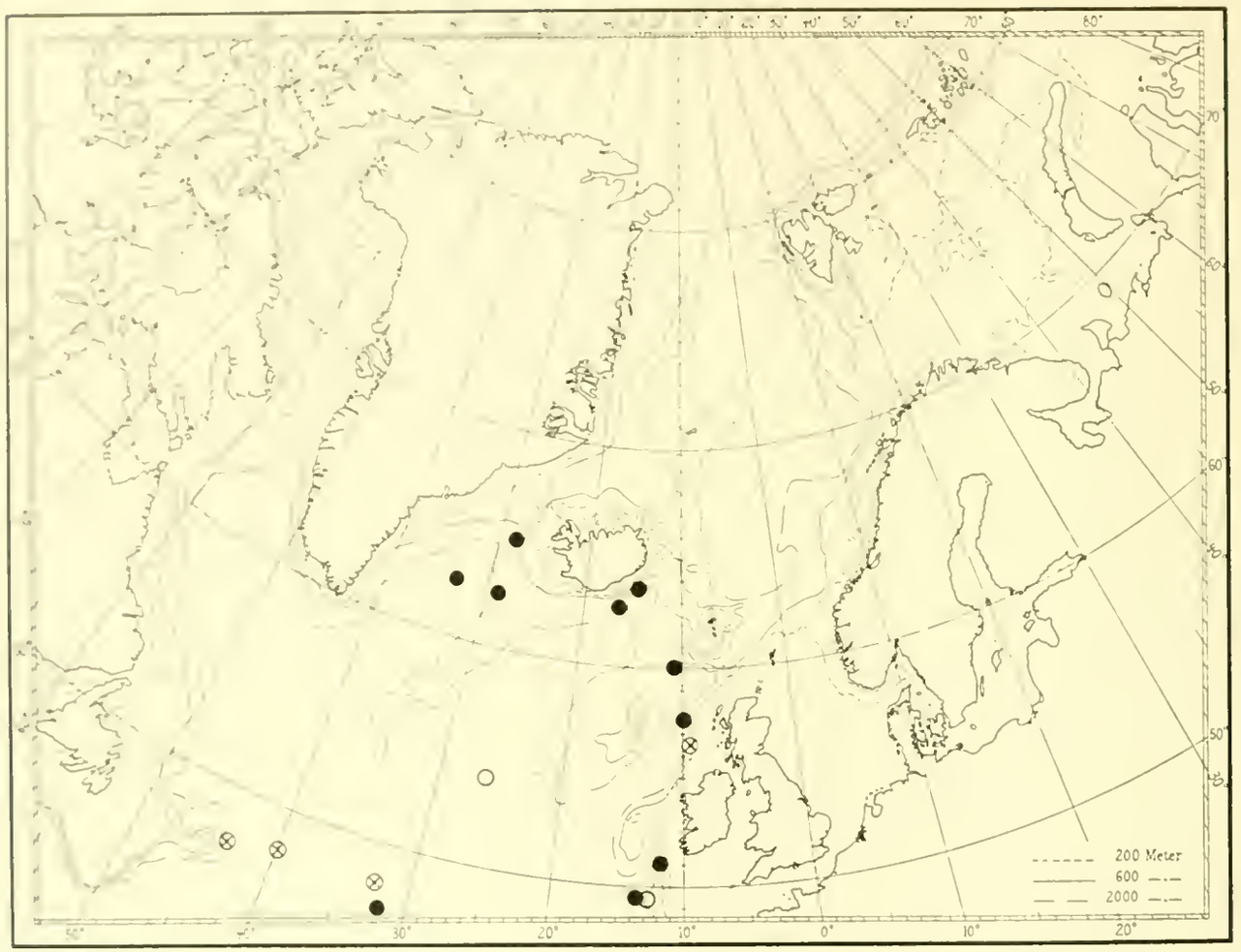


Fig. 6. Distribution in the northern Atlantic of *Colobonema sericeum*; ● new records; ○ previous records; ⊗ records not yet published.

cannot be determined, until it has been found in other regions. THIEL, it is true, records it from numerous localities in the central and southern Atlantic and in antarctic seas and illustrates its distribution on a map (THIEL 1936, fig. 5 p. 32); but, as mentioned above, his records are unreliable, because he identifies *H. platyporos* with a considerable number of other species.

Genus Colobonema Vanhöffen 1902.

Trachynemidae with tentacles all of one kind, 32 in number, of which the 8 perradial, the 16 adradial, and finally the 8 interradial develop in succession with free, club-shaped statocysts; with elongated gonads along the radial canals; without a stomachal peduncle with the apical outlines of the subumbrella muscular fields forming a star-shaped figure.

I agree with RANSON (1936) and BIGELOW (1938) that *Colobonema* should be regarded as a proper genus distinct from *Pantachogon* partly on account of the characteristic succession in the development of the tentacles, partly on account of the configuration of the subumbrella musculature which, in *Pantachogon*, leaves an apical clear space with a circular outline around the [illegible] tentacles, whereas in *Colobonema* the corresponding space gets a star-shaped outline with eight pointed rays extending for a considerable distance along the eight radial canals. The circumstance that the circular fields is already pointed out by VANHÖFFEN (1902 p. 20), and it was emphasized by RANSON as a distinct feature that distinguishes the genus from *Pantachogon*. The diagnosis given above is modified from MAAS (1905 p. 52) with addition of the characters of the statocysts and the musculature.

Colobonema sericeum Vanhöffen.

Principal references:

Colobonema sericeum Vanhöffen 1902 b p. 57, Pl. IX fig. 1, Pl. XII figs. 39–42.
Colobonema typicum Maas 1905 p. 53, Pl. X figs. 62–65.
" sericeum Bigelow 1909 a p. 133, Pl. 2 figs. 4, 5, Pl. 45 fig. 12.
Homoeonema typicum Mayer 1910 p. 385.
Colobonema sericeum Vanhöffen 1912 a p. 372.
" typicum Bigelow 1913 p. 16.
" typicum Bigelow 1919 p. 322.
Homoeonema (Colobonema) sericeum Broch 1929 p. 500.
Colobonema sericeum Ranson 1936 p. 152, Pl. II figs. 14–15.
" typicum Bigelow 1938 p. 117.

North-Atlantic records:

Colobonema sericeum Browne 1906 p. 172.
" Kramp 1920 p. 5.
" 1921 p. 28.

Material (see the map, textfig. 6):

62°25′N. 28°30′W., $^{14}/_{6}$ 1896.	"Ingolf" St. 83.	1 specimen
65°00′N. 28°10′W., $^{19}/_{6}$ 1901.	"Thor" St. 152.	1 specimen
51°00′N. 11°43′W., $^{15}/_{6}$ 1905.	" "	82. 4 specimens
60°00′N. 10°35′W., $^{28}/_{8}$ 1905.	" "	165. 1000 m wire. 1 spec.
57°16′N. 9°55′W., $^{1}/_{9}$ 1905.	" "	167. 1 specimen
19°27′N. 13°33′W., $^{11}/_{6}$ 1906.	" "	76. 2 specimens
19°22′N. 12°52′W., $^{4}/_{9}$ 1906.	" "	181. 1800 m wire. 3 spec.

62°35′N. 32°53′W., $^{27}_{7}$1925.	"Dana" St. 2137.	1900 m wire	1 spec.
47°02′N. 31°15′W., $^{27\ 28}_{6}$31.	–	–	1201. 2000 m	15
–	–	–	–	1201. 4000 m	7
–	–	–	–	1201. 5000 m	2
62°15′N. 16°01′W., $^{7}_{5}$1931.			5083. 2000 m	6
63°38′N. 14°13′W., $^{18}_{5}$1931.	–	–	5113. 2000 m	1

The morphology of *Colobonema sericeum* is comparatively well known, with only a few uncertain points still awaiting elucidation. Bigelow (1938 p. 118) is of the opinion that the stump-like appearance of the tentacles is normal, and not the result of mutilation; I do not think this view is correct; in several specimens the tips of the tentacle stumps show distinct marks of being broken, so that evidently the tentacles have been longer. An account of the rate of development of the tentacles and the gonads in relation to size of specimens will be postponed to another occasion, when I have finished the examination of the extensive collections from other geographical areas.

As a rule the manubrium of the preserved specimens is strongly contracted and very short; but sometimes the manubrium has been preserved in a more or less extended condition, and such specimens perfectly resemble that figured by Maas (1905, Pl. X fig. 62) from the "Siboga" collection. We can therefore state with certainty that the Siboga specimens of *Colobonema* belong to *C. sericeum*. But I must still maintain my former opinion (Kramp 1924 p. 28) that the "Albatross" specimen, as it is described and figured by Maas (1897, *Homoconema typicum*) cannot be referred to the same species, partly on account of the much greater number of tentacles, and also because the gonads are much shorter. Ranson (1936 p. 153) has ably expressed the same opinion of *H. typicum* in the following way: "elle est différente de *Colobonema sericeum* ou la description . . . est tellement défectueuse que nous ne devons pas en tenir compte." There is no reason, therefore, to introduce the specific name of *typicum* for the well described and well known medusa *Colobonema sericeum* Vanhöffen.

Remarks on the vertical distribution: In the northern Atlantic as well as in its other areas of distribution, *Colobonema sericeum* is a distinctly bathypelagic medusa. At the "Dana" St. 4201 the hauls containing specimens of this species were all made with the $1^1/_2$ m ringtrawl with bag of stramin ("S. 150") hauled horizontally during four hours: the greatest number of specimens were taken in the haul with 2000 m wire out, and several of them were young ones (height of bell 4–27 mm); unfortunately, they are all in a bad state of preservation, unsuitable for closer examination; the specimens caught with 1000 and 5000 m wire out were 21–36 and 25–33 mm respectively. This indicates that the young individuals preferably occur at a higher level than the fully developed ones. The other North-Atlantic catches, from which the depth of capture is known, seem to confirm this (e. g. the only specimen taken with 1000 m wire out, "Thor" St. 165 (1905), was only 14 mm high); but further investigations must decide, whether this is the general rule.

Horizontal distribution: The three specimens from "Thor" St. 181 (1906) S. W. of Ireland, were mentioned by me in a previous paper (Kramp 1921); moreover one specimen is recorded from a locality, 51°05′ N. 26°08′ W., taken by the Norwegian ship "Armauer Hansen" (Kramp 1920). On the map, textfig. 6, are also included some localities in which this species was taken by the "Michael Sars" North Atlantic Expedition in 1910, not yet published. Browne (1906) records a specimen from the Bay of Biscay.

Colobonema sericeum is apparently generally distributed in the deep parts of all the great oceans; it has never been taken in the Mediterranean, and its distribution northwards in the Atlantic is evidently limited by the continental shelves and the submarine ridges between Scotland, Iceland, and Greenland. It has not yet been found in the southern part of Davis Strait, where several others of the bathypelagic medusæ from the Atlantic Ocean are known to occur.

Genus **Pantachogon** Maas 1893.

Trachynemidæ with 64 or more tentacles all of one kind; with gonads extending along the radial canals; with free, club-shaped statocysts; without a stomachal peduncle; with the apical outlines of the subumbrella muscular fields forming an entire circle.

In the original definition of this genus, Maas (1893 p. 17) emphasized the supposed discontinuity of the gonads as the most characteristic feature, and in his "Siboga" paper (1905 p. 54) he maintains that this is not due to the state of preservation; but it must now be regarded as an established fact that it really is so (see Kramp 1942 p. 78). We can also state that *Pantachogon rubrum* Vanhöffen (1902 b) is identical with the genotype, *P. haeckeli* Maas (1893). Adult specimens of this species always have 64 tentacles; only two more species are known, *P. scotti* Browne (1910) with about 120 tentacles and *P. militare* (Maas) (formerly *Homoconema militare*, see above, p. 15). The relation between *Pantachogon* and *Colobonema* has been discussed above (p. 18).

Pantachogon haeckeli Maas.

Pl. II figs. 7–8.

North-Atlantic records:

Pantachogon haeckelii Maas 1893 p. 17, Pl. I fig. 2.
? – – – 1904 p. 29.
– rubrum Kramp 1913 a p. 271.
– – – 1914 p. 433.
– – – 1920 p. 5.
– – – 1924 p. 22.
– haeckeli Kramp 1942 p. 78.

Material (see the map, textfig. 7):

61°15′N. 9°35′W., $^{21}_{5}$1904.	"Thor" St. 93.	1 specimen		
65°00′N. 28°10′W., $^{19}_{6}$1904.	–	–	152. 5 specimens	
61°30′N. 17°08′W., $^{11}_{7}$1904.	–	–	183. 7	–
57°47′N. 11°33′W., $^{7}_{6}$1905.	–	–	71. 3	–
60°00′N. 10°35′W., $^{29}_{8}$1905.	–	–	165. 1000 m wire.	1 spec.
57°16′N. 9°55′W., $^{1}_{9}$1905.	–	–	167. 1500 m	5	–
60°59′N. 22°29′W., $^{29}_{5}$1925.	"Dana" St. 2306.	2000 m wire.	125 sp.	
60°20′N. 29°21′W., $^{31}_{5}$1925.	–	–	2307. 1500 m	–	65	–
59°21′N. 37°56′W., $^{1-2}_{6}$1925.	–	–	2308. 1000 m	–	2	–
–	–	–	2308. 3000 m	–	1200	–
62°35′N. 32°53′W., $^{27}_{7}$1925	–	–	2137. 1900 m	–	1	–
63°19′N. 26°50′W., $^{24}_{5}$1928.	"Godthaab" St. 1.	1000 m	–	20	–
47°02′N. 31°15′W., $^{27\ 28}_{6}$31.	"Dana" St.	1201. 2000 m	–	270	–
–	–	–	–	1201. 3000 m	–	630	–
–	–	–	–	1201. 4000 m	–	180	–
–	–	–	–	1201. 5000 m	–	180	–
62°23′N. 16°05′W., $^{25}_{6}$1932.	–	–	1402. 2000 m	–	235	–
–	–	–	–	1402. 3000 m	–	250	–
–	–	–	–	1402. 4000 m	–	500	–
61°52′N. 35°30′W., $^{15}_{8}$1933.	–	–	1686. 600 m	–	–	–
62°36′N. 32°48′W., $^{16}_{8}$1933.	–	–	1687. 2000 m	–	250	–
62°45′N. 16°01′W., $^{7}_{5}$1931.	–	–	5083. 2000 m	–	33	–
63°38′N. 14°13′W., $^{18}_{5}$1931	–	–	5113. 1800 m	–	165	–
–	–	–	5113. 2000 m	–	200	–

Among these numerous specimens very few are in such a condition that a closer examination of their morphology can be carried out; in a few cases, however, I have seen tentacles which are somewhat more than "stump-like", i. e. they are broken at some distance from their base, and I have no doubt that they have been of greater length.

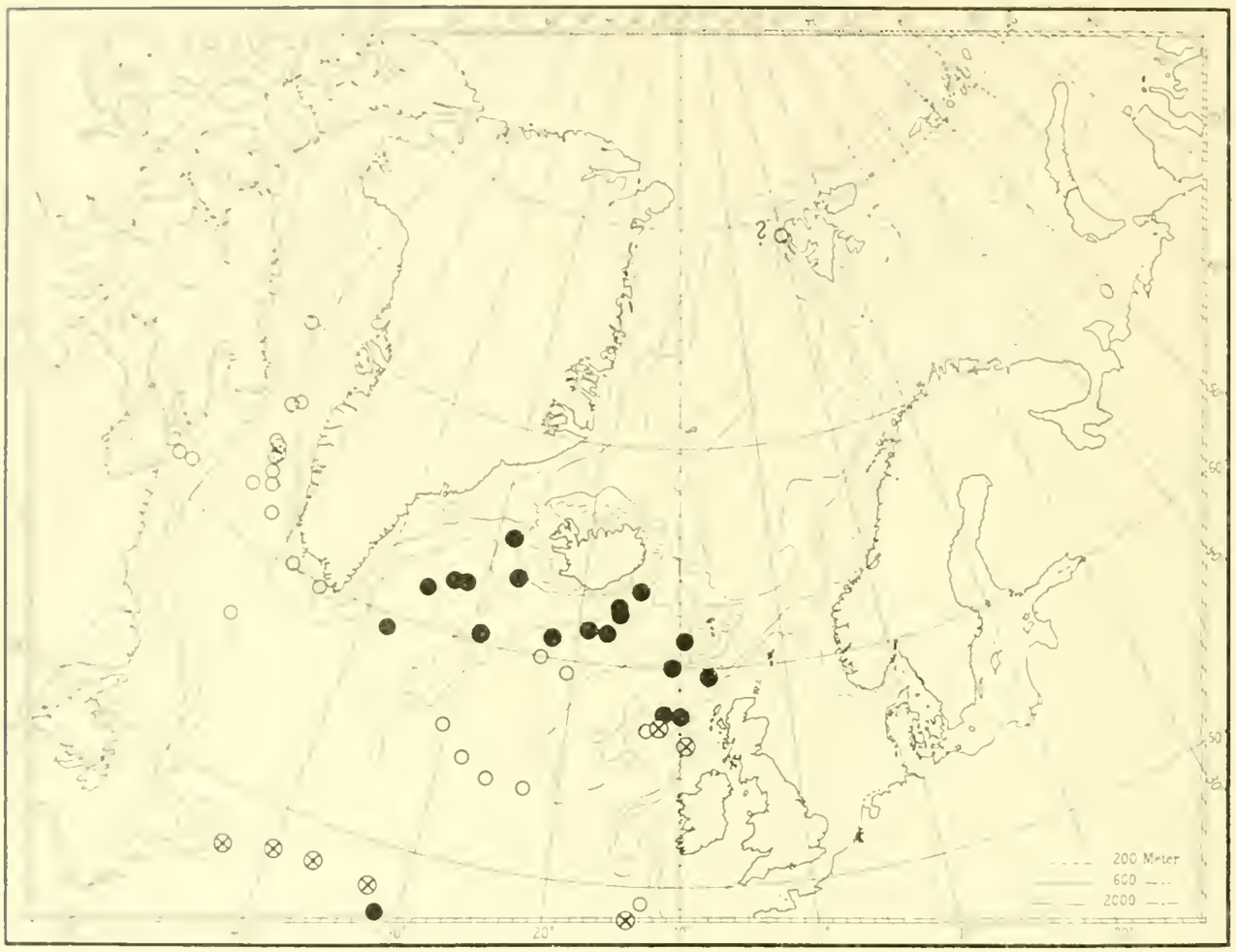


Fig. 7. Distribution in the northern Atlantic of *Pantachogon haeckeli* ● new records; ○ previous records; ⊗ records not yet published.

The statocysts are very small, each of them containing one statolith (Pl. II figs. 7–8).

I have particularly looked for young specimens which might give information of the development of the tentacles, but they were almost all in a very bad state of preservation. I shall communicate the few observations which I was able to make.

In a specimen only 2 mm high there are 2 tentacles and one interradial statocyst between every successive pair of radial canals, except in one octant, where there is one, interradial, tentacle and a statocyst close beside it. In a few specimens 3 mm high there are 3 tentacles between the radial canals, but it cannot be decided which of them is the youngest. When the height of the bell is 3–3½ mm the number of tentacles between the canals usually seems to be 5, but in some cases the middle one (the interradial) is only a tiny rudiment. In one specimen, 5 mm high, there are 6 tentacles between the canals, all alike, and in three of the others there is also a tiny rudiment of the seventh, final tentacle, and then always the third one from the left. In the course of the development of the tentacles *Pantachogon haeckeli* thus might seem to differ from *Colobonema sericeum*, in which an interradial tentacle does not appear until four other tentacles have been developed.

Bigelow (1913 p. 115) has found that "a tentacle does not always stand opposite a canal, i. e., it appears that in some cases it cannot be described as strictly perradial". I have turned my attention towards this statement and found that even in cases where the tentacle nearest to a radial canal would seem to be opposite to it, and if it happens exceptionally, that one of the canals (which might be called "secondary" canals, from the manubrium in the sectors between the four mouth lips, whereas there is always a tentacle exactly opposite the "primary" canals which agree in position to the lips; as, however, the cases observed are very few, I am not sure that it is the general rule.

Occurrence in the North Atlantic. — Maas (1893) originally recorded *Pantachogon haeckeli* from a locality south of Iceland, Lat. 60° N., and in 1904 he referred, with some doubt, a mutilated specimen from Spitzbergen to the same species. In three papers (Kramp 1913, 1914, and 1942) I have dealt with its occurrence in the waters west of Greenland, and moreover I have seen a number of specimens collected by the "Armauer Hansen" in six localities in deep water west and east of the Rockall plateau (Kramp 1920). Some few specimens, taken by the "Thor" south-west of Ireland in 1906 and in the Bay of Biscay in 1909, were recorded by me in 1924. On the map, textfig. 7, are also given the localities, at which it was taken by the "Michael Sars" North-Atlantic Expedition in 1910 within the area dealt with here.

The species seems to be generally distributed over the deep-sea areas of the northern Atlantic; in the north-eastern part the distribution is limited by the continental shelves and the submarine ridges Scotland–Iceland–Greenland (apart from the doubtful record from Spitzbergen, Maas 1904); the finds in this area are all outside the 600 m line. In the waters west of Greenland, on the other hand, it has occasionally been taken in more shallow water. It has its main occurrence in the deep strata, but is not strictly limited to the deep-sea. Within the area under consideration it has been taken in altogether 75 hauls from which the depth of the haul is known; an enumeration of the catches made by the "Tjalfe", "Godthaab", "Thor", "Dana", "Armauer Hansen",

and "Michael Sars" will show that 65 catches were made with 1000–5000 m wire out (about 660–3300 m below the surface); west of Greenland the "Tjalfe" took numerous specimens in two hauls with 800–900 m wire out, and on five occasions it has been taken with 600 m wire out. Exceptionally it has even been found at still higher levels: 400 m wire ("Godthaab" St. 18, 1 specimen), 300 m wire ("Godthaab" St. 5, 1 specimen), and 100 m wire ("Michael Sars" St. 81, east of the Newfoundland Bank, 9 specimens). In hauls with less than 800 m wire the number of specimens caught has always been very small, but from about 500 m below the surface downwards the species is frequently taken in great abundance; at the "Dana" St. 2308, east of the south point of Greenland, no less than about 1200 specimens were taken in a haul of 2 hours' duration with the 2 m ringtrawl with 3000 m wire out. *Pantachogon haeckeli* is thus a predominantly bathypelagic medusa, though occasionally it may ascend into higher strata, especially in colder regions; in certain areas, e. g. in the waters west of Greenland, it may therefore be carried with the currents into the coastal waters; thus it was taken by the "Godthaab" expedition near the south point of Greenland and off the entrance to Hudson Strait, and it is also able to cross the submarine ridge in Davis Strait and penetrate into the deep basin of Baffin Bay (for details, see KRAMP 1942 pp. 78–79).

In the hauls from the "Dana" the specimens caught in the stramin-nets varied in size from 3 or 5 mm to 10 or 11 mm in diameter; specimens more than 11 mm wide were found on two occasions only: St. 4201, 5000 m wire (12 mm), and St. 2308, 3000 m wire (13 mm). (In Baffin Bay, "Godthaab" St. 54, one specimen 14 mm wide was taken in a haul with 3000 m wire out). The measurements of the specimens present no evidence of a difference in the vertical distribution of the various size classes of individuals.

Geographical distribution: *Pantachogon haeckeli* is generally distributed over the deep parts of all the oceans from the slopes of the antarctic continent to the Bering Sea and to the submarine ridges separating the North-Atlantic deep-sea area from the arctic basins

Genus **Crossota** Vanhöffen 1902.

Trachynemidæ with 8 or more radial canals; with numerous densely crowded tentacles all of one kind; with pendent, sausage-shaped gonads on the radial canals; with free, club-shaped statocysts; with or without a short stomachal peduncle.

Since this genus was established by VANHÖFFEN (1902 b p. 72) the supposed multiserial position of the tentacles has been emphasized by all subsequent authors as the most characteristic feature of the genus. In my paper on the "Godthaab" medusæ (KRAMP 1942 p. 80) I expressed a different opinion and doubted the correctness of one of VANHÖFFEN's figures (Pl. 12 fig. 47), and now, having examined a large number of well-preserved specimens of the genotype, *Crossota brunnea* Vanhöffen, I can state that I was entirely right in my view: the tentacles of *Crossota* are not placed in several rows; they all make their appearance on the bell margin proper in close connection with the ring-canal, but during growth their basal portion becomes adnate to the lower margin of the exumbrella; in older tentacles, therefore, the point of issue of the free portion is gradually displaced a little outwards on the exumbrella. If this should be called an arrangement in several rows, it is at least effected in quite another way than that illustrated by VANHÖFFEN in his figure 47, in which the youngest tentacles are the farthest removed from the ring-canal, implanted in the jelly of the exumbrella without the slightest connection with the ring-canal. In the other species which I have seen, the arrangement is the same as in *C. brunnea*, but the displacement of the free portion is less pronounced (see below).

VANHÖFFEN gave no definition of the genus but a comparatively thorough description of the species *Crossota brunnea*, which was found to be widely distributed in the deep-sea of the Atlantic and Pacific Oceans between the equator and about Lat. 60° S. He also mentioned another new species, *Cr. norvegica*, from the Norwegian Sea, but he gave no description of it, beyond stating that it was characterized by its cherry-red colour and smaller size as compared with *C. brunnea*.

BIGELOW (1909 a p. 134) showed that *C. brunnea* also occurs in the tropical Pacific; he considered *C. norvegica* (which he only knew from VANHÖFFEN's insufficient description) a synonym of *C. brunnea* and placed the genus in the family Pectyllidæ, whereas MAYER (1910 p. 395) placed it near *Botrynema*, *Halicreas*, and "*Homoeonema*".

In 1913 a (pp. 17 ff.) BIGELOW found that *Crossota* was not related to *Ptychogastria* but to *Aglantha* and *Aglaura*, and he described two new species from the north-western Pacific, *C. alba* and *C. pedunculata*, the latter characterized by the presence of a short, solid, gelatinous peduncle. He also found numerous specimens of a *Crossota* which he called *C. brunnea* var. *norvegica*: I have seen two of these specimens, kindly sent to me by professor BIGELOW; they are very similar to the North-Atlantic species *C. rufobrunnea*, which I described in the same year (KRAMP 1913 a p. 273), and undoubtedly belong to the same species (see below).

When I described this species from the deep strata in the Davis Strait, I saw that it resembled an *Aglantha* in the pendent, sausage-shaped gonads, the ribbon-like radial canals, and the shape of the stomach, and I even thought I saw a trace of a stomachal peduncle; it also had a great resemblance to "*Helicertum proboscifer*" Maas (1897 p. 19, Pl. II figs. 5–7), which was provided with a long gelatinous peduncle and undoubtedly was closely allied to *Aglantha*: I therefore also referred my new species to *Aglantha*. Later on I was very sorry that I had made such a mistake, but now I am aware that I was not altogether wrong: *Crossota* is undoubtedly closely allied to *Aglantha*. Shortly after my paper had been published, I recieved a letter from professor VANHÖFFEN who was inclined to think that my "*Aglantha rufobrunnea*" was identical with his *Crossota norvegica*, and I, being young and inexperienced, naturally complied with such an authority and in a subsequent paper (KRAMP 1920 p. 5) referred some other North-Atlantic specimens, collected by the Norwegian vessel "Armauer Hansen", to *C. norvegica*. At about the same time I found in the collections of the Zoological Museum of Copenhagen some specimens of a larger *Crossota* with a cherry-red colour and with 10–14 radial canals, collected by the "Ingolf" Expedition in deep water in the Norwegian Sea, north-east of Iceland; they were labelled by G. M. R. LEVINSEN *Crossota* n. sp. How I wished to know what VANHÖFFEN's *C. norvegica* was really like! My curiosity was soon disposed of, for during my stay with professor D. DAMAS at Liége in Belgium in the autumn of 1920 I saw VANHÖFFEN's original specimens and found that they had 10–12 radial canals (a fact overlooked by VANHÖFFEN) and in every respect were similar to the specimens which I had seen in our own museum. This discovery was published in KRAMP & DAMAS (1925 p. 317) with an addition that *Crossota rufobrunnea* Kramp was a distinct species occurring in the northern Atlantic, but not in the Norwegian Sea nor in the Polar Sea. Unfortunately, the specimens of *C. rufobrunnea* from the "Armauer Hansen" (KRAMP 1920) are still mentioned under *C. norvegica* in the "Nordisches Plankton" by BROCH (1929 p. 507).

As mentioned above (p. 12), UCHIDA (1928 p. 80) refers *Crossota* to the sub-family Aglaurinæ.

RANSON (1936 pp. 160 ff.) describes a specimen of *C. rufobrunnea* from the Bay of Biscay and discusses the genus, which he places near *Arctapodema*: he will not admit the presence of a gelatinous peduncle in *C. pedunculata* Bigelow, and he is cer-

from the Norwegian Sea where it occurs in the deep strata under purely arctic conditions.

C. rufobrunnea Kramp 1913 is a comparatively small species, up to 15 mm in diameter, with about 200–250 tentacles. It also differs from *C. brunnea* in some minor details. It occurs in the northern Atlantic south of the submarine ridges but not in the arctic basins further north; probably also in the northern Pacific.

C. alba Bigelow 1913 is 22 mm wide, with 179 tentacles; the dark pigmentation seems to be restricted to the manubrium. It differs from the other species (except *pedunculata*) by the situation of the gonads "only about one-third of the meridional distance above the margin," which seems to me sufficient to maintain it as a proper species distinct from *brunnea* and *rufobrunnea*. Two specimens were found in Japanese waters.

C. pedunculata Bigelow 1913 may attain a size of 25 mm in diameter with 610 or more tentacles. According to Bigelow the gonads progressively attain a lower and lower position with the growth of the bell, terminating at about one-third of the meridional distance above the margin. The reddish-brown pigmentation covers the entire subumbrella. It seems to me that we must accept Bigelow's definite statement of the presence of a solid gelatinous peduncle, about 5 mm long; it is very improbable that this should merely be the result of contraction as implied by Ranson. On the other hand, we must strongly disagree with Thiel who will refer this species to *Aglantha* on account of the peduncle; in all other respects it is a typical *Crossota*. Four specimens were taken near the mouth of the Columbia River on the west coast of North America, and it is the only species of *Crossota* occurring in the upper strata, 50–0 fathoms.

It should still be mentioned that "*Melicertum proboscifer*" Maas 1897 has been supposed to be a *Crossota*. It was taken in the Gulf of Panama. Apart from the low shape of the umbrella (15 mm high and 40 mm wide) it greatly resembles an *Aglantha* in all respects, including the colour which seems to be very nearly the same as that seen in the large *Aglantha digitale* in arctic regions and quite different from the dark pigmentation of *Crossota*. I have not the slightest doubt that it should be referred to *Aglantha*, as already supposed by Mayer (1910 p. 209).

Most other bathypelagic medusæ have a world-wide distribution in the oceans between the continental shelves in the south and the north, but this does not apply to any of the species of *Crossota*. Besides *C. norvegica* which is an arctic deep-sea medusa, and *C. alba* and *pedunculata* which are only known from restricted areas in the northern Pacific, we have two widely distributed species, but they do not occur within the same areas: *C. brunnea* is a common deep-sea species in all the oceans from the continental shelf of the Antarctic Continent northwards, but its northward distribution ends at or about the equator, and in the northern parts of the Atlantic and Pacific Oceans it is replaced by *C. rufobrunnea*; these two species seem to be about equally abundant, each within its area, but none of them has extended its distribution into the area of the other species.

Crossota rufobrunnea Kramp.

Pl. II figs. 9–10, Pl. III figs. 1–8, Pl. IV figs. 1–4, Pl. VI fig. 5.

Crossota brunnea var. norvegica Bigelow 1913 p. 18.
Aglantha rufobrunnea Kramp 1913a p. 273, figs. 1–2.
— — 1914 p. 133.
Crossota norvegica Kramp 1920 p. 5.
— rufobrunnea Kramp & Damas 1925 p. 317.
— — Broch 1929 p. 506, fig. 17.
— norvegica pars Broch 1929 p. 507.
— rufobrunnea Thiel 1932a p. 153.
— — Thiel 1932b pp. 141, 156, 159, 162, 166, 167, 186, 199.
Crossota rufobrunnea Ranson 1936 p. 162.

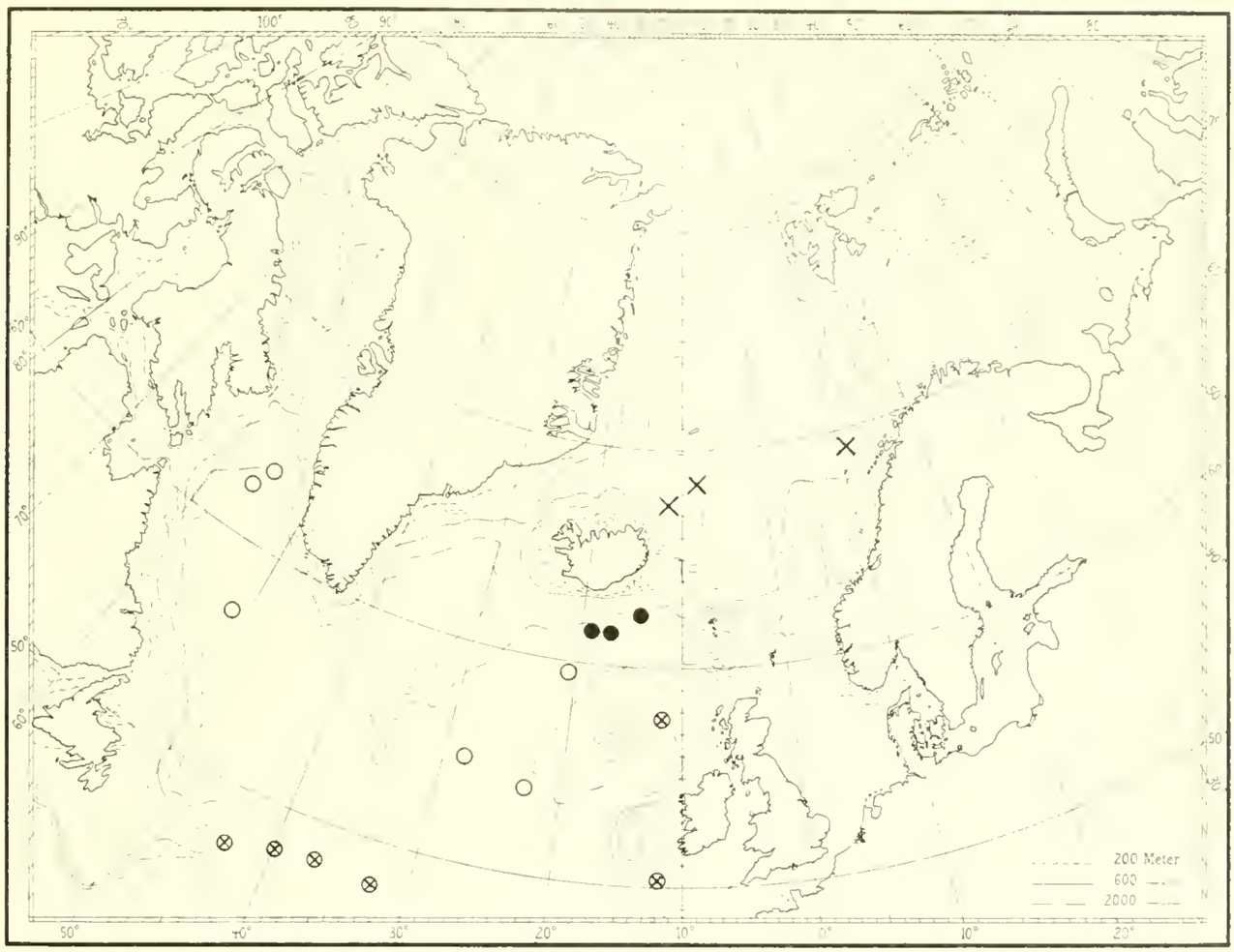


Fig. 8. Distribution in the northern Atlantic of: ● *Crossota rufobrunnea*, new records; ○ *Crossota rufobrunnea*, previous records; ⊗ *Crossota rufobrunnea*, records not yet published; × *Crossota norvegica*.

Crossota brunnea Bigelow 1938 p. 119.
– rufobrunnea Kramp 1942 p. 79.

North-Atlantic records:
Kramp 1913, 1920, 1942; Ranson 1936.

Material (see the map, textfig. 8):

61°34′N. 19°05′W., $^{10}/_{7}$1904. "Thor" St. 180. 1800m wire. 2 spec.
61°30′N. 17°08′W., $^{11}/_{7}$1904. – – 183. 4 specimens
62°23′N. 16°05′W., $^{25}/_{6}$1932. "Dana" St. 4402. 3000m wire. 35 spec.
– – – – – 4402. 1000m – 220 –

Description: Umbrella (Pl. VI fig. 5), when moderately contracted, somewhat higher than a hemisphere, up to 15 mm in diameter and 10 mm in height, evenly rounded; gelatinous substance fairly thin, about 1.5 mm at the apex, gradually tapering in thickness towards the bell margin. Exumbrella with about 20 meridional grooves in each octant, running from the bell margin upwards and all of equal length, terminating at about the level of the base of the manubrium, leaving the top of the umbrella smooth. The circular musculature of the subumbrella is weak. Velum broad, but thin and with weak muscles.

Manubrium (Pl. III figs. 1–2) bottle-shaped, its length about one-third of the height of the subumbrella cavity, varying according to state of contraction. The basal part, the stomach proper, is rather broad, the mouth-tube somewhat narrower and shorter than the stomach, mouth with four short but well-developed, outturned lips. In transverse section the mouth-tube is quadrangular with thin walls, in each corner is a string of large, vacuolated endoderm cells covered by a thin ectoderm and visible on the external side as a prominent edge, on the internal side marked by a sharp groove (Pl. III figs. 1, 2, 3); these four strings and the corresponding grooves are continued to the points of the lips and upwards to the top of the stomach. The attachment of the stomach to the subumbrella is star-shaped, corresponding to the eight radial canals. The walls of the stomach are rather thin and provided with two whorls of deep folds. Those of the upper whorl are eight small, narrow lappets hanging down into the cavity of the stomach (Pl. III fig. 2); their inner edges almost meet in the centre (Pl. III fig. 1); they are hollow, and their cavities communicate with the bell cavity through eight small, radiating fissures in the apical wall of the stomach between the radial canals. The lower whorl consists of eight large elongated pouches, placed immediately below those of the upper whorl, sharply marked off from them, and gradually tapering downwards towards the distal portion of the stomach (Pl. III fig. 2). On the external side of the stomach they are seen as eight deep, open grooves (Pl. III fig. 1); when the stomach is strongly contracted in circular direction, these grooves may become so narrow as to be termed fissures, and the spaces between them may then protrude like eight longitudinal ridges. The large pouches of the lower whorl are not quite equidistant, the four spaces with the above-mentioned four prominent edges being somewhat broader than the four other spaces (Pl. III fig. 1). The endoderm of the pouches is slightly thickened and has a papillose surface.

Externally no trace of a stomachal peduncle is observed,

continuous epithelium, but in the lateral bands this epithelium is gradually dissolved into a meshwork of branched cells winding themselves in the spaces between the flattened, pigmented cells of the endoderm lamella, which, outside the border of the "lateral band", becomes directly adnate to the thin supporting lamella separating it from the muscular layer of the subumbrella. The "lateral bands" of the radial canals are the portions where two layers of endoderm cells are present without being separated by a cavity. Moreover the bands are made conspicuous by a difference in configuration of the cells of the endoderm lamella: the exumbrellar, pigmented epithelium of the canal consists of small cells, fairly high and with large, round vacuoles; in the lateral bands the pigmented cells are flattened, large, roundish, and separated by rather broad spaces partly filled by the branching non-pigmented cells; outside the bands the cells are somewhat smaller, with wavy outlines and closely set. Sometimes the lateral bands of the radial canals are very sharply marked out by a clear line on each side; this is undoubtedly due to artificial rupture of the tissues caused by strong contraction at the moment of fixation. In the material available no specially developed musculature may be observed in the lateral bands of the radial canals.

The ring canal is fairly broad: its subumbrellar epithelium is unpigmented and similar to that of the radial canals.

The eight sausage-shaped gonads are attached to the eight radial canals near the stomach (Pl. III fig. 2); they are hollow, their internal cavity communicating with the radial canals. In fully developed specimens the gonads are somewhat shorter than the manubrium, in young individuals they are small globular swellings.

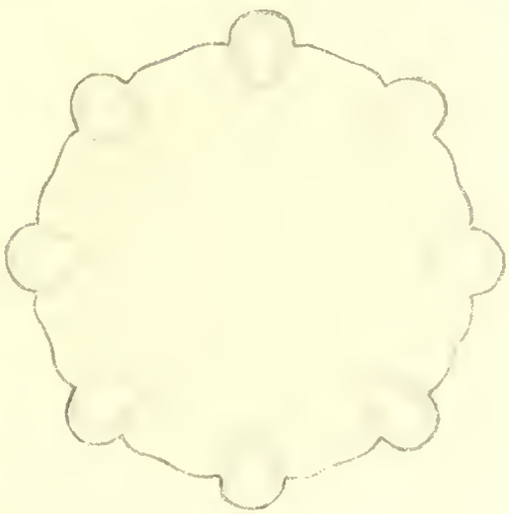
The length of the tentacles cannot be decided, as in all the specimens available they are broken off at some distance from their base, but from what remains they seem to have been rather long. The abaxial side of their basal portion is adnate to the lower margin of the exumbrella (Pl. IV figs. 1–2), and the point of issue of their free portion is therefore somewhat removed from the ring-canal, mainly in the oldest tentacles, but the displacement is less pronounced in this species than in *C. brunnea*. The tentacles are provided with a large and broad endodermal spur protruding into the gelatinous substance of the umbrella in front of the ring-canal. Tentacles in different stages of development are always present simultaneously, but they are not regularly alternating. The tentacles are usually separated from each other by spaces similar to their own breadth.

The total number of tentacles in fully developed individuals is usually about 250. It is rarely possible to count the tentacles within every single octant, partly because some of the radial canals in badly preserved specimens often cannot be exactly located right out to the bell margin. The radial canals are not always quite equidistant, and the number of tentacles per octant varies accordingly: in a specimen 10 mm high with altogether 240 tentacles the number per octant varied from 16 to 37; in some other specimens of similar size I have counted the following numbers:

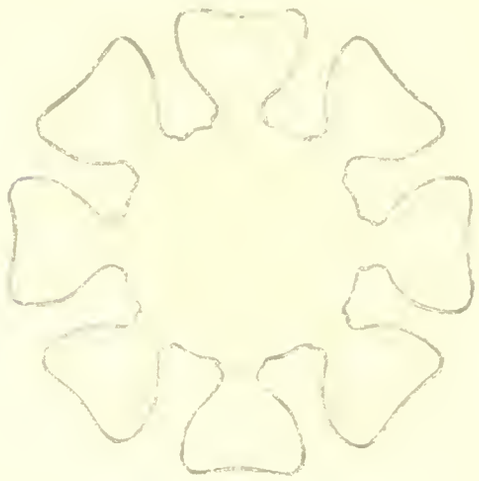
27	22	23	26	28	25	28	26	205
36	31	35	26	31	31	33	25	251

The statocysts are evidently readily lost; even among the best preserved specimens I have seen only a few statocysts; they agree with those found by Bigelow (1913 p. 49 and 50, Pl. 9 fig. 12) in the Pacific specimens and in *C. alba*; two of them are seen in Pl. IV figs. 3–4.

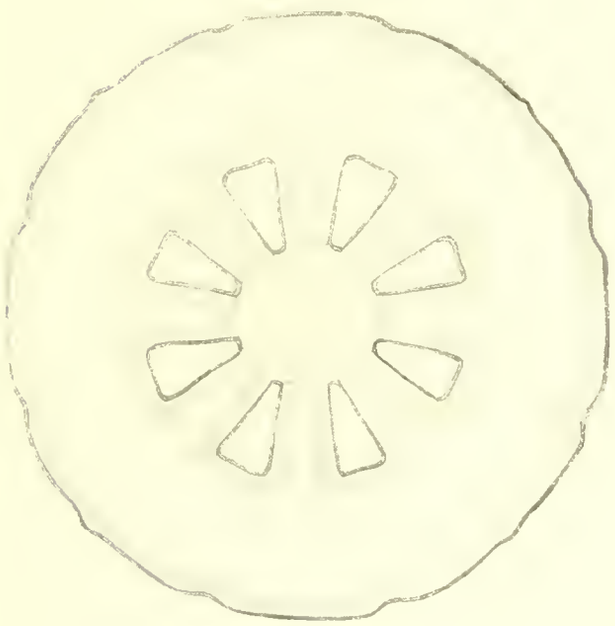
Colour (Pl. VI fig. 5). Fresh or well preserved specimens are so densely pigmented that they are almost completely opaque: the colour is a deep reddish-brown and, as mentioned above, it is due to dense accumulations of minute pigment granules in the cells. The pigmentation comprises the following tissues: the



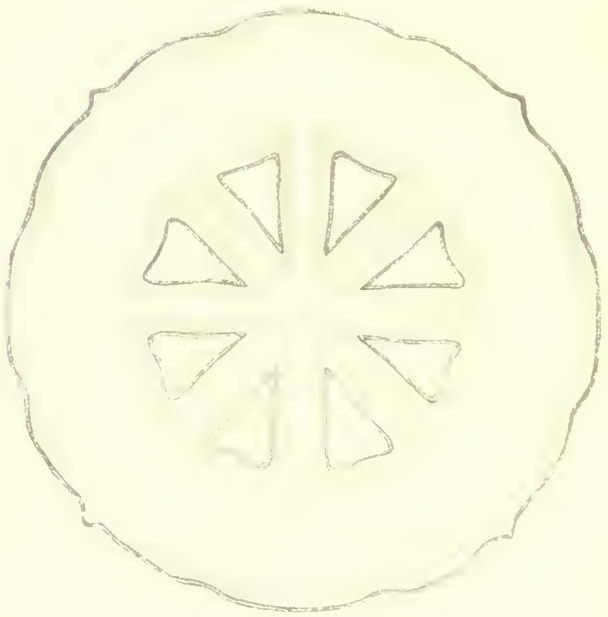
a



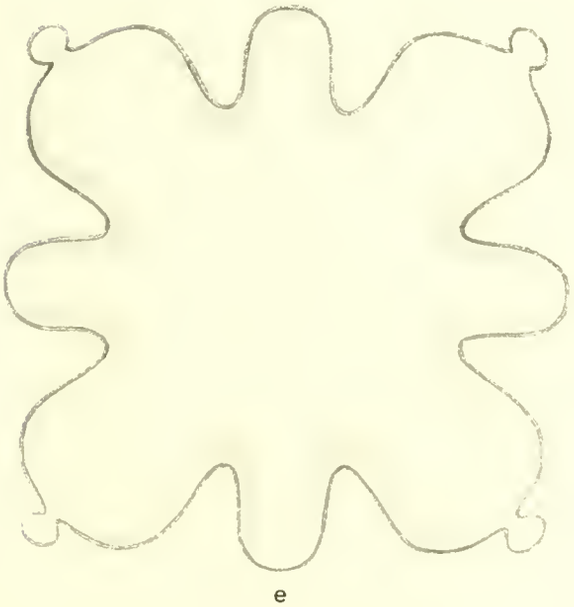
b



c



d



e

Fig. 9 *a*—*e*. *Crossota rufobrunnea*, transverse sections of manubrium. Diagrams based upon microtome sections. Size-proportions correct, with the exception that the thickness of the ectodermal epithelium is a little exaggerated. — Dark shade: ectoderm; medium shade: endoderm; light shade: mesogloea. — For further explanation, see the text, pp. 23–24.

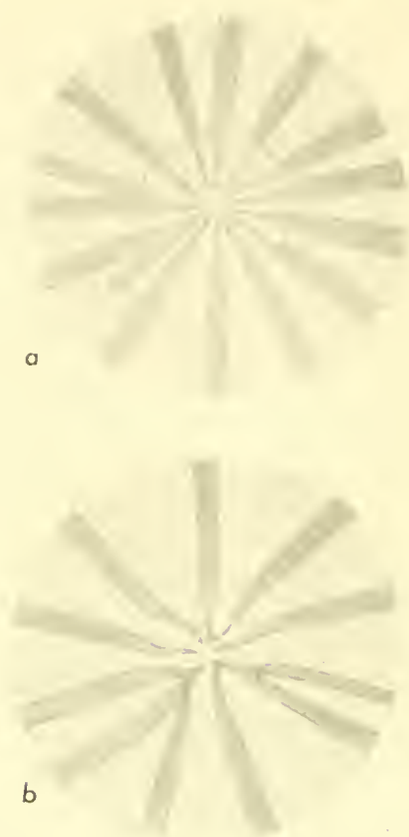


Fig. 10 *a*—*b*. *Crossota norvegica*. Mode of issue of the radial canals in two specimens. — *a* with 14 radial canals and one blind canal ("Ingolf" stat. 118; outline of stomach indicated). *b* with 11 radial canals ("Ingolf" stat. 120).

the specimens, with 10 and 11 radial canals, they all issue separately from the centre of the subumbrella; in two other specimens (textfig. 10*a* and *b*) one or more of the canals are seen branching off from the others at a short distance from their proximal ends. One of these specimens (textfig. 10*a*) has 14 complete radial canals reaching the ring-canal, and also one short blind canal. The terminal points of the radial canals, where they join the ring-canal, are not quite equidistant.

The manubrium (Pl. IV fig. 6) is bottle-shaped, about one-third to two fifths as long as the height of the bell cavity. The mouth has 5–7 outturned lips (the number of lips being about half the number of radial canals); from each of the lips a prominent ridge proceeds upwards over the mouth tube; in the proximal portion of the stomach proper some of these ridges become more or less irregularly divided. The stomach is provided with similar invaginations as those described above in *C. rufobrunnea* and also seen in *C. brunnea*, but in *C. norvegica* they are variable in number and irregular in position.

The gonads are sausage-shaped, about half as long as the manubrium, attached to the radial canals very near the stomach; the number of gonads is equal to the number of radial canals.

The tentacles could not be counted exactly; in the best preserved specimen there are about 275. The displacement of the point of issue of the older tentacles is not very pronounced. The basal endodermal spur is comparatively long, more elongated than in *C. rufobrunnea*. Statocysts are not observed.

Colour. This medusa has about the same deep reddish-brown colour as that found in *C. rufobrunnea*.

Variation: The seven specimens of this species observed up to now have the following dimensions:

Crossota norvegica Vanhöffen.

Pl. IV figs. 5–6.

Crossota norvegica Vanhöffen 1902 b p. 75.
Kramp & Damas 1925 p. 317.
C. p. Crossota norvegica Broch 1929 p. 507.
C. p. Thiel 1932a p. 153.
Crossota — *brunnea* var. *norvegica* Bigelow 1913 p. 48.
Crossota *norvegica* Kramp 1920 p. 5.

Material (see the map, textfig. 8):

58°27′ N.	8°20′ W.	24/7 1896.	"Ingolf" St. 118. 3 specimens
57°20′ N.	11°52′ W.	25/7 1896.	" 120. 2 "

Only one of the specimens is in a fair condition, the others are more or less damaged, but various details are well preserved.

Description (Pl. IV figs. 5–6): Umbrella dome-shaped, rather less than a hemisphere, about 20 mm in diameter and 18 mm in height; apex rounded, gelatinous substance fairly thin; exumbrella with numerous meridional grooves, about 16–18 between each adjacent pair of radial canals. Velum fairly broad. The number of radial canals varies from 10 to 14. In two of

	Vanhöffen's original specimens		"Ingolf" St.				
			118	118	118	120	120
Diameter, mm	20	20	15	17	19	18	20
Number of radial canals	10	12	?	11	10	11	11

Distribution: The two localities, where *C. norvegica* was taken by the "Ingolf" expedition, are north-east of Iceland in the deep basin of the Norwegian Sea; at St. 120, nearest to Iceland, the depth of the bottom was 1666 m, at St. 118 it was 1996 m. The labels do not tell us how far below the surface of the water the specimens were captured, but according to the journal of the expedition they must have been caught in the trawl, either near the bottom of the sea or at some higher level during the hauling in of the trawl. Vanhöffen's original specimens were found in the eastern part of the Norwegian Sea, 69° 13′ N. 10° 10′ E., west of the Lofoten, at a depth of about 1000 m. We may suppose, therefore, that the "Ingolf" specimens were likewise taken in the deep strata where the temperature of the water is very low; at the "Ingolf" St. 118 and 120 the temperature was below 0° from about 500 metres downwards, being $+1°0$ at the bottom. *C. norvegica* may thus be designated as an arctic deep-sea medusa.

Genus **Aglantha** Haeckel 1879.

Trachynemidæ with a well-developed, gelatinous stomachal peduncle; with eight radial canals; with numerous tentacles all alike; with free, club-shaped statocysts; with eight pendent, sausage-shaped gonads, equally developed and attached to the subumbrella.

By this diagnosis *Aglantha* is distinguished from *Aglaura* in which the eight gonads are upon the peduncle, and from *Amphogona*, in which the eight gonads are not equally developed; moreover *Aglantha krampi* Ranson, with linear gonads on the peduncle, is removed from the genus *Aglantha* (see above, p. 12).

In two papers (1932 and 1936) Ranson has dealt with the history of the Aglaurinæ and discussed the various genera and species referred to this division of the Trachynemidæ, and in most respects I can agree with him. As far as the species which have been referred to the genus *Aglantha* are concerned, we may safely state as follows: *A. globulifera* (Haeckel) belongs to *Aglaura*; *A. ignea* Vanhöffen should be transferred to the Rhopalonemінæ; *A. camtchatica* (Brandt), *A. rosea* (Forbes), *A. occidentalis* Maas, and *A. conica* Hargitt are forms (races or varieties) of *A. digitale*. *A. elata* (Haeckel) is probably identic with *A. elongata* (Lesson), and Ranson is inclined to identify this form with *A. digitale*; considering its occurrence off the African coasts, far removed from the area of distribution of *A. digitale*, it seems to me that, at least at present, we must retain it as a proper species (the specimens from the Bay of Biscay, identified by Maas (1904 p. 30) as *Aglisera elata*, certainly belong to *A. digitale* as demonstrated by Ranson, who has re-examined the specimens). *Aglantha digitale* var. *intermedia* Bigelow (1909 a p. 122, Pl. 29 figs. 4–10), taken by the "Albatross" in the eastern tropical Pacific, differs from *A. digitale* in the shape of the manubrium and in the peculiar S-like course of the canals upon the peduncle; therefore, and also for geographical reasons, it seems to me that this form should better be regarded as a distinct species. *Melicertum proboscifer* Maas is most probably an *Aglantha*, distinguished by the considerable breadth of the umbrella in proportion to the height (see above, p. 22). As mentioned above (p. 12) *Aglantha krampi* Ranson seems to me to represent a proper genus, *Ransonia* mihi.

Only one species of *Aglantha* occurs in the northern portions of the Atlantic area, viz. *A. digitale* (O. F. Müller); different races may be more or less distinctly recognized, but on the present occasion I shall not enter into this matter because only scattered portions of the material at my disposal are in a condition which make them suitable for this kind of investigations. I shall only give a general survey of the North-Atlantic occurrence of the species as a whole, particularly of the bathymetrical occurrence in the different regions within the area of distribution.

As, from several points of view, *Aglantha digitale* is one of the most important species of medusæ in northern seas, it might be desirable for once to give a list of the references in the literature, as complete as possible. As to the literature previous to 1910 I refer to Mayer, Medusæ of the World (1910 p. 402), with addition of Levinsen 1893 p. 116 containing a list of Greenland localities. – In the following list the North-Atlantic records are marked by an *n*.

Aglantha digitale (O. F. Müller).

Aglantha digitale Mayer 1910 p. 402 (list of previous literature).
n – digitalis Le Danois 1913a p. 488, and 1913b p. 27. figs. 11–17 (description of development; localities S.W. of Ireland, near Jan Mayen, and between Jan Mayen and Iceland.
n – digitalis Le Danois 1914 p. 314 (Bay of Biscay, Faroes, Jan Mayen).
n – digitalis Linko 1913 (Kara Sea).
– digitale Bigelow 1913 p. 43 (N.W. Pacific; discussion of species).
n – digitalis Kramp 1913a p. 269 (W. Greenland).
n – – 1913b p. 527 (N.W. Europe).
n – – – – 1914 p. 428 (W. and E. Greenland).
n – digitale Bigelow 1914 (New England).
n – digitalis Kramp 1915 (Great Belt and Kattegat).
n – digitale Bigelow 1915 (discussion of species; between Nova Scotia and Cape May).
n – digitale Bigelow 1917 pp. 303, 304, 305 (Cape Cod – Halifax).
n digitale Bigelow 1918 p. 388 (near Chesapeake Bay).
n – digitalis Kramp 1920 p. 5 (N. Atlantic).
n – digitale Bigelow 1920 p. 10 (Alaska) and p. 17 (Labrador).
n Aglaura hemistoma var. "laterna" Sverdrup 1921 p. 26, Pl. 3 fig. 14 (Kristianiafjord).
n Aglantha digitalis Sverdrup 1921 p. 27, Pl. 4 fig. 16 (Kristianiafjord).
n digitale Bigelow 1922 p. 134 (Gulf of Maine).
n – Lebour 1922 p. 664 (food).
n – – Peacock 1923 p. 95 (Northumberland coast).
n – digitalis Jespersen 1923 p. 109 (N. W. Greenland).
n – digitale var. rosea Coy 1924 p. 56 (Northumberland coast).
n digitale var. rosea Peacock 1924 p. 60 (Northumberland coast, remarks on var.).
n – digitale Kramp 1924 p. 29, fig. 24 (Bay of Biscay, S.W. of Ireland).
n digitale Kramp & Damas 1925 p. 318 (Norway).
n rosea Russell 1925 p. 786 (Plymouth).
digitale Uchida 1925 p. 97 (Japan).
n – – Bigelow 1926 pp. 38, 40, 48, 50, 352 (Gulf of Maine).
digitale Uchida 1927 p. 225 (Japan).
n – Jaschnov 1927 p. 7 (Kara Sea).
n rosea Russell 1927 p. 573 (Plymouth).
n digitale Kramp 1927 (Denmark; races in Danish waters).
digitalis Uchida 1928 p. 79 (Japan).
n digitale Broch 1929 p. 512 figs. 22, 23 (northern seas).
n rosea Sanderson 1930 p. 229 (Northumbrian coast).
n Watson 1930 p. 236 (Northumbrian coast).
digitalis Uchida 1930 p. 335 (Japan).
n rosea Plymouth marine Fauna 1931 p. 83 (Plymouth).

1931 pp. 21–30, 76 (east coast of Iceland).
" Rathke Rathke 1932 p. 31 (Norway).
" " Cowles 1930 p. 531 (Chesapeake Bay).
" " Thiel 1932a p. 154 and 1932b (distribution).
" Russell 1933 p. 76 (Plymouth).
" digitale Uchida 1933 p. 132, fig. 8 (Kamtchatka).
" " Kramp 1933 p. 46 (E. Greenland).
" " Bernstein 1934 pp. 9, 26 (Kara Sea).
" " rosea Russell 1935a pp. 314, 315, 318 (Channel).
1935b p. 27 (biology).
" digitalis Kunne 1935 p. 65 (Baltic).
" digitale Ranson 1936 p. 177, Pl. 2 figs. 18–20 (temperate Atlantic, discussion of species and varieties).
" digitalis rosea Künne 1937a p. 6 (Baltic).
" " " 1937b pp. 139, 147, 151–162 (North Sea).
" digitalis Frost 1937 p. 26 (Newfoundland).
" " digitale Hardy 1936 (N. of Spitzbergen).
" " Kramp 1937 p. 130, fig. 59 (Denmark).
" " Uchida 1938a p. 54 and 1938b p. 43 (Japan).
" rosea Russell 1938 pp. 413, 416, 417, 419, 433, 437 (Plymouth).
" digitale Bigelow & Sears 1939 p. 362 (Cape Cod – Chesapeake Bay).
" " digitale Kramp 1939 p. 16 (Iceland).
" " Jaschnov 1939 pp. 112, 114 (Kara Sea, Tschukotski Sea).
" " digitalis var. rosea Russell 1940 p. 517 (nematocysts).
" digitale Uchida 1940 p. 292 (Japan).
" Dunbar 1942 p. 71 (around Baffin Land).
" " Kramp 1942 p. 81 (W. Greenland; discussion of races; biology).
" digitale Kramp 1943 p. 7 (E. Greenland).

The Danish Zoologist O. F. Müller (1776 p. 233) was the first to publish a brief diagnosis of "*Medusa digitale*", for which, as he added, he was indebted to O. Fabricius. In "Fauna Groenlandica" (1780[1] p. 366) Fabricius gave the same diagnosis, and also a somewhat more detailed description of the specimens which he had collected in Greenland. Though this species is one of the most widely distributed and common medusæ in the northern seas, many years elapsed before it was found in other regions. The variety *camtschatica* was collected by Mertens in the Pacific and figured and described by Brandt (1838 p. 354, Pl. 1 figs. 1–5), and the first record from European seas (the Shetland Islands) is due to Forbes (1848 p. 31, Pl. 1 fig. 2, *Circe rosea*). From the east coast of North America it was recorded for the first time by A. Agassiz (1865 p. 57, figs. 81–86, *Trachynema digitale*). The generic name *Aglantha* is introduced by Haeckel; his new description is mainly based upon the specimens in our museum in Copenhagen, collected in several localities off the west coast of Greenland and in the northern Atlantic, mainly from the vessels sailing between Denmark and Greenland; most of these specimens are still in our collections. The Greenland localities, and some of the North Atlantic, are published by Levinsen (1893 p. 146); the other localities, not previously published in details, are as follows: 48° N. 8° W. (Hygom 1851); 59° 07′ N. 13° 32′ W. (Mohn 1867); 50° 00′ N. 16° W. and 58° 17′ N. 30° 59′ W. (Olrik 1899); 57° 4′ N. 27° 03′ W. (Bang 1868).

We learn from the literature that *Aglantha digitale* is commonly considered to be a northern species from the Polar Sea to the Bay of Biscay in the East and to the Gulf of Maine in the West, and also occurring to a small extent further south in both sides of the Atlantic. There is no reason, therefore, to give a complete list of the rich and extensive material of this species in our collections.

Mayer (1910 p. 304), for instance, quotes Fabricius as published 1780

In some previous papers I have dealt with the occurrence in the waters round Denmark, Norway, Iceland, and Greenland, and several other authors have given equally thorough accounts of the occurrence in other coastal areas. It may be worth while, however, to examine the distribution in the large, open oceanic basins, from which the records in the literature are somewhat scattered and from which rather considerable collections are available in our museum. Though *Aglantha digitale* is a holoplanktonic medusa, we cannot beforehand be sure that it is equally abundant everywhere within its extensive area of distribution.

For the following discussion of the occurrence I have divided the area under consideration into six sections, as seen from the map, textfig. 11, and I am going to deal with them separately, leaving out the records from the coastal regions.

I. The Kara Sea: – Material: Kara Sea, "Dijmphna" 1882–83. – Previous records: Linko 1913, Jaschnov 1927, Bernstein 1934, Jaschnov 1939.

Unfortunately, we have no information of the exact localities at which the specimens were taken by the "Dijmphna" expedition, and no records of depth or date. The expedition comprised the southern portion of the Kara Sea, south of 72° N. and west of 66° E. Linko was the first to mention *Aglantha digitale* from the Kara Sea, but his paper has not been accessible to me. Jaschnov (1927 p. 7) has dealt with its occurrence at some length; according to this author the medusa was never taken east of 66° E., where the salinity of the water is considerably lowered by the influence of the great Siberean rivers; adult specimens were mainly taken in the deeper strata at very low temperatures, whereas very young specimens were found almost exclusively in the surface layers. The largest specimens measured by him were 15 mm in height, thus considerably smaller than those found in other arctic regions. According to Bernstein this species may occur in the Kara Sea in great abundance.

II. The Barents Sea: – No new material. – Records in the literature: Linko 1904a p. 15 (preliminary list of species) and 1904b p. 219; Kramp 1913b. *Aglantha digitale* may be extremely abundant in this region, but the quantity seems to be variable from one year to another. Linko has given valuable information of the seasonal occurrence, and he concludes that the propagation predominantly takes place during the winter in the neighbourhood of the coasts.

III. The Norwegian Sea and the Polar Sea east of Greenland:

66° 23′ N.	8° 52′ W.,	$^{10}/_{7}$ 1896.	"Ingolf" St. 103.	188–0 m. 2 spec.
66° 23′ N.	7° 25′ W.,	$^{11}/_{7}$ 1896.	– – 104.	188–0 m. 3 –
68° 27′ N.	8° 20′ W.,	$^{24}/_{7}$ 1896.	– – 118.	1 specimen
62° 58′ N.	7° 09′ W.,	$^{11}/_{8}$ 1896.	– – 143.	1 –
abt. 62½ N.	1° E.	$^{20}/_{6}$ 1900.	E.-Greenl. Exp.	vert. hauls. 3+2 spec.
abt. 63° N.	½° E.	$^{20}/_{6}$ 1900.	– –	3+2+1 –
abt. 63½ N.	0°	$^{21}/_{6}$ 1900.	– –	1 spec.
abt. 64° N.	½° W.	$^{21}/_{6}$ 1900.	– –	7 –
61° 05′ N.	9° 38′ W.,	$^{5}/_{5}$ 1901.	"Thor" St. 63.	3 specimens
63° 36′ N.	6° 20′ W.,	$^{11}/_{5}$ 1903.	– –	12. 600 m wire. 22 spec.
61° 01′ N.	4° 33′ W.,	$^{23}/_{7}$ 1905.	– –	121. 3 specimens
66° 49′ N.	24° 59′ W.,	$^{9}/_{8}$ 1927.	"Dana" St. 3221.	800 m wire. 200 sp.
66° 22′ N.	6° 26′ W.,	$^{23\,24}/_{5}$ 34	– – 5142.	600 m – 800 –
65° 14′ N.	6° 06′ W.,	$^{24}/_{5}$ 1934.	– – 5113.	900 m – 2000 –
			– – 5143.	1100 m – 2000 –
			– – 5143.	1900 m – 4800 –
			– – 5143.	2100 m – 2000 –

Previous records: Le Danois 1913a and b, 1914 records this species from the neighbourhood of Jan Mayen; Kramp 1913b, in which the collections by the International Plankton

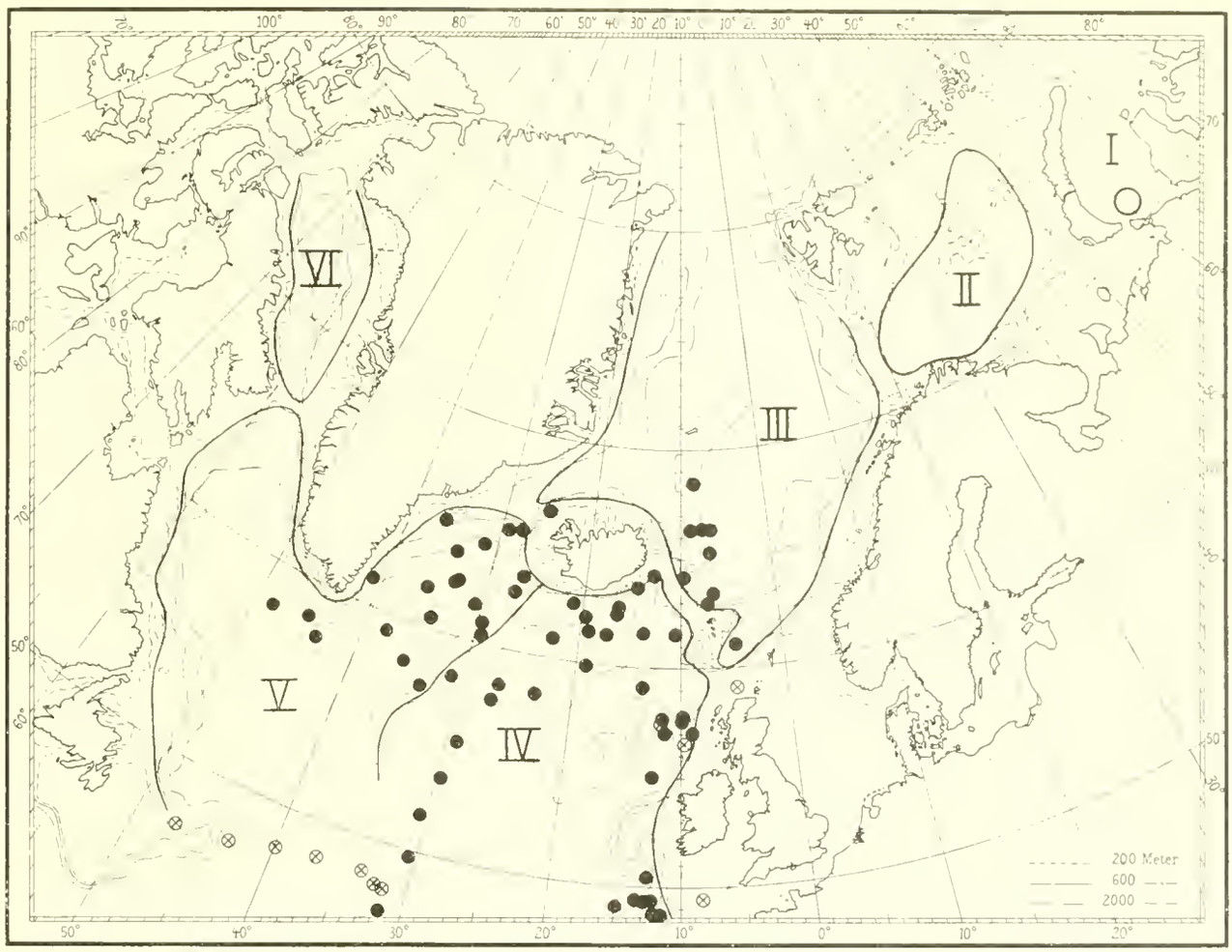


Fig. 11. *Aglantha digitale*. ● new records outside the coastal waters; ⊗ records yet not published; exact localities not stated. The strongly drawn lines indicate the boundaries of the regions mentioned in the text.

Investigations 1902–1908 are summarized and illustrated on a map; *Aglantha digitale* was taken in several localities between Norway and Iceland, usually in small numbers, but in May 1903 it was taken in very great abundance in three localities about 67° N.

The few specimens collected by the "Ingolf" Expedition were taken in hauls through the upper strata with fairly small nets; the specimens from St. 104 were small, 2 mm, the others varied in height between 14 and 18 mm. The specimens taken by the East-Greenland Expedition 1900 in vertical hauls with small nets were all very small, 2–4 mm. The specimens taken by the "Thor" at two stations east of the Wyville Thomson Ridge in May 1903 and 1904 were of considerable size, 19–24 mm high. "Thor" St. 124, 1905, was in the Faroe-Shetland Channel: the three specimens taken there were 10, 17, and 21 mm high. The most interesting material available from the Norwegian Sea is that collected by the "Dana" in May 1931, St. 5142 and 5143, above deep water east of Iceland: the hauls were made with the 2 m ringtrawl with bag of stramin, and at St. 5143 the duration of the hauls was two hours; as seen from the list above great numbers of *Aglantha* were taken at all depths between about 600 and 1600 metres below the surface, especially in the haul with 1900 m wire out (about 1300 m below the surface); there were no remarkable differences in the size of the specimens at these different depths, almost all the specimens were large, up to 20 mm in height, with a slight admixture of small ones. The haul with 600 m wire out at the neighbouring St. 5142 caught about 800 specimens during one hour; the size limits were about the same as in the deeper hauls at St. 5143, 5–19 mm, but very few of them were adult, the vast majority being young ones, about 6 mm in height. There can be no doubt, therefore, that the numerous large specimens brought up by the deep hauls were really caught in the deep strata, where the temperature of the water was below 0°, whereas the vast majority of the young ones occurred at higher levels with positive temperatures.

IV. North-East Atlantic, east of the Mid-Atlantic ridge running southward from south-western Iceland (the Reykjanes Ridge).

Material:

57°43′N. 27°03′W., $^{17}_{9}$1868. Bang.
58°17′N. 30°59′W., Olrik 1859.
58°27′N. 26°13′W., Moberg 1857
59°07′N. 13°32′W., -
59°00′N. 19°02′W., Ryder 1883
58°17′N. 23°19′W., $^{22}_{5}$1898, Ostenfeld
55°25′N. 29°05′W., $^{18}_{5}$1890, Lundbeck
61°11′N. 10°17′W., $^{14}_{8}$1895. "Ingolf" St. 12. 188 0 m. 18 spec.
61°10′N. 13°33′W., $^{2}_{6}$1903. "Thor" St. 87. 5 specimen
62°10′5N. 19°36′W., $^{12}_{7}$1903. 161. 20 specimens
62°11′N. 20°11′W., $^{9}_{7}$1904 179. 50 m wire. 1 spec.
61°31′N. 19°05′W., $^{10}_{7}$1904. 180. 100 m – 10 –
61°30′N. 17°08′W., $^{11}_{7}$1904 183. 12 specimens
57°17′N. 11°33′W., $^{7}_{6}$1905. 71. 3 –
57°52′N. 9°33′W., $^{8}_{6}$1905 72. 600 m wire. 8 spec.
57°16′N. 9°55′W., $^{31}_{8}$1905 167. 22 specimens
48°43′N. 12°05′W., $^{21}_{5}$1906. 52. 300 m wire. 78 spec.
50°25′N. 12°11′W $^{5}_{6}$1906. 62. 1500 m 16

[illegible] N 11 [illegible] W	[illegible]	Thor St.	65	500 m wire	120 spec.		
57 40′ N 32 [illegible] W	[illegible]		69	200 m	120		
[illegible] N [illegible] W	[illegible]		72	500 m	9		
[illegible] N 12 [illegible] W	[illegible]		74	200 m	34		
[illegible] N [illegible] W	[illegible]		76		2		
[illegible] N [illegible] W	[illegible]		88	300 m	8		
[illegible] N [illegible] W			89	200 m	800		
			80	350 m	30		
[illegible] N [illegible] W	[illegible]		181	1800 m	1		
[illegible] N [illegible] W	[illegible]		11	10 m	15		
[illegible] N [illegible] W	[illegible]		11	65 m	17		
[illegible] N 11 20 W			12	300 m	1		
60 [illegible] N 22 29 W	[illegible]	1925	Dana St.	2300	600 m wire.	3 sp.	
				2306	2000 m	11	
64 [illegible] N 12 40 W	[illegible]	1927		3079.	700 m	8	
63 26′ N 22 28 W	[illegible]	1927		3162.	600 m	6	
17 02′ N 61 45 W	[illegible]	31		1201.	50 m	35	
				1201.	100 m	20	
				1201.	300 m	14	
				1201	600 m	8	
				1201	2000 m	115	
				1201.	3000 m	190	
				1201.	1000 m	250	
				1201.	5000 m	220	
14 [illegible] N 30 22 W	[illegible]	1931		1203	50 m	2500	
				1203	100 m	330	
				1203	300 m	160	
				1203	600 m	160	
51 48′ N 30 30 W	[illegible]	1931		1205.	50 m	650	
				1205.	100 m	600	
				1205.	300 m	80	
				1205.	600 m	20	
56 38′ N 29 11 W				1206.	100 m	400	
				1206.	300 m	75	
				1206.	600 m	170	
62 23′ N 16 05 W	[illegible]	1932		1102.	50 m	5000	
				1102.	300 m	2100	
				1102.	600 m	1800	
				1102.	1000 m	2000	
				1102.	2000 m	1500	
				1102.	3000 m	2000	
				1102.	1000 m	1100	
62 45′ N 16 01 W	[illegible]	1931		5083.	1000 m	55	
				5083.	1500 m	15	
				5083.	2000 m	30	
63 38′ N 11 13 W	[illegible]	1931		5113.	1800 m	95	
				5113.	2000 m	100	

Previous records: Mohn (1893 pp. 23, 79, 85): *Aglantha* [illegible] was taken by the Plankton Expedition during the first [illegible], from the north point of Scotland westwards towards the south point of Greenland, in great abundance in the [illegible] portion of this area, but remarkably decreasing in number [illegible] completely lacking west of about 30° W. Vanhöffen (1902 p. 78) records this species from between the Faroes [illegible] Greenland. Browne (1903 p. 127, *A. rosea*) collected this [illegible] of localities west of Ireland, about 52° N. and [illegible] W in November 1898. He found it "in hauls from [illegible] fathoms, occurring in the greatest numbers in catches [illegible] 1000 fathoms, but in hauls from between 1600 and [illegible] specimens [illegible] frequent". Some records from the [illegible] are given by de Daxois (1913b p. 27) [illegible] Jacob (1924 p. 29). Kramp (1913a p. 269): during its [illegible] in 1908 the "Tjalfe" expedition took several [illegible] a horizontal haul with 175 m wire out [illegible] N 22° W. Kramp (1920 p. 5), at almost all [illegible] the "Ingolf" in the deep basin west of the Rockall Bank, at all depths down to about 600 metres below the surface, sometimes in great abundance.

Young specimens were taken in almost all of the hauls listed above, also in the deepest strata, though as a rule the young ones are more predominant in the upper strata than in the deep-sea. The numbers of specimens given in the list do not always represent the entire catch, but in some cases (some of the stations of the "Thor" 1906, and the stations of the "Dana") the whole sample was preserved. From the data available we may state that *Aglantha* is generally distributed and very common throughout the area here dealt with, and in all parts of the area it may sometimes be taken in very great abundance. There is evidently a difference in the maximal size of the adult individuals in the different parts of the area. S. W. of Ireland and between the Rockall Bank and the continental slope west of Ireland and Scotland the majority of the specimens were less than 12 mm high, and only in a few cases a height of 15 or 16 mm was attained. In the interesting series of stations taken in June 1931 approximately along the Long. 30° W. ("Dana" St. 1201–1206) the numerous specimens showed a remarkable increase in size from south towards north; at the two southernmost stations, St. 1201 and 1203, very few specimens were more than 10 mm and none more than 13 mm in height: at St. 1205 the largest specimens were 15 mm, and at St. 1206 still further north several specimens attained a size of 18–19 mm in height. This increase in the maximal size of *Aglantha* apparently coincides with a decrease in the temperature of the water in the intermediate strata: e. g. at a depth of 100 m below the surface the temperatures were as follows: St. 1201 and 1203 about 11°, St. 1205 about 6°, St. 1206 about 5°. Still further north, off the south coast of Iceland, several specimens 20–21 mm high were taken. On the whole, however, *Aglantha* does not seem to grow to such considerable size within this portion of the Atlantic Ocean as in the cold basin of the Norwegian Sea (see above).

V. North-West Atlantic, west of the Reykjanes Ridge.

Material:

57 32′ N. 33 31′ W., Olrik 1859						
57 48′ N. 43 15′ W., Olrik 1861						
58 29′ N. 11 51′ W., Olrik 1861						
58 11′ N. 35 34′ W., [illegible] 1898. Ostenfeld						
61 34′ N. 31 12′ W., [illegible] 1895. "Ingolf" St.	11.	377–0 m.	1 specimens			
62 49′ N. 26 55′ W., [illegible] 1895.	–	–	17.	377–0 m.	2	–
61 41′ N. 30 29′ W., [illegible] 1895.	–	–	18.	377–0 m.	6	–
60 29′ N. 34 14′ W., [illegible] 1895.			19.	565–0 m.	6	–
58 10′ N. 48 25′ W., [illegible] 1895.	–	–	22.	377–0 m.	5	–
61 02′ N. 29 32′ W., [illegible] 1896.			80.		1	
65 24′ N. 29 00′ W., [illegible] 1896.			96.	188–0 m.	1	–
65 28′ N. 27 39′ W., [illegible] 1896.	–	–	97.		1	
abt. 65 N. 36 W., [illegible] 1900. E.-Greenl. Exped., 2 specimens						
60 20′ N. 29 21′ W., [illegible] 1925. "Dana" St.	2307.	600 m wire.	180 sp.			
– –	2307.	1000 m	–	85	–	
– –	2307.	1500 m		150	–	
59 21′ N. 37 56′ W., [illegible] 1925.	2308.	600 m	–	320	–	
	2308.	3000 m	–	215	–	
– –	2308.	4000 m	–	9	–	
61 13′ N. 40 57′ W., [illegible] 1925	2436.	600 m	–	150	–	
	2436.	1000 m	–	350	–	
– –	2436.	1700 m		10	–	
62 35′ N. 32 53′ W., [illegible] 1925.	2437.	1000 m	–	25	–	
63 32′ N. 26 23′ W., [illegible] 1925	2438.	600 m	–	170	–	
–	2438.	1000 m	–	30	–	
– –	2438.	1500 m		2	–	
63 19 N. 26 50 W., [illegible] 1928 "Godthaab" St.	1.	50 m wire.				
– –	–	1.	150 m			
63 51′ N. 33 51′ W., [illegible] 1931. "Dana" St.	1235.	600 m wire	300 sp.			
– –	1235.	1000 m		14	–	

61°52′N. 35°30′W.,	15 8 1933.	"Dana"	St. 1686.	600 m	wire	mm. sp.
62 36′N. 32°48′W.,	16 8 1933.	–	St. 1687.	600 m	–	300 –
–	–	–	–	1687. 1000 m		500
–	–	–	–	1687. 2000 m		500

Previous records: The occurrence of *Aglantha digitale* in the coastal waters of the north-western Atlantic has been dealt with by several authors; summaries are given by Bigelow 1926 p. 352 (east coast of North America, with special reference to regional and seasonal occurrence in the Gulf of Maine); Kramp 1911, 1942, and 1943 (the coasts of Greenland); Kramp 1939 (Iceland). Special records from Newfoundland and Labrador are given by Bigelow 1909b p. 312 and 1920 p. 17 and by Frost 1937 p. 26. From the off-shore areas of this section very few records are found in the literature. The Plankton-Expedition in 1889 did not take the typical form west of 30° W., but Maas (1893 p. 24) described a new species or variety, *occidentalis*, from a series of localities across the Newfoundland Bank. The "Tjalfe" expedition, on its voyage to the west coast of Greenland in 1908, collected numerous specimens of *Aglantha* in a series of localities about 58° N. and 34°53′ to 39°24′ W. (Kramp 1913a p. 239). The occurrence in the waters between the southern part of the west coast of Greenland and the eastern coasts of Labrador and Baffin Land is dealt with by Kramp 1913, 1914, and 1942.

Besides the material listed above and the extensive collections from the waters between Greenland and Labrador (Kramp 1942) I have seen numerous specimens collected by the "Michael Sars" expedition in 1910 in a series of localities east of the Newfoundland Bank, and we may state that the species is generally distributed and very abundant in this part of the Atlantic. In the Davis Strait it is particularly numerous above the coastal banks on both sides, off the Greenland coast as well as off the coast of Labrador, but less abundant in the middle parts of this region; in the area east of the southern part of Greenland, however, it may also be taken in great quantities above the greatest depths. At most of the "Dana" stations the greatest number of specimens were taken in hauls with 600 m wire out, but considerable numbers were also sometimes taken in deeper strata. The appliance used by the "Dana" was almost always the 2 m ringtrawl with bag of stramin, and the numbers caught in different depths may therefore be directly compared. Only at St. 2436, 2438, and 4235 the deepest haul was made with a coarser net with more open meshes, which may account for the small number of specimens taken in these hauls. The deepest haul, with 1000 m wire out, at St. 2308 was, however, made with the 2 m ringtrawl and only brought up 9 specimens of *Aglantha*, which may even have been caught at higher levels during the hauling in of the net; undoubtedly, therefore, the species is really rare in the very deep strata. At St. 4687, in the middle of the deep basin east of southern Greenland, the hauls with 1000 and 2000 m wire contained more specimens than the haul with only 600 m wire out.

At all depths and at any time between May and August, from which material is available, small as well as large specimens were taken. The largest specimens, 21–22 mm in height, were found as well in the neighbourhood of the east coast of Greenland as above the Reykjanes Ridge and in the deepest parts of the basin. In the Davis Strait the specimens frequently attain a still larger size, especially in the cold marginal zones off the coasts of Greenland and Labrador, where they grow to a size of about 28 mm in height.

VI. The Baffin Bay. No new material. A general account of the occurrence of *Aglantha* in this deep and cold basin is given in my paper on the medusæ of the "Godthaab" expedition (Kramp 1942). In certain parts of this cold area the specimens attain a very considerable size, 31 mm or more in height.

The statements above confirm the previous conception of *Aglantha digitale* as a very common medusa throughout the northern part of the Atlantic and adjacent waters, frequently occurring in great numbers. It is rarely taken in the surface water, and as a rule it is likewise rare in the very deep strata, though sometimes it may be met with in considerable numbers as deep down as 3000 metres or more below the surface. We know from the literature that in the southern part of its area of distribution it only occurs in the intermediate and deep strata.

Aglantha digitale has a circumpolar distribution: in the Pacific it penetrates southwards as far as Misaki in Japan (about 31° N.) and Vancouver on the west coast of North America (about 50° N.). In the western Atlantic it is common in the Gulf of Maine and occasionally found as far south as Chesapeake Bay (about 37° N.). In the eastern Atlantic it is frequently mentioned from the Bay of Biscay (Browne 1906, le Danois 1914, Kramp 1921, Ranson 1936); according to Browne it is even the most common of all medusæ in the Bay of Biscay. It is also recorded from a locality west of Cape Finisterre (43° N., Ranson 1936). Re-examination of the specimens taken by the "Thor" in 1909 and 1910 in two localities off the Straits of Gibraltar and formerly (1921) referred by me to *Aglantha digitale*, has proved that they belong to the species which later on (1932) was described by Ranson as *Aglantha krampi*. According to Ranson *Aglantha digitale* is found east and south of the Azores (southernmost locality 36°17′ N. 28°53′ W.) and between the Azores and the Bermudas. In the collections of the "Dana" expedition in 1921–1922 (which I have worked up but not yet published) *Aglantha* was completely lacking, also from the northernmost stations in the Atlantic about 35–36° N. The southern limit of distribution thus seems to be at about 36° N. across the Atlantic Ocean.

Pl. VI fig. 6 presents a typical specimen of the red form of *Aglantha* as found in the cold areas in the waters west of Greenland. The figure was drawn by me on board the "Godthaab" in 1928.

Fam. **Geryonidæ** Eschscholtz 1829.

Trachymedusæ with 4 or 6 radial canals; with blindly ending centripetal canals; with well-developed manubrium mounted upon a peduncle; with leaf-like gonads upon the radial canals.

Gen. **Liriope** Lesson 1843.

4-rayed Geryonidæ.

Every author of recent time, who has dealt with this genus, emphasizes the difficulty, or impossibility, of finding reliable characters for distinction and limitation of the species. Ranson (1936 p. 188) still retains at least three Atlantic species, *exigua*, *eurybia*, and *tetraphylla*. Thiel (1936 p. 15) unites all the numerous species into one, *L. tetraphylla* Chamisso & Eysenhardt, and Bigelow (1938 p. 126) is inclined to follow him in this respect. They may be right, but I prefer to leave the question open until I have examined the extensive collections at my disposal.

None of the various forms of *Liriope* are constant inhabitants of the areas here dealt with. Shoals of them are sometimes carried into the western part of the British Channel, where they are usually identified as *L. exigua*, and some few specimens were taken at two of the stations of the "Dana". They agree perfectly with the descriptions of *L. eurybia* as given by Haeckel and subsequent authors.

Liriope eurybia Haeckel

Liriope eurybia Haeckel 1864 pp. 529, 462, Pl. 12 figs. 11–25.
– 1879 p. 291.
Maas 1893 p. 35, Pl. II figs. 2–3.
Mayer 1910 p. 120.

Material						
47°32′ N., 51° 45′ W.	5.8.1931	"Dana" St. 1201	50 m wire	2 spec.		
		1201	100 m	1		
49° 49′ N., 50° 22′ W.	9.8.1931	–	1203. 50 m	–	2	–
–	–	–	1203. 300 m	–	1	–

These localities are near the northern boundary of the Gulf Stream, where the temperature of the water in the upper strata was about 13–14° C. In the colder water a little further north the species was lacking.

Geographical distribution: *Liriope eurybia* is abundant in the Mediterranean and is also common in the warm parts of the Atlantic; it is recorded by Maas (1893) from the Northern Equatorial Current and the Florida Current, and by Ranson (1936) from the Bay of Biscay.

II. Narcomedusæ.

Fam. Solmaridæ.

Genus **Pegantha** Haeckel.

Pegantha clara R. P. Bigelow.

Pegantha clara R. P. Bigelow 1909 p. 80, 2 figs.
– – Mayer 1910 p. 445, fig. 298 A.
– – H. B. Bigelow 1918 p. 397.
1938 p. 134.

Material:

47° 02′ N. 31° 15′ W., $^{27\,28}_{6}$31. "Dana" St.	1201.	50 m wire.	1 spec.	
– – – –	1201.	100 m	–	1 –
– – –	1201.	300 m	–	1 –
– –	1201.	5000 m		1 –
49° 49′ N. 30° 22′ W., $^{30}_{6}$1931.	4203.	100 m		2 –
– –	4203.	300 m		2
–	4203.	600 m		1

The original description of this species was based upon one large, well-preserved specimen, taken near the borders of the Gulf Stream, off Woods Hole; Mayer (1910) examined the same specimen and gave new figures of it. H. B. Bigelow (1918 and 1938) has seen several small specimens, most probably belonging to the same species, taken in the surroundings of the Bermudas and the Bahama Islands. The type specimen was 53 mm in diameter with 11 long tentacles alternating with the same number of smaller size. The specimens examined by H. B. Bigelow varied in diameter between about 10 and 20 mm, with about 20 to 21 tentacles; Bigelow does not state, whether the tentacles are of different sizes.

I have no doubt that the present specimens, from the northern boundary area of the Gulf Stream, belong to the same species; they are in rather poor condition, but in some places the otoporpæ and the stomach saccules may be traced. They vary in size between 7 and 17 mm; the tentacles, 11–21 in number, are of different sizes, but large and small ones are usually not regularly alternating, as will appear from the adjacent diagrams (textfig. 12).

Geographical distribution: H. B. Bigelow (1938) is inclined to think that the medusæ identified by Vanhöffen (1912a and b) as *Polycolpa forskäli* Haeckel, and also *Pegantha smaragdina* Bigelow, belong to *Pegantha clara*; in such case this species has a very wide distribution in the oceans, being found in the tropical Pacific between the Hawaiian and Caroline Islands and off Chile and Peru, in the tropical Atlantic off the Cape Verde Islands, and in the localities mentioned above in the northwestern Atlantic. *P. smaragdina* (found off Peru) is a large medusa, 50–73 mm wide, with 28–31 tentacles; these are of almost equal size, in contradistinction to the alternately large and small tentacles of the large original specimen of *P. clara* as described by R. P. Bigelow. Most records are from the upper strata, but, as stated by Bigelow, the species has also been taken in "open net-hauls from considerable depths." The specimen from "Dana" St. 4201, 5000 m wire, may have been taken in the upper strata during the hauling in of the net.

The distribution of *Pegantha clara* in the North Atlantic seems to be extended still farther north than hitherto supposed, if the parasitic larvæ, which shall now be described, really belong to that species.

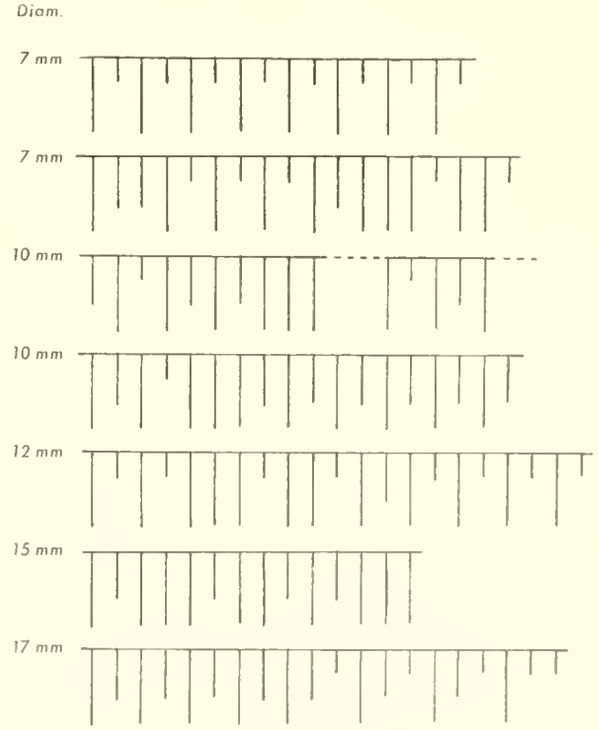


Fig. 12. *Pegantha clara*. Diagram showing relative length of tentacles in seven specimens from "Dana" St. 1201 and 1203.

Larvæ of *Pegantha clara* in Periphylla.

Pl. IV fig. 7, Pl. V figs. 1–10.

Several Narcomedusa larvæ in different stages of development were found in the stomach cavity of a young *Periphylla peraphylla* from "Godthaab" St. I, south-west of Iceland, 63° 19′ N. 26° 50′ W., $^{24}_{7}$ 1928, 1000 m wire out. The larvæ were lying free in the gastric cavity of the host, most of them in the stomach proper, but a few young stages were seen in the distal part of one of the marginal lappets. Pl. IV fig. 7 presents the *Periphylla* with the larvæ *in situ*. Two of them are medusoids ready for liberation.

each statocyst an otoporp is seen running some distance towards the central part of the aboral surface, the middle one in each octant being the longest and the others decreasing in length towards both sides. The peronia and otoporpæ are also seen in fig. 7, which shows a section of the aboral surface of a larva similar to those figured in figs. 5 and 6. The oral portion of the larva, below the collar, is still egg-shaped, and there is no indication of a mouth-opening.

I have seen no further developmental stages between the actinulæ just described and the two medusæ shown in Pl. V figs. 8–10. The medusæ are about 2 mm in diameter. There are still only four tentacles, with a solid core of cylindrical endoderm cells, and with the nematocysts still clustered in the tip of the tentacle. The umbrella is watchglass-shaped, its mesogloea moderately thick. The umbrella margin is turned inwards, and it is slightly notched outside the four peronia. The statocysts are well developed, club-shaped with a basal, cushion-like pad; their number is unaltered, five in each quadrant. The most remarkable feature is the extraordinary length of the otoporpæ; the four interradial otoporpæ are nearly concurrent at the apex of the exumbrella, and some of the others are only slightly shorter, their length however decreasing towards the tentacular radii. The velum is well developed.

The egg-shaped body of the actinula has now been transformed into the manubrium of the medusa; it has decreased in size, but it is still hanging down like the tongue of a bell; in one of the two specimens the manubrium is even somewhat constricted at its base. In this developmental stage of the medusa the first trace of a mouth is observed as a minute depression in the distal end of the manubrium (Pl. V fig. 10), not yet quite perforating the tissue to connect the stomach cavity with the outside. Until now the nutrition of the larva must evidently have been accomplished by osmosis. Probably the young medusa will leave the host as soon as the opening of the mouth is fulfilled, enabling the medusa to catch and swallow its own food.

The specific affinity of the larvæ here described seem to me beyond doubt. Very few species of Narcomedusæ are known from the northern Atlantic, and the possession of well-developed otoporpæ in the young medusa at once separates it from *Solmaris corona*, *Solmissus incisa*, *Æginа citrea*, *Æginura grimaldii*, and *Æginopsis laurentii*. The only remaining species is *Pegantha clara*, which is characterized by the possession of 2–5, usually 3, long, slender, linear otoporpæ on each of the marginal lappets. The fully developed medusa may have as many as 28 tentacles and marginal lappets, but as mentioned above the number is increasing with age; in a specimen 7 mm in diameter I counted 8 large tentacles and as many very small ones, and there can hardly be any objection against the supposition that the young medusa begins its free-swimming life with only four tentacles as in the specimens found in the stomach of *Periphylla*. It seems to me highly probable, therefore, that the parasitic larvæ described above belong to *Pegantha clara* R. P. Bigelow, a species which seems to be widely distributed in the northern Atlantic.

In the closely related species *Pegantha smaragdina* H. B. Bigelow, which occurs in the tropical Pacific, the development of the larvae takes place in the stomach cavity of the parent medusa. Mayer (1910) and also Bigelow himself (1938) are inclined to think that the two species are identical. This supposition seems, however, to be contradicted by the development of the larvæ. In both species the larvæ, while in the actinula stage, propagate by aboral budding, and the proceeding of the budding process is very similar in both species. But during the further development the larva of *P. smaragdina* differs from that of *P. clara* in several respects. It has a greater number of tentacles, 6–8 in the older actinula stages, and 10–12 in the young medusa before its liberation. The actinula soon attains a broadly flattened shape, very different from the elongate shape of the actinula of *P. clara*. A mouth opening is pierced in very young actinula stages of

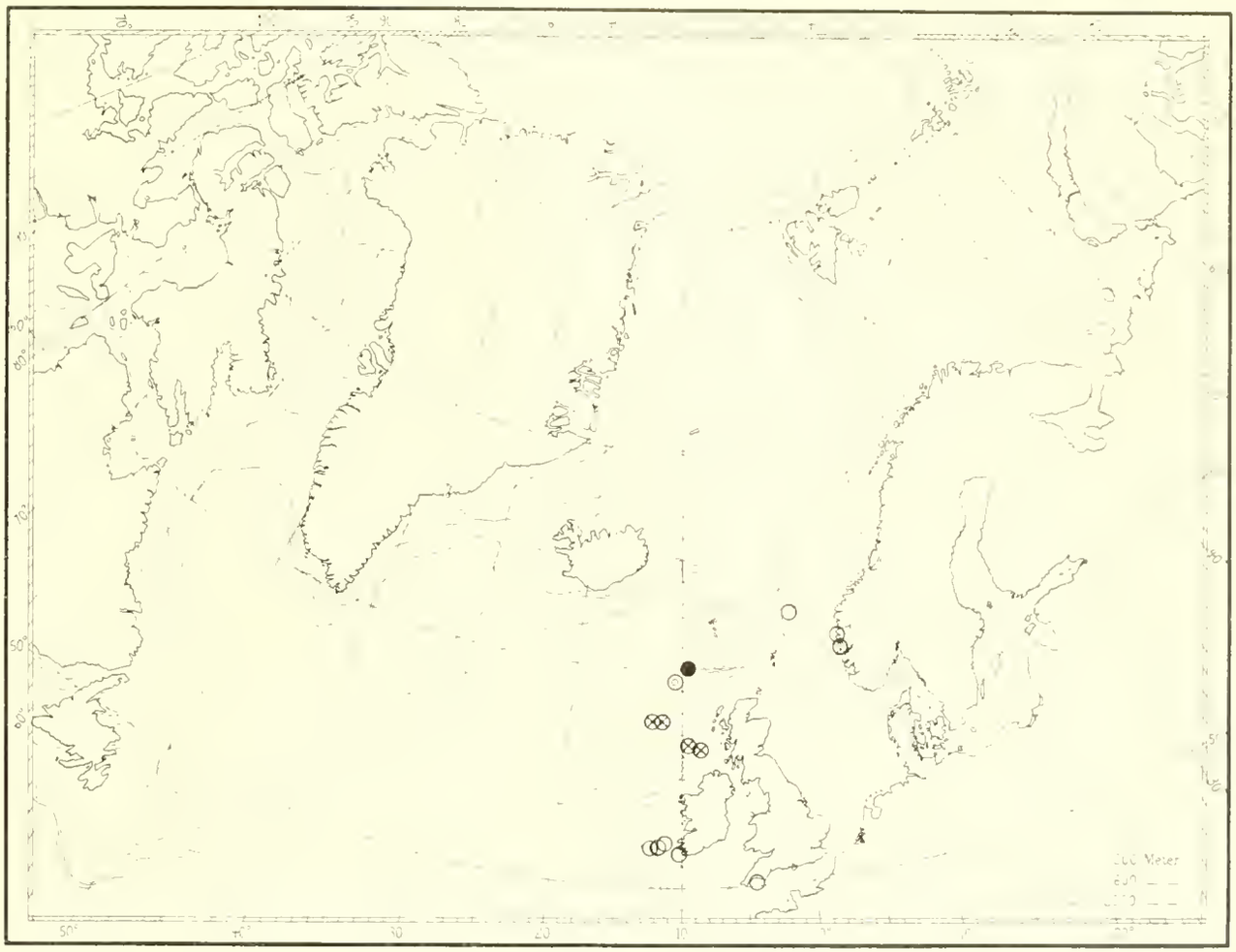


Fig. 13. Distribution in the northern Atlantic of: ● *Solmaris corona*, new record; ○ *Solmaris corona*, previous records; × *Solmaris corona*, records not yet published; ◎ *Solmaris multilobata*.

P. smaragdina, whereas in *P. clara* the mouth does not appear until immediately before the liberation of the medusa. The statocysts of *P. smaragdina* make their first appearance in much later developmental stages of the larva, and even in the latest state of the medusa before its liberation there are only one or two statocysts between each successive pair of tentacles. Moreover otoporpæ are completely lacking in the larvæ of *P. smaragdina*.

Metagenesis. – A very important difference between the larvæ of the two species is the absence of what I have called "primary polyp" in *P. smaragdina*. Bigelow expressly states (p. 96) that larvæ produced by budding are indistinguishable from those developed directly from eggs. The larvæ being all alike, they probably all develop into medusæ, and consequently the developmental circle of this species is a hypogenesis and not a metagenesis. In *P. clara*, on the other hand, a metagenesis most probably takes place. It is very improbable that the larva described above with its two very large tentacles, much larger than the tentacles in even the most advanced actinula stages, might be transformed into a typical actinula; this would only be possible by a reduction in size of its tentacles, which hardly seems to be possible. This polyp should evidently be regarded as an oozoid, directly derived from an egg; it propagates asexually by budding, producing a number of larvæ which are transformed into medusæ, but it never becomes a medusa itself; it represents an asexual generation, and its offspring, the medusæ, constitute the sexual generation. Thus the cycle of development in *Pegantha clara* is a typical metagenesis, secondarily arisen in connection with the parasitic habit of the larvæ.

How the *Periphylla* becomes infected with the parasitic *Pegantha*-larvæ, can only be guessed; no stages younger than the primary larvæ with two large tentacles were observed. Probably these primary larvæ have entered the stomach cavity of the host while in a ciliated planula stage.

The larvæ of *Cunina lativentris*, parasitic in *Tomopteris* (Damas 1936) apparently enter the body cavity of the host in very early stages, as Damas found morula stages in the parapodia of the polychaete. They increase enormously in number by asexual propagation, first by polyembryonic fission of the morula, in later stages by aboral budding, which is continued after the larvæ have attained the medusoid shape. The budding takes place in almost the same manner as in the species of *Pegantha* and, as in *P. smaragdina* but unlike *P. clara*, the larvæ derived directly from the eggs are similar to those developed by budding, so that probably no metagenesis takes place.

It is possible that a metagenetic development will be discovered in some of the species of Narcomedusæ, in which the cycle of development is not yet fully elucidated; until now, however, the classical example of *Cunina proboscidea* = *rubiginosa* was the only undoubted case of metagenesis known among the Narcomedusæ. In *Pegantha clara* the parasitic habit has brought about a metagenesis of quite another type.

Genus **Solmaris** Haeckel.

Solmaris corona (Keferstein & Ehlers).

Æginета corona Keferstein & Ehlers 1861 p. 91, Pl. 11 figs. 7–9.
Solmaris corona Haeckel 1879 p. 358.
coronantha Haeckel 1879 p. 359, Pl. 20 figs. 7–10.

North-Atlantic records:
[illegible] Browne 1900 p. 752
1903 p. 30
Kramp 1905 p. 8
multilobata Vanhöffen 1908 p. 61
[illegible] Plankton Catalogues III 1916 p. 44.
Kramp & Damas 1925 p. 319
Broch 1929 p. 535
Plymouth marine Fauna 1931 p. 83.

multilobata Maas 1893 p. 15. Pl. 1 figs. 7–13.

Material:

[illegible] 60 N. 9 42 W., $^{28}/_{9}$ 1900. East Greenland Exped. 1 spec.

This specimen was taken S.W. of the Faroe Bank; moreover I have seen numerous specimens collected by the "Michael Sars" North Atlantic expedition between Scotland and Rockall in August 1910.

The specimen from the East-Greenland expedition is 9 mm in diameter (preserved in alcohol) with 36 tentacles and marginal lappets.

The Mediterranean specimens described by Keferstein & Ehlers (1861) were 14 mm in diameter with 27–30 tentacles and marginal lappets; the specimens from the Canary Islands, described by Haeckel as *S. coronantha*, were 10–15 mm wide with 24–32 tentacles. Specimens from north-western Europe generally have a somewhat larger number of tentacles and lappets, but it can hardly be doubted that they belong to the same species. Browne (1900), who examined a number of specimens from the south-west coast of Ireland, found that very small specimens, 2–3 mm wide, had only 12–16 tentacles, but 29 were found in specimens only 5 mm wide, and in specimens 12 mm in diameter the number of tentacles varied between 25 and 35; the greatest number found by him was 36, in a specimen 10 mm wide. In specimens, 10–15 mm wide, from the Norwegian coast (Browne 1903, Kramp & Damas 1925) 31–42 tentacles have been counted, and in specimens from the "Michael Sars" the number of tentacles varies between 33 and 41, regardless of the size of the individuals, measuring 8–15 mm. I have no doubt, therefore, that the specimens from the Hebrides, examined by Vanhöffen (1908), belong to the same species; they were 5–10 mm in diameter with 31–45 tentacles. Vanhöffen referred his specimens to *S. multilobata* Maas, and, as a matter of fact, it seems probable that this species is really identical with *S. corona*. *S. multilobata*, as described by Maas (1893), had a much larger number of tentacles and lappets than *S. corona*, more than 64 in specimens 12–18 mm in diameter; it was taken north-west of the Hebrides, in almost the same locality as the specimens examined by Vanhöffen. Later on *S. corona* has repeatedly been taken in great abundance in the waters west and north of the British Isles and on the Norwegian coast, whereas *multilobata* has never been observed since it was described by Maas, who saw no less than 28 specimens of this multilobated form, taken in one haul with the plankton-net in June 1889. The number of tentacles and lappets makes the only difference between the two forms, and it is certainly very astonishing that one of them, *multilobata*, was abundant in 1889 in the same region where subsequent investigations during several consecutive years brought forward the other form, *corona*. The explanation is not easy; presumably, in that particular summer, 1889, for some unknown reason the entire population of *Solmaris corona* in the Scottish waters has undergone an unusual development, involving the multiplication of the normal number of tentacles and marginal lappets without an increase of the size of the specimens.

Solmaris corona is evidently indigenous and very common in the western seas of Ireland and Scotland, it mainly belongs to the Lusitanian fauna, but in the autumn (August to November) it is more or less regularly carried by the Gulf Stream to the southern part of the west coast of Norway, and also into the Channel, at least as far as Plymouth.

Further distribution: Mediterranean; the Canary Islands.

Fam. Æginidæ.

Ægina citrea Eschscholtz.

Ægina citrea Eschscholtz 1829 p. 113. Pl. 11 fig. 1.
rosea Eschscholtz 1829 p. 115. Pl. 10 fig. 3.
rhodina Haeckel 1879 p. 338. Pl. 20 figs. 11–15.

North-Atlantic record:
Ægina rhodina Kramp 1924 p. 37.

Material (see the map, textfig. 11):

57° 52′ N. 9° 53′ W.,	$^{8}/_{6}$ 1905.	"Thor" St. 72.	600 m wire.	1 spec.
49° 22′ N. 12° 52′ W.,	$^{4}/_{9}$ 1906.	– – 181.	1800 m –	1 –
17° 02′ N. 31° 15′ W.,	$^{27\ 28}/_{6}$ 31.	"Dana" St. 1201.	50 m wire.	1 spec.
– –	– –	– – 1201.	4000 m –	3 –
62° 23′ N. 16° 05′ W.,	$^{25}/_{6}$ 1932.	– – 1102.	2000 m –	1 –
63° 38′ N. 11° 13′ W.,	$^{18}/_{5}$ 1934.	– – 5113.	1800 m –	3 –
– –	– –	– – 5113.	2000 m –	3 –

The specimens are fairly small, 5–15 mm in diameter; they all have four tentacles, and, as far as can be seen from their state of preservation, the eight stomachal lobes have an entire margin with no indication of a secondary notch; the specimens belong, accordingly, to the *rosea* type.

Geographical distribution: The various forms of *Ægina*, all of which probably belong to one species, *Æ. citrea*, are widely distributed in the tropical and subtropical parts of all the oceans, including the Mediterranean. In the Pacific it penetrates northwards into the Bering Sea. In the Atlantic it is quite common east of Florida and near the Bahamas and the Bermuda Islands; in the eastern part of the Atlantic it is recorded from the Azores and off the coast of Portugal (Raxson 1936). As demonstrated by the present collections the area of distribution in the Atlantic extends considerably farther north; on a previous occasion (Kramp 1924) I have recorded the species from a locality S.W. of Ireland ("Thor" St. 181, 1906). It was also taken by the "Thor" (St. 72, 1905) west of Scotland and by the "Michael Sars" (St. 101, 1910) in the Rockall Channel. The "Dana" has taken it in the northern boundary area of the Gulf Stream about midway between Newfoundland and the British Isles (St. 1201) and also in two localities off the south coast of Iceland, as far north as 62° 23′ and 63° 38′ N. (St. 1102 and 5113).

The vertical range is very considerable. Thiel (1936 p. 77) designates this species as a typical deep-sea medusa, but as a matter of fact, it occurs at all depths, being frequently taken in the surface waters. On the "Dana" St. 1201 one specimen was taken near the surface (with 50 m wire out), others in a deep haul, 4000 m wire. The other specimens in the present collections were all taken at rather considerable depths, most of them in hauls with 1800–2000 m wire out.

We may state, accordingly, that *Ægina citrea* is a widely distributed oceanic medusa, its northwards distribution in the Atlantic being limited by the submarine ridges separating the Atlantic proper from the adjacent arctic basins, occurring at all depths in the warmer regions, but restricted to the deep strata in the northern boundary areas.

Æginopsis laurentii Brandt.

North-Atlantic records:
Æginopsis laurentii Wagner 1885 p. 79.

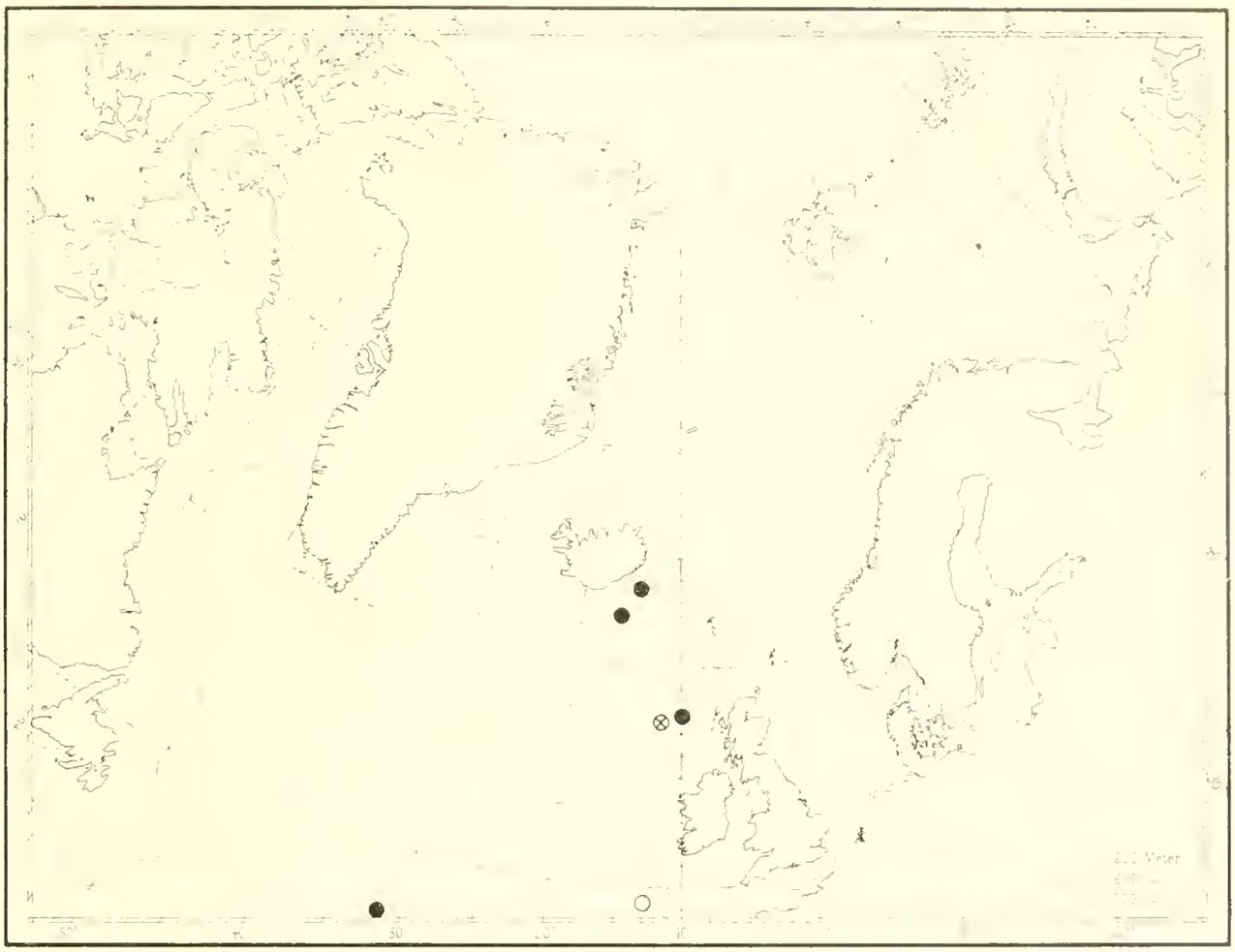


Fig. 14. Distribution in the northern Atlantic of *Ægina citrea*. ● new records; ⊗ previous records; ○ record not yet published.

Solmundus sp. Fewkes 1888.
Æginopsis laurentii Schlater 1891 p. 342.
– – Birula 1896 p. 347.
– – Vanhöffen 1897 p. 273.
Solmundus glacialis Grönberg 1898 p. 466, Pl. 27 figs. 7, 8.
– – Aurivillius 1899
Æginopsis laurentii Linko 1904b p. 219.
– – Maas 1906a p. 185.
Solmundus glacialis Broch 1905 p. 8.
– – Broch 1907 p. 8.
Æginopsis laurentii Hartlaub 1909 p. 172, Pl. 76 figs. 7, 8.
– – Bigelow 1909b p. 314, Pl. 32 figs. 2-6.
– – Kramp 1911 p. 434.
– – Kramp & Damas 1925 p. 320.
– – Thiel 1932b.
– – Kramp 1933c p. 16.
– – Bernstein 1934 pp. 9, 26.
Ranson 1936 p. 212.
– – Jaschnov 1939 pp. 112, 114.
– – Dunbar 1942 p. 71.
– – Kramp 1942 p. 97.
– – 1943 p. 8.

Material: The numerous specimens in our collections are all from the Greenland waters and have been dealt with by me in the papers cited above. The species was well described and figured by Bigelow (1909b), and I have nothing to add to his description.

Mayer (1910 p. 472) includes *Solmaris tetranema* Hargitt (1902 p. 17 and 1904 p. 58) among the synonyms of *Æginura laurentii*. An identification of these two medusæ seems to me rather questionable. *Solmaris tetranema* was deficiently described from a single specimen, somewhat damaged, so that "accurate determination was not practicable." The bell was flat, discoid, and between the four primary tentacles were "what appeared to be 4 undeveloped or rudimentary tentacles." It was found near the Gulf Stream off Woods Hole, thus quite outside the area of distribution of *Æginopsis laurentii*. For geographical reasons it also seems to me rather objectionable to refer *Æginopsis mertensii* Haeckel to *Æ. laurentii*. This latter has never been observed in the Pacific south of the Bering Strait, whence it was described by Brandt (1838). *Æ. mertensii* was taken in the Sea of Japan, and Haeckel expressly states that the only specimen was "ein sehr unvollkommen erhaltenes Spiritus-Exemplar." It should at present be regarded as an obsolete species, until some medusa be found in Japanese waters which may correspond to Haeckel's description.

Geographical distribution: *Æginopsis laurentii* is an arctic, circumpolar species. Thiel (1932b p. 166) designates it as arctic boreal, but its occurrence outside the true arctic regions is evidently restricted to areas, where cold currents prevail. It is common in the waters west of Greenland at least as far north as Smith Sound and is also found on the north coast of Ellesmere Land.[1] It follows the cold Labrador Current southwards along the coast of Labrador to Fogo Island, Newfoundland (Bigelow 1909b). It also occurs along the entire east coast of Greenland. It has been found in deep water in a locality between Iceland and Norway in the cold bottom water of the Norwegian Sea. From Vardo in

[1] Recently recorded from several localities around Baffin Land (Dunbar 1942).

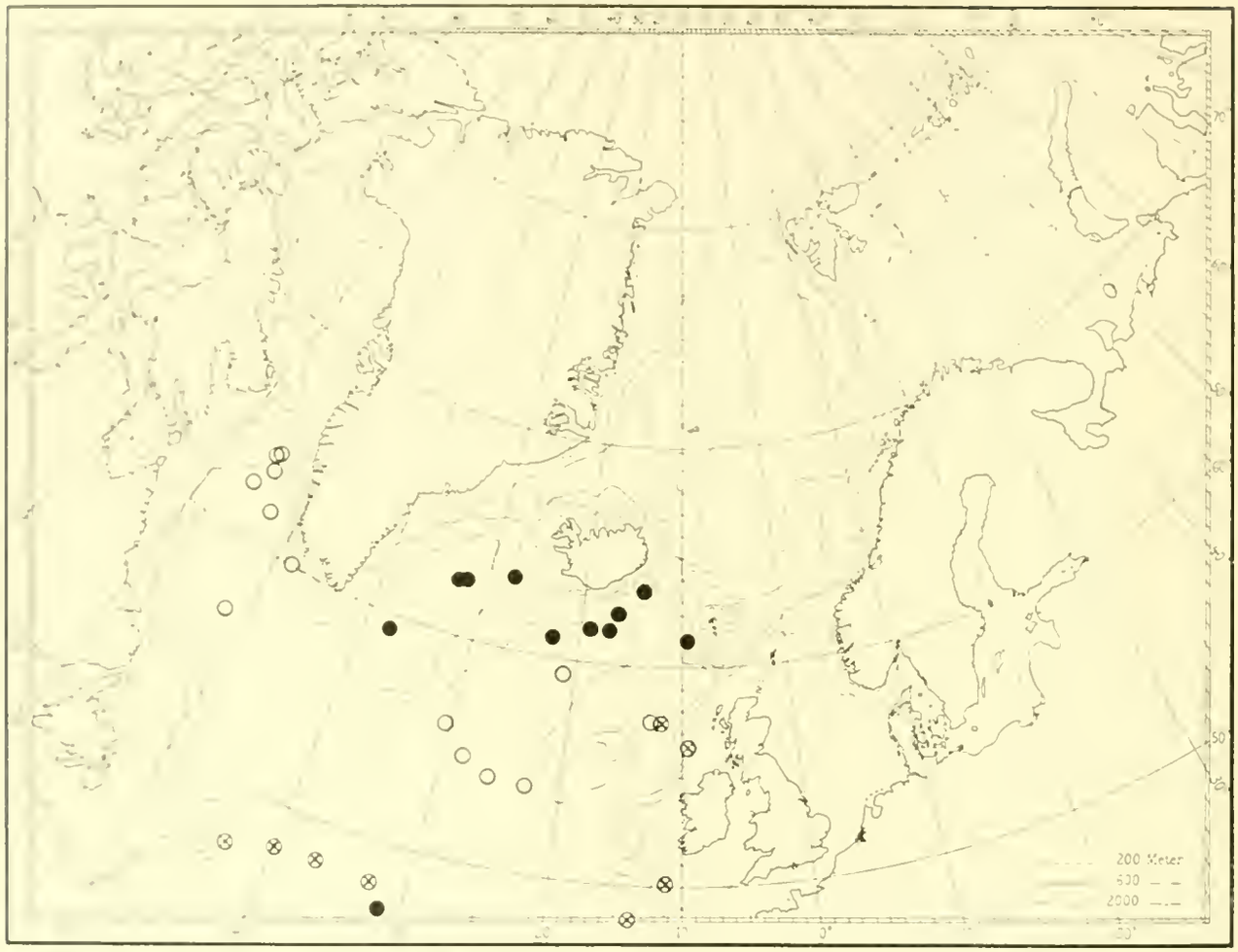


Fig. 15. Distribution in the northern Atlantic of *Æginura grimaldii*. ● new records; ○ previous records; ⊗ records not yet published.

the extreme north of Norway it is distributed northwards to Spitzbergen and eastwards along the north coast of Russia and Siberia (Jashnov 1939) and the north coast of Alaska (Bigelow 1920). Brandt described it from Laurent Bay in Bering Strait, but it does not seem to penetrate further southward into the Pacific. The bathymetrical occurrence ranges from the surface down to at least 1000 m. In the Davis Strait it avoids the comparatively warm Atlantic water of the deep-sea area; in the Norwegian Sea it avoids the upper strata which are influenced by the Gulf Stream.

Genus Æginura Haeckel.

Æginura grimaldii Maas.

North-Atlantic records.

Æginura grimaldii Maas 1901 p. 38, Pl. 3 figs. 19–28.
Kramp 1913a p. 276
1914 p. 136
1920 p. 6.
1942 p. 100

Material (see the map, textfig. 15)

61°43′N. 4°30′W.,	1904	"Thor" St. 99.	1700 m wire.	1 spec.
61°48′N. 4°42′W.	1904		180–8 specimens	
61°38′N. 47°38′W.	1904		183. numerous specimens	
61°36′N. 39°42′W.	1925	"Dana" St. 2306.	600 m wire.	1 spec.
		2306.	2000 m	175 –
		2306.	3000 m	100 –
60°21′N. 47°38′W.	1925	2308.	3000 m	770 –
		2308.	1000 m	70 –
62°35′N. 32°53′W.,	$^{27}_{7}$1925.	"Dana" St. 2137.	1900 m wire	10 spec.
63°19′N. 26°50′W.,	$^{21}_{5}$1928.	"Godthaab" St. 1.	1000 m	8 –
47°02′N. 31°45′W.,	$^{27\ 28}_{6}$31.	"Dana" St. 1201.	5000 m	12 –
62°23′N. 16°05′W.,	$^{25}_{6}$1932.	1102.	2000 m	500 –
		1102.	3000 m	650 –
		1102.	1000 m	125 –
62°36′N. 32°18′W.,	$^{16}_{8}$1933	1687.	2000 m	600 –
63°38′N. 14°13′W.,	$^{18}_{5}$1931.	5113.	1800 m	75 –
		5113.	2000 m	130 –

On the map, textfig. 15, are included eight localities in which this species was taken by the "Michael Sars" in 1910 in hauls with 1000–3000 m wire out.

Æginura grimaldii was well described by Maas (1901 p. 38, Pl. III figs. 19–28) from a locality outside the Bay of Biscay, 17°13′ N. 17°10′ W., where one single specimen was taken by the Prince of Monaco at a depth of 781 m. The original specimen was only 12 mm in diameter, but the medusa may attain a much larger size; the largest specimens at my disposal are 34 mm wide.

The specific name has been discussed by Thiel (1935 p. 37 and 1936 p. 86), Bigelow (1938 p. 132), and Kramp (1942 p. 100).

Thiel has found that in the tropical parts of the Atlantic young specimens may occur in the upper strata; in the northern Atlantic, however, this species is truly bathypelagic. In one locality, south of Iceland ("Dana" St. 2306) a specimen was taken in a haul with only 600 m wire out, at the same time as hauls with 2000 and 3000 m wire captured a large number of specimens, and in no other North-Atlantic localities was this medusa taken in hauls with less than 1000 m wire out, 600 metres or more below the surface.

Very large specimens, more than 25 mm in diameter, were taken only on one occasion ("Dana" St. 2308, 3000 m wire out); otherwise there is no indication of a difference in the bathymetric occurrence of specimens of different sizes; young as well as adult ones, 4–25 mm wide, were taken at all depths.

Geographical distribution: The map, textfig. 15, clearly shows that the horizontal distribution of this species in the North Atlantic is strictly limited by the continental shelves and the submarine ridges connecting Scotland, Iceland, Greenland, and Baffin Land; it is generally distributed and very common throughout the deep-sea area of the northern Atlantic. It is also common in the areas around the Bermudas and the Azores, and is frequently met with in the deep-sea west of southern Europe and north-western Africa, but it seems to be fairly rare in the southern Atlantic. Some young specimens were taken by the "Meteor" in a few localities (THIEL 1936), and it is recorded from the Guinea Current and the Benguela Current off the west coast of Africa, where it was taken by the "Valdivia" (VANHÖFFEN 1908); in the vast collections of the "Dana" expedition in 1930, from Cape of Good Hope northwards, this species was altogether lacking south of the Cape Verde Islands. It is unknown in the Mediterranean, but it is recorded from several places in the Indian and Pacific Oceans; in the Pacific it occurs as far north as in the Bering Sea. *Eginura grimaldii* may thus be designated as a bathypelagic medusa with a world-wide distribution, comprising all the great oceans, except the Mediterranean and the arctic seas, though apparently it is not equally abundant everywhere.

Narcomedusæ indeterminatæ.

Fragments of medusæ, probably Narcomedusæ, which I am unable to determine, were taken in the following localities:

60° 59′ N.	22° 29′ W.,	$^{29}/_{5}$ 1925.	"Dana" St. 2306. 2000 m wire
59° 21′ N.	37° 56′ W.,	$^{1\ 2}/_{6}$ 1925.	– 2308. 3000 m
61° 13′ N.	40° 57′ W.,	$^{25}/_{7}$ 1925.	2136. 1700 m
62° 35′ N.	32° 53′ W.,	$^{27}/_{7}$ 1925.	– 2137. 1900 m –
17° 02′ N.	31° 15′ W.,	$^{27\ 28}/_{6}$ 31.	1201. 5000 and 6000 m wire
62° 23′ N.	16° 05′ W.,	$^{25}/_{6}$ 1932.	1102. 2000 m wire
62° 36′ N.	32° 18′ W.,	$^{16}/_{8}$ 1933.	1687. 2000 m
63° 38′ N.	11° 13′ W.,	$^{18}/_{5}$ 1934.	5113. 1800 and 2000 m wire

III. Scyphomedusæ.

Order Coronatæ.

Fam. Periphyllidæ.

Genus Periphylla Haeckel.

Owing to the thorough investigations of extensive collections of *Periphylla* from all the oceans carried out by Broch, Bigelow, Stiasny, and others it is beyond doubt that this genus comprises one species only. It is necessary, therefore, to discuss the name of the species as well as of the genus. I am going to do so from the point of view that the law of priority should only be followed so far as unnecessary confusion is avoided. In the present case I consider it unavoidable to adopt the oldest specific name, and, fortunately, that name is *peryphylla* (introduced by Péron & Lesueur in 1809), which may be adopted as specific name without much danger of confusion. The determination of the generic name, on the other hand, will occasion more troublesome considerations.

Haeckel (1880) distinguished between no less than six species of *Periphylla*. Two of them (*regina* and *mirabilis*) were described as new species, the others were: *peronii* Haeckel (= *Carybdea periphylla* Péron & Lesueur), *bicolor* Quoy & Gaimard, *dodecalobastricha* Brandt, and *hyacinthina* Steenstrup. According to the original descriptions and figures of these species there is no doubt of their identity.

Haeckel's description of *Periphylla hyacinthina* was based upon specimens from Greenland and Iceland in the collections of the Zoological Museum of Copenhagen (almost all these specimens are still in our possession), and he applied the name of Steenstrup as the author of the generic as well as the specific name, quoting "Acta Mus. Hafniensis" by Steenstrup 1837 and 1842. These "Acta", however, have never been printed, and as a matter of fact the generic name of *Periphylla* appears in the printed literature for the first time in Haeckel's monograph. The specific name *hyacinthina* was given by Faber (1829) to a medusa from Iceland which Steenstrup determined the same specimens which Haeckel examined and described by Haeckel. Provided this determination of the identification, Faber thus becomes the author of the specific name.

In 1875 this species was mentioned twice in the literature: Claparède gives a list of *Charybdea hyacinthina* (Faber)" it is mentioned by Lütken 1875 p. 188) as occurring in Greenland waters, Mörch, and the following addition: "*Dodecabastricha* Brandt, Quoy & Gaim. and *Charybdea periphylla* Péron & Lesueur are either to be closely allied species of this [illegible] names the medusa after drawings by Dr. Lütken [illegible] *Dodecabostrica* Lütken Groenlands [illegible]

Haeckel [illegible] that "*Medusa (Melitea) hyacinthina* Faber 1829, p. 197, ought to be a *Periphylla*. It was a [illegible] the size of a swan's egg, provided with [illegible] pointed at the tips and hanging down like a peduncle, "sonst keine Fäden bemerklich." Also for biological reasons the identification of this medusa with *Periphylla* seems very improbable: Faber saw it twice in Eyjafjord on the north coast of Iceland; it seems most unlikely that an oceanic deep-sea medusa like *Periphylla* should be observed (evidently swimming at the surface) in such a locality; it has occasionally been taken in the coastal area off the south coast of Iceland and once off the north-west coast but never on the north coast (see Kramp 1939 p. 20). Haeckel likewise doubts the identity of Faber's medusa with *Periphylla*.

Faber identified his *Melitea hyacinthina* with some medusæ mentioned in 1772 by Olafsen under the name of "Kiölmandshuer" (merchant-caps), and later on by Mohr (1786) as *Medusa cruciata* or "Blä-Pose" (blue-pouch). Some years ago I wrote to Dr. B. Sæmundsson in Reykjavik asking him, whether he had ever heard about "merchant-caps" from the Icelandic fishermen, but he had never heard that name, neither could he tell me, whether the merchants in Iceland had ever used caps which might have any resemblance to *Periphylla* or other medusæ. It also seems unlikely that the fishermen in the eighteenth century should have a proper name for a medusa like *Periphylla*, which is only a stray visitor in the coastal regions of Iceland. It seems, however, that Steenstrup has met with "merchant-caps" during his voyage to Iceland in 1839.

Steenstrup has examined the old specimens of *Periphylla* in the museum, and it would be desirable to know, why he identified them with *Melitea hyacinthina* Faber. With the kind assistance of professor R. Spärck I have therefore searched the old "Acta" in the museum for any notes which might give a clue to the question. The first record of a *Periphylla* is found in a journal from 1851, when a specimen was presented to the museum by captain Hygom: it was collected in the Atlantic, 18° N. 8° W., and was introduced in the journal as *Carybdea* sp. with a later addition in Steenstrup's handwriting: "*periphylla* Pér. = *hyacinthina* Fab.". Another specimen, collected by Hygom in 13° N. 23° W., is entered in the journal for 1857 as "Kjobmandshue" (*Periphylla* Stp.)", and a third specimen, likewise taken by Hygom (39° N. 13° W.), is immediately listed by Steenstrup, in 1863, as *Periphylla hyacinthina*. Of considerable interest is a scrap of paper written by Steenstrup, with the head-lines:

Periphylla hyacinthina Faber (1829)
Charybd. periphylla Péron.

Faber. Islands Fiske p. 197.

with a list of the localities, from which the species was known by then, including the Atlantic, Hygom 1851, but not the find

by Hygom 1857; it must, accordingly, have been written between 1851 and 1857. It appears from these notes that Steenstrup himself has seen *Periphylla* between the Faeroes and Iceland during his voyage to Iceland in 1839, and also that on his arrival the medusa was named to him as "merchant-cap". The possibility, therefore, exists that Faber's medusa was really a *Periphylla*, and if so Faber becomes the author of the specific name *hyacinthina*.

In 1877 our whole collection of medusæ was sent to Haeckel in Jena together with a complete hand-written list of the specimens, written by Lütken with provisional identifications of the species; the list was returned in 1880 with the final identifications in Haeckel's hand-writing. The several specimens of *Periphylla* are by Lütken designated as "*Charybdea hyacinthina* Faber" or "*Periphylla*, ♂: *Charybdea hyacinthina*", and to all of them Haeckel has added the name *Periphylla hyacinthina* Steenstr. – Two of the first numbers in the list are dated 1837 and 1842 (specimens from Greenland), and this is probably what induced Haeckel to quote the "Acta Musei Hafniensis" 1837 and 1842.

If Faber's medusa from Iceland was really a *Periphylla*, the specific name *hyacinthina* takes precedence over *dubia* Brandt 1838 as well as *bicolor* Quoy & Gaimard 1833. But, as mentioned above, there is no doubt that the same species was formerly described by Péron & Lesueur (1809) under the name of *Carybdea Periphylla*. The description was not very clear, and the atlas, which was intended to follow the text, was never issued as a whole; but the figure of *Carybdea periphylla* was reproduced in 1834 by Blainville and in 1839 by Milne-Edwards and leaves no doubt of the identity. The correct specific name of the only existing species of this genus thus becomes *periphylla* Péron & Lesueur.

In order to determine the generic name we must look up all the names which have been applied to the medusa since it was first described; they will appear from the following synopsis, in which the four so-called species are placed in four separate columns:

Péron & Lesueur 1809			Carybdea Periphylla	
Faber 1829	Medusa (Melitea) hyacinthina			
Quoy & Gaimard 1833		Carybdea bicolor		
Brandt 1837		Carybdea (Cyclophylla) bicolor	Carybdea (Cyclophylla) periphylla	
Brandt 1838				Chrysaora (Dodecabostrycha ?) dubia
Lesson 1843		Carybdea bicolor	Carybdea periphylla	Cassiopea (Dodecabostrycha) dubia
Mörch 1857	Dodecabostrica Umataursak Groenlandorum			
L. Agassiz 1862		Quoyia bicolor	Charybdea periphylla	Dodecabostrycha dubia
Lütken 1875	Charybdea hyacinthina			
Haeckel 1880	Periphylla hyacinthina	Periphylla bicolor	Periphylla peronii	Periphylla dodecabostrycha

Carybdea Péron & Lesueur 1809 comprised two species, *periphylla* nov. and *marsupialis* Linné; this latter is generally adopted as the genotype of *Carybdea*, and it would cause a most disastrous confusion if that generic name were applied to *periphylla*. Agassiz (1862 pp. 172–174), it is true, adopted the division introduced by Lesson, in which *Carybdea* was retained as the generic name of *periphylla*, whereas the name of *Carybdea marsupialis* was changed to *Marsupialis planci*. Brandt (1837 p. 187), on the other hand, divided the genus *Carybdea* P. & L. into three subgenera, one of which was *Carybdea* genuinae comprising *C. marsupialis* P. & L. and *alata* Reynaud.

Faber (1829 p. 197) referred his *Medusa hyacinthina* to the genus *Melitea* Péron & Lesueur. *Melitea purpurea* P. & L. (1809 p. 343) is however a Rhizostomid.

The name *Dodecabostrycha* is due to Brandt and has been adopted as generic or sub-generic name by Lesson, Mörch, and Agassiz, and as specific name by Haeckel; but all these and several subsequent authors have misunderstood the combinations of names in Brandt's well-known paper of 1838, because they have paid no regard to his previous paper (Brandt 1837 pp. 187 and 189)[1]), in which the genus *Carybdea* is divided into three sub-genera, one of which is *Cyclophylla* (comprising *C. periphylla* P. & L. and *C. bicolor* Q. & G.), and the genus *Chrysaora* is likewise divided into three sub-genera, one of which is *Dodecabostrycha* with the species *gaudichaudii* Lesson (= *Desmonema gaudichaudi* of the Rhizostomeæ). In 1838, when Brandt described the new species *dubia*, he was in doubt of its affinities and thought it possible, but not certain, that it might belong to the sub-genus *Dodecabostrycha*. His doubt also appears from the various applications of queries. In the text (p. 387) the species is called *? Chrysaora (Dodecabostrycha?) Dubia;* in the explanation of the plates and also on one of the plates (Tab. 29) is written *? Chrysaora (Dodecabostrycha) dubia*, and on the other plate (Tab. 30) the same without any query. Accordingly *Dodecabostrycha* cannot be applied to any of the forms of *Periphylla*, because it was originally established for a Rhizostomid.

Cyclophylla, on the other hand, was introduced by Brandt (1837 p. 187) as the name of a new sub-genus comprising the two species *C. periphylla* P. & L. and *bicolor* Q. & G. If we were to decide a change of the generic name *Periphylla*, we must accordingly take into consideration the possibility of replacing it with *Cyclophylla* Brandt.

This name, at any rate, takes precedence over *Quoyia*, introduced by Agassiz (1862 p. 173) for *Carybdea bicolor* Quoy & Gaimard; it would certainly be a most inconvenient name, especially if the name of the family, to which the genus belongs, should be derived from it (Quoyiadæ!).

In the printed literature *Periphylla* is used for the first time as a generic name in Haeckel's monograph (1880 p. 118). A strict application of the law of priority would lead us to cancel that name in favour of the older name *Cyclophylla* Brandt 1837. It seems to me, however, most deplorable if *Periphylla* should be replaced by a name, which has appeared only once in the literature and never revived, whereas this very common and

[1]) Haeckel, in his fifth addition (p. 650) regarded almost all the names in that paper as obsolete.

widely distributed species is known to everybody employed in plankton zoology under the name of *Periphylla*, and I most entreatingly request that the familiar name *Periphylla* be retained for the genus. It should also be borne in mind that this name was not a new invention by HAECKEL, nor was it invented by STEENSTRUP in his written notes, from which HAECKEL adopted it: the name was introduced in the literature in 1809 by PÉRON & LESUEUR for one of the two species which, in their classification, constituted the genus *Carybdea*, viz. *periphylla* and *marsupialis*, two species now placed very far from each other, in two different orders. STEENSTRUP saw that his medusae from Iceland and Greenland belonged to *Carybdea periphylla* P. & L., and as a new generic name was required, he elevated PÉRON's specific name to the rank of a generic name, a procedure not uncommon in those days. HAECKEL adopted the idea and introduced the generic name *Periphylla* into the zoological literature, where it will be wise to let it remain.

We may state that the name of the only species of this genus should be

Periphylla periphylla (Péron & Lesueur).

Periphylla periphylla (Péron & Lesueur).

North-Atlantic records:

? Medusa (Melitea) hyacinthina Faber 1829 p. 197.
Dodecabostrica Umataursak Groenlandorum Morch 1857 p. 95.
Charybdea hyacinthina Lütken 1875 p. 188.
Periphylla hyacinthina HAECKEL 1880 p. 419, Pl. 24 figs. 11–16.
Dodecabostrycha dubia Fewkes 1881 p. 138.
Periphylla hyacinthina Fewkes 1886 p. 930.
humilis Fewkes 1886 p. 931.
hyacinthina Levinsen 1893 p. 148.
Vanhöffen 1892 p. 6, Pl. I figs. 1–10. Pl. II figs. 3–8. Pl. III figs. 1–7
– Nordgaard 1900 p. 18.
– – Browne 1903 p. 30.
– – Kramp 1913a p. 277.
Kramp 1914 p. 450.
Bigelow 1914 p. 27.
– – Broch 1914 p. 1, textfig. 1.
regina Broch 1914 p. 8.
– hyacinthina Kramp 1920 p. 7.
– Bigelow 1922 p. 138.
– – Havno 1926 p. 286.
Rumnström 1932 p. 31.
Kramp 1939 p. 20.
– – Stiasny 1940 p. 6.
– – Kramp 1942 p. 106.

Material (see the map, textfig. 16):

62°01′N. 16°50′W.,	30/9	1893.	E. BAST.	2 specimens	
62°49′N. 26°55′W.,	16/6	1895.	"Ingolf" St. 17.	2 specimens	
60°50′N. 26°50′W.,	12/6	1896.		76. 1	
65°20′N. 27°12′W.,	20/6	1904.	"Thor" St. 153.	4	–
61°34′N. 19°05′W.,	19/7	1901.	– –	180. 1	
61°50′N. 17°08′W.,	11/7	1904		183. 1	[1]
61°11′N. 11°00′W.,	28/5	1905.		61. 2	
57°47′N. 11°53′W.,	7/6	1905.	–	71. 3	
57°32′N. 9°55′W.,	8/6	1905.		72. 1	
60°03′N. 10°35′W.	28/5	1905	–	165. 5	–
57°40′N. 9°55′W.,	9/6	1905	–	167. 2	
60°36′N. 22°29′W.,	29/6	1925	"Dana" St. 2306.	2000 m wire.	75 spec.
59°24′N. 29°21′W.,	19/6	1925		2307. 600 m	14
			–	2307. 1500 m	32 –
59°21′N. 17°36′W.,	14/6	1925		2308. 3000 m	31

[1] In the museum at Reykjavik.

59°24′N. 37°56′W.,	1-2/6	1925.	"Dana" St. 2308.	1000 m wire.	8 spec.
61°13′N. 40°57′W.,	25/7	1925.	–	2436. 600 m –	17 –
			–	2436. 1000 m	11 –
–	–	–	–	2436. 1700 m –	21 –
62°35′N. 32°53′2W.,	27/7	1925.		2437. 600 m –	28
				2437. 1000 m –	26 –
–	–	–	–	2437. 1900 m –	32 –
63°32′N. 26°23′W.,	28/7	1925.	–	2438. 600 m –	1 –
–	–	–	–	2438. 1500 m –	8 –
51°18′N. 30°30′W.,	1/7	1931.	–	1205. 300 m –	1 –
				1205. 600 m –	1 –
53°38′N. 29°41′W.,	1/7	1931.		1206. 100 m –	2 –
–	–	–	–	1206. 300 m –	2 –
–	–	–		1206. 600 m –	38 –
–	–	–	–	1206. 1000 m –	1 –
63°51′N. 33°51′W.,	19/7	1931	–	1235. 600 m –	2 –
62°23′N. 16°05′W.,	25/6	1932.		1402. 2000 m –	22 –
				1402. 3000 m –	6 –
–				1402. 4000 m –	6 –
61°52′N. 35°30′W.,	15/8	1933.	–	1686. 600 m –	2 –
62°36′N. 32°18′W.,	16/8	1933	– –	1687. 600 m –	7 –
–		–	– –	1687. 1000 m –	9 –
–	–	–	–	1687. 1500 m –	110 –
–	–	–	–	1687. 2000 m –	100 –
63°38′N. 14°13′W.,	18/5	1934.	–	5113. 1800 m –	12 –
–	–	–	–	5113. 2000 m –	19 –

In our collections are numerous specimens from other localities in the North-Atlantic area, which have previously been recorded in the literature: they are indicated on the map, textfig. 16, by a special signature.

Periphylla periphylla is very abundant in the Atlantic Ocean south of the submarine ridges between Scotland, the Faroes, Iceland, Greenland, and Baffin Land. It has its main occurrence in the deep and intermediate strata, but it may sometimes ascend towards the surface and may then cross the ridges and be carried considerably farther northwards, but it evidently avoids areas where cold currents prevail. I have previously dealt with its occurrence in the waters west of Greenland (KRAMP 1942), where stray specimens are sometimes seen in the coastal area even as far north as Godhavn, about 70° N. From the deep-sea south of Iceland it may penetrate as far as the north-west point of the island, but we have no evidence of its occurrence off the north coast, unless the "*Melitea hyacinthina*" Faber, recorded from Eyjafjord, be really a *Periphylla*. By the Gulf Stream it is frequently carried to the west coast of Norway; it is recorded from the Sognefjord in May and the fjords in the neighbourhood of Bergen in January, March, and July, and according to HAVNO (1926) it is a regular visitor to the Lofoten region, about 68° N. In Sognefjord it was taken in great numbers, partly small individuals, which might indicate that the medusa is indigenous in this deep fjord; it is also possible, however, that the fjord, being provided with a submarine barrier at the mouth, acts as a trap to the medusae which happen to be carried in across the barrier (BROCH 1914 p. 8). *Periphylla* is also said to occur at Spitzbergen (MAYER 1910 p. 546), but I have been unable to find any precise records from this region in the literature.

As far as the horizontal distribution is concerned the present material only adds a number of localities within the same area, from which the species was previously known; but the numerous representative samples from different depths taken by the "Dana" provide us with valuable information of the vertical distribution of the various developmental stages of the medusa. In my paper on the West-Greenland medusae (KRAMP 1942 p. 108) I have mentioned the disagreement between the bathymetrical occurrence, especially of the young individuals, in the Greenland waters as observed by me, and the corresponding observations from other

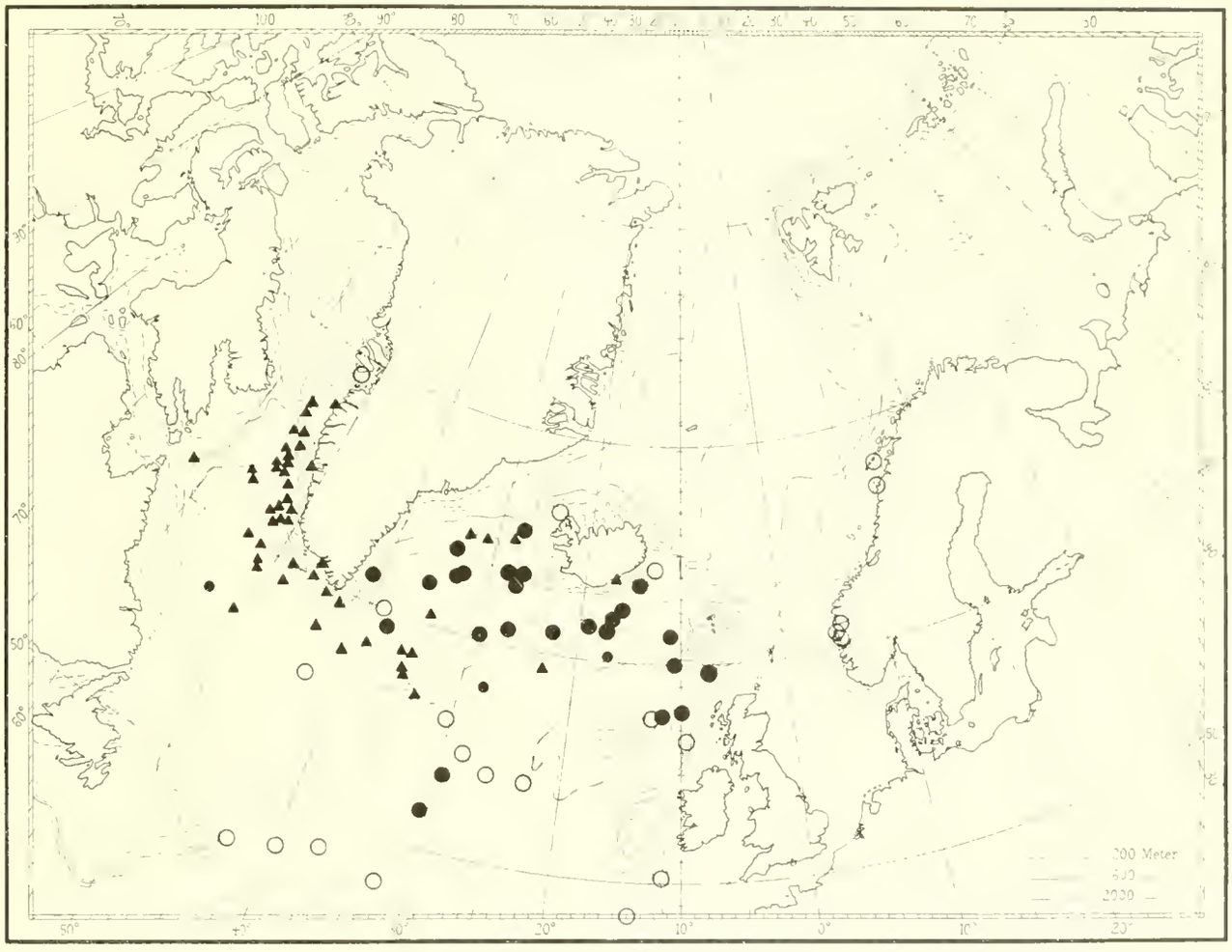


Fig. 16. Distribution in the northern Atlantic of *Periphylla periphylla*. ● new records; ▲ previous records, specimens in Zoological Museum, Copenhagen; ○ other previous records.

regions. In a previous paper (1913a) I pointed out that in Davis Strait the young specimens are particularly abundant in the deep strata, whereas STIASNY (1934 p. 363) is of the opinion that the small individuals mainly occur at higher levels than the large ones, and this opinion was based partly upon his own examination of the "Discovery" collections, partly on the statements by BROCH in the "Michael Sars" report (1914).

I have measured the diameter of all the specimens taken by the "Dana"; in the collections from the older expeditions the specimens were picked out and preserved more or less at random, and these collections are therefore not representative and are not considered in the following calculations. The results of the measurements are given in Tables V–VII, and for comparison I have summarized the results from other geographical areas as obtained by STIASNY, BROCH, and myself in Tables I–IV. The results are not directly comparable, because the diameter of the medusæ has been measured in different ways by the various authors. The diameter of the "Dana" specimens is measured to the base of the marginal lappets; BROCH preferred to measure the diameter of the central disk above the annular furrow. None of these methods are quite reliable, because the shape of the medusa is very variable according to the state of contraction, and this applies not merely to the bell margin, but to the gelatinous central disk as well. Nevertheless, in spite of the unavoidable incorrectness of the measurements, they give an impression of the bathymetrical distribution of small, middle-sized, and large specimens in the various regions, sufficient for the purpose.

In the southern part of the Atlantic (Table I, STIASNY 1931, "Discovery" collections) the largest specimens (forma *regina*) evidently have their principal occurrence between about 1250 and 2000 m below the surface, whereas middle-sized (forma *hyacinthina*) and small specimens (forma *dodecabostrycha*) are mainly caught between about 750 and 1000 m below the surface, and several specimens were even taken at depths of less than 250 m, whereas these stages were almost entirely lacking in the deepest strata, from about 1250 m downwards.

In the Mediterranean (Table II, KRAMP 1921, "Thor" collections) this species never seems to attain any considerable size, the largest specimens observed being only 35 mm wide. In the collections by the "Thor" specimens more than 25 mm in diameter were restricted to the deepest strata, about 1100–1700 m below the surface (1600–2600 m wire out; in my paper of 1921 I have calculated the depth as about one half the length of wire out, whereas two thirds probably comes nearer to the truth), whereas middle-sized and small specimens occur at all depths; "the young individuals seem normally to ascend into the intermediate, occasionally even into the upper strata, but sink to the deep water once more before breeding."

Table III is a contraction of the table, fig. 3, given by BROCH (1911, "Michael Sars" collections). In this portion of the North Atlantic, predominantly between 25° and 50° N., small and middle-sized specimens likewise occur at all depths, the majority being found rather high up in the water, about 500–600 m below the surface, occasionally even quite near to the surface, whereas the large individuals evidently prefer the deep strata.

Table IV illustrates the facts as observed in the Davis Strait by the "Tjalfe" expedition (KRAMP 1913); in the corresponding table in that paper are included some observations from the

Table I. Vertical distribution of *Periphylla* in the South Atlantic from Stiasny 1931.

Depth m	Diameter of specimens, mm		
	5–35	35–80	80–200
[illegible]–250	5	3	
250–500	2	1	1
500–750	2		4
750–1000	23	10	
1000–1250	8	1	
1250–1500	1		11
1500–1750			5
1750–2000			1

Table II. Vertical distribution of *Periphylla* in the Mediterranean, from Kramp 1924.

Approximate depth m	Diameter of specimens, mm		
	5–15	15–25	25–35
10	2	2	
200	26	18	
600	1	..	..
800	15	5	..
1100	1	2	2
1350	17	34	11
1500	3	2	2

Table III. Vertical distribution of *Periphylla* in the North Atlantic between about 25° N. and 50° N., from Broch 1911.

Approximate depth m	Diameter of specimens, mm			
	3–15	15–25	25–40	40
50	6			..
100	8	1		..
150–250	5	3	.	
500–600	30	4	2	.
700–800	13	4	2	
1000–1100	10	5	2	1
1250	5	2	..	..
1500	4	6	2	..

Table IV. Vertical distribution of *Periphylla* in the Davis Strait, from Kramp 1913.

Approximate depth m	Young	Medium-sized	Large
[illegible]		1	
[illegible]	1		
[illegible]	1		
[illegible]		1	3
[illegible]			1
[illegible]			1
[illegible]			1
[illegible]		1	
[illegible]			4
[illegible]			
[illegible]			1
[illegible]		1	

Irminger Sea; they are left out here. In this region specimens of all sizes may be met with at all depths; all of them predominate in the deep strata, and young specimens are very rarely taken in the upper layers, where, on the other hand, large specimens have repeatedly been observed, not merely by the "Tjalfe" expedition, but also on other occasions.

The material collected by the "Dana" in the North Atlantic between about 52° and 64° N. gives the following results (Tables V–VII). Table V presents the actual number of individuals taken in hauls of two hours' duration with the 2 m ringtrawl (S 200), the numbers obtained by hauls of only one hour's duration being multiplied by 2. This table is directly comparable with the tables presented above from other geographical regions, and it shows that the vast majority of the smallest individuals, 1–10 mm in diameter, are densely crowded in the deeper strata, only very few being taken in the upper layers, whereas the middle-sized and large specimens seem to be somewhat more dispersed. The number of hauls made at each depth must, however, be taken into consideration, and this is done in Table VI, giving the number of specimens per one haul of two hour's duration with the S 200, (only positive hauls are included in the table). It confirms the impression of a dense accumulation of small specimens, 4–15 mm wide, at depths between about 1000 and 1350 m, the number decreasing gradually downwards and very suddenly upwards; specimens 15–25 mm in diameter are far less numerous than the small ones, and they are about equally common from 100 to about 1350 m below the surface; the same apparently applies to the larger specimens, 25–40 mm wide. Specimens more than 40 mm in diameter were altogether scarce, but were taken at all depths, even in the uppermost strata, and it may be noted that the specimen taken nearest to the surface (with only 50 m wire out, "Dana" St. 2306, south of Iceland) was the largest of the specimens brought home, being about 250 mm in diameter. Table VII, giving the percentage number of specimens of each size-class at the various depths, shows that at depths between about 400 and 650 m below the surface the stock of *Periphylla* mainly consists of middle-sized individuals, whereas in the deeper strata, from 1000 m downwards, the vast majority are quite young ones.

In this portion of the North Atlantic, accordingly, the vertical distribution of the various developmental stages of *Periphylla periphylla* is very nearly the same as in the Davis Strait, which was also to be expected, as the southern, deep part of Davis Strait is a direct continuation of the deep basin of the Atlantic Ocean. In both areas the majority of the specimens were taken in strata which had a temperature of about 3–4°.

Stiasny (1931 p. 361) is inclined to think that "the small stages of *Periphylla* have their origin on the continental slope or near the coast ... and that they are driven into the open sea and sink slowly to greater depths," and also (p. 363) that the occasional occurrence of young stages in the superficial layers in the tropical regions "is perhaps to be explained by cold vertical currents which carry deep-sea animals to the surface." — To this may be remarked: In the North Atlantic there is no indication of small specimens of *Periphylla* being particularly plentiful in the neighbourhood of the continental slopes; the proportionate number of small and larger individuals seems to be independent of the position of the localities, and we may conclude, therefore, that breeding takes place everywhere in the deep-sea areas. The development of *Periphylla* is unknown, but it is generally supposed that, like other Scyphomedusæ, the specimens pass through a fixed, benthonic polyp stage. The remarkable fact, pointed out above, that the majority of the young specimens are accumulated in certain intermediate strata (different in different regions) and almost lacking deeper down, regardless of the distance to the bottom, makes it probable that the development is independent of the sea bottom, so that no fixed bottom stage comes into the cycle of development.

Moreover it should be remarked that the horizontal currents

Tables V-VII. Vertical distribution of *Periphylla* collected by the "Dana" in the North Atlantic between about 52° N. and 61° N.

Table V. Actual number of specimens taken in hauls of two hours' duration with the 2 m ringtrawl.

Length of wire out, m	Approximate depth, m	Diameter of specimens mm							Total number of specimens	Number of hauls made	Number of hauls containing Periphylla
		4–10	10–15	15–20	20–25	25–30	30–40	40			
50	25	..	..	..	..	..	..	1	1	9	1
100	60	2	..	..	.	..	2	..	4	10	2
300	200	2	..	..	.	..	..	1	3	10	2
600	400	20	31	49	26	10	4	2	142	12	10
1000	650	2	13	19	17	1	2	3	57	7	4
1500	1000	302	28	12	6	..	..	1	349	3	3
1800–2000	1350	175	143	33	19	5	2	1	378	5	5
3000	2000	15	16	6	..	..	2	..	39	2	2
4000	2700	4	2	2	3	2	..	..	13	2	2

Table VI. Number of specimens per one haul with the 2 m ringtrawl in two hours.

Approximate depth m	Diameter of specimens, mm				Total number per one haul
	4–15	15–25	25–40	40	
25	..	..	..	0.1	0.1
60	0.2	.	0.2	..	0.4
200	0.2	.	..	0.1	0.3
400	4.2	6.2	1.2	0.2	11.8
650	2.1	5.1	0.4	0.4	8.1
1000	110.0	9.0	..	0.3	119.3
1350	63.5	10.4	1.4	0.2	75.5
2000	15.5	3.0	1.0	..	19.5
2700	3.0	2.5	1.0	..	6.5

Table VII. Percentage number of specimens of each size-class in the various depths.

Approximate depth, m	Diameter of specimens, mm			
	4–15	15–25	25–40	40
25	0	0	0	100
60	50	0	0	50
200	67	0	0	33
400	36	53	10	1
650	26	63	5	5
1000	95	5	0	0.3
1350	86	11	2	0.3
2000	79.5	15.5	5	0
2700	46	39	15	0

in the intermediate strata of the Atlantic Ocean are slow, their velocity being somewhat more or less than 1 cm/sec., which means that it takes the water with its contents of plankton organisms about a year to pass through a distance of 300 kilometres; floating animals, bred on the continental slopes, must therefore have attained a rather advanced age before they can reach the central parts of the oceanic basins. E. g. at the "Dana" St. 4206, 53°38′ N. 29°41′ W., several small specimens of *Periphylla*, 5–10 mm in diameter, were taken in a haul with 600 m wire out, nearly 900 kilometres from the nearest continental shelf (the Rockall Bank); it should have taken them about three years to cover that distance providing they followed a straight line, and still more by a curved route. It is highly improbable, therefore, that these specimens have arisen from benthonic polyps growing somewhere on the continental slopes surrounding the northern basin of the Atlantic Ocean.

The difference in the vertical distribution of the various stages of development in different geographical areas must be due to differences in the hydrographical conditions. I quite agree with Bigelow (1938 p. 158) that "it seems likely that the upper boundary for *Periphylla* is set by light combined with temperature." As pointed out by the same author in a previous paper (Bigelow 1928 p. 496), "*Periphylla* never normally swims upward to the zone of strong illumination in Tropic seas, contrasting with its not exceptional occurrence right at the surface in arctic and subarctic latitudes." In the various geographical regions the majority of the specimens are accumulated in strata with very different temperatures, about 13–15° in the Mediterranean, about 7–12° in the subtropical belt of the North Atlantic, about 2–5° in the southern Atlantic, about 3–1° in the northern part of the Atlantic north of 50° N. and in the Davis Strait. 15° C. probably marks the upper limit of temperature endurable to the species. The young medusæ are most probably bred in the intermediate strata above the great depths; the fact that in some areas the young individuals are inclined to ascend towards the surface, while in other areas, as in the northernmost portions of the Atlantic, the young specimens are almost entirely restricted to the deeper strata and only large specimens occasionally occur in the surface layers, is most probably due to differences in the vertical circulation of the water masses, and it seems likely that the large specimens are more capable of resistance against the movements of the water. Upwelling currents will carry young specimens towards the surface, but in the subarctic portions of the Atlantic the vertical movement of the water is predominantly downwards, and this will keep the small medusæ in the deeper layers, while the large ones have the capability to force their way upwards towards the surface.

In the above discussion of the vertical distribution of *Periphylla* I have only dealt with the specimens collected by the "Dana" in the 2 m ringtrawl with bag of stramin (the so-called

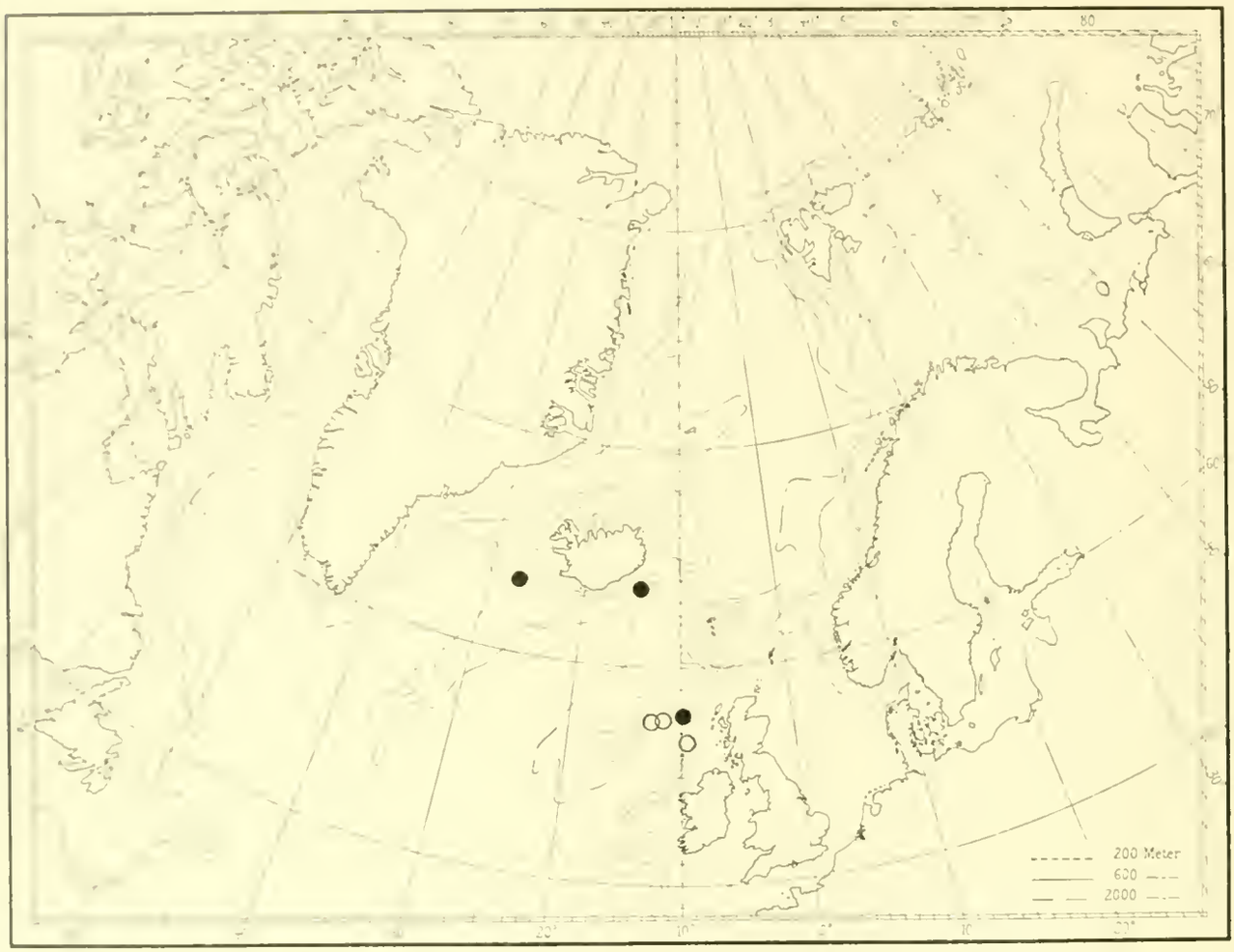


Fig. 17. Distribution in the northern Atlantic of *Nausithoë globifera*. ● new records; ○ previous records.

S 200, omitting the material taken in hauls with 2 and 3 m ring-trawls with coarser net, 7 mm between the knots (E 200 and E 300), because many of the small specimens must be supposed to have escaped through the meshes. At the stations, where *Periphylla* was present in the samples taken with the S 200, altogether eight hauls were made with coarser nets, *viz.* four hauls with 1000 m wire out (*Periphylla* taken in two hauls), one haul with 1500 m wire out, one with 1700, one with 1900, and one with 3000 m wire out; *Periphylla* was taken in all of these deep hauls, and in spite of the larger meshes the catches predominantly consisted of small specimens which, accordingly, must have been present in great numbers in these deep strata.

Geographical distribution: *Periphylla periphylla* is a bathypelagic medusa widely distributed in the deep parts of all the great oceans, except the Arctic; towards the south it almost reaches the Antarctic continent, and in the Pacific it occurs as far north as the Bering Sea and the Okhotsk Sea. In the Mediterranean it seems to be restricted to the western basin.

Fam. Nausithoidæ.

Genus Nausithoë Kölliker.

Nausithoë globifera Broch

Nausithoë globifera Broch, Egypt. 1914 p. 12, Pl. I figs. 5–8, textfig. 6.
Kramp 1920 p. 7
Nausithoë globifera Bigelow 1928 p. 198

Material (see the map, textfig. 17):

57°52′N. 9°53′W., $^{8}/_{6}$1905. "Thor" St. 72. 1 specimen
63°19′N. 26°50′W., $^{21}/_{5}$1928. "Godthaab" St. 1. 1000 m wire. 2 spec.
63°38′N. 14°13′W., $^{18}/_{5}$1931. "Dana" St. 5113. 1800 m wire. 2 spec.
" " 5113. 2000 m " 3 "

Remarks on the specimens. The specimens are all in a rather poor condition, but all of them show some of the features characteristic of *Nausithoë globifera* as described by Broch. The rhopalia are provided with a diffuse accumulation of dark pigment, but no lense is present. The pedalia are very indistinct, but the annular furrow is deep and strongly marked, and in the best preserved specimens the central disk has retained its solid mesogloea and its globular shape. The gastric cirri are very numerous and arranged in a single row, not in clusters. The gonads are very large in all the specimens, and in most of them the eight gonads are all in contact with each other; but in two of the specimens ("Dana" St. 5113, 2000 m wire, diam. 9 mm, and "Godthaab" St. 1, diam. 17 mm) they are arranged in pairs, separated by four narrow, perradial spaces. The dark and vivid colours, which according to Broch attracts attention in this species, have almost completely disappeared; only in the specimens from "Dana" St. 5113 the remnants of the stomach exhibit a vivid orange colour.

Diameter of the specimens: "Thor" St. 72, 17 mm; "Godthaab" St. 1, 8–16 mm; "Dana" St. 5113, 1800 m wire, 10–13 mm; 2000 m wire, 9–11 mm.

Bigelow (1928) is inclined to think that the two Atlantic deep-sea species, *N. atlantica* and *globifera*, described by Broch

in his account of the "Michael Sars" Scyphomedusæ (1911), both are identical with *N. rubra* Vanhöffen, and he may be right as far as *atlantica* is concerned. It seems to me, on the other hand, that *N. globifera* differs so much from the two other species that it is unsafe to unite them, unless further studies of a larger number of well preserved specimens perhaps might lead to the conclusion that the differences were only due to individual variation. The specimens of *N. rubra* from the eastern tropical Pacific, examined by Bigelow himself (1909a p. 36), agree very well with the original description by Vanhöffen (1902a p. 29), in which it is expressly stated that the pedalia are prominent, the tentacular spaces between the marginal lappets larger than the rhopalar, and the marginal lappets narrow and pointed; in all the specimens examined by me (in so far as they are sufficiently well preserved to show the outline of the margin) the lappets are equidistant and broad and rounded, exactly as in Broch's original specimens. Moreover the gonads of *N. rubra* are separated from each other by large and equal spaces, which is in striking contrast to the characteristic position of the gonads in *N. globifera* as observed by Broch as well as by me.

Geographical distribution: *Nausithoë globifera* occurs in the deep and intermediate strata of the north-eastern Atlantic; two of the new localities recorded in the present paper are considerably farther north than the localities from which the species was previously known; the distribution is evidently limited by the continental slopes of Iceland and the British Isles.

Fam. **Atollidæ.**

Genus **Atolla** Haeckel.

Atolla wyvillei Haeckel.

North-Atlantic records:

Atolla bairdii Fewkes 1886 p. 936, Pl. 1–3.
– verrillii Fewkes 1886 p. 939, Pl. 4–5.
– bairdii + verrillii Fewkes 1889 p. 530.
– wyvillei Roule 1896 p. 302.
– bairdii Browne 1906 p. 179.
– – Vanhöffen 1906 p. 44, textfigs. 4, 5.
– tenella Hartlaub 1909 p. 477, Pl. 77 figs. 1, 2.
– bairdii Kramp 1913a p. 279.
– – Kramp 1914 p. 453.
– wyvillei + bairdi Broch 1914 p. 14.
– bairdi Kramp 1920 p. 7.
– wyvillei Bigelow 1928 p. 508.
– – Stiasny 1940 p. 14.
– – Kramp 1942 p. 109.

Material (see the map, textfig. 18):

64°38′N. 32°37′W.,	$^{22}/_{5}$1895.	"Ingolf" St.	12. 1958 m.	1 specimen
62°00′N. 21°36′W.,	$^{9}/_{8}$1895.	– –	40. 1591 m.	1 –
62°58′N. 23°28′W.,	$^{8}/_{6}$1896.	– –	73. 914 m.	1 –
62°25′N. 28°30′W.,	$^{14}/_{6}$1896.	– –	83. 1717 m.	1 –
64°44′N. 31°00′W.,	$^{25}/_{6}$1896.	– –	91. 2328 m.	fragments
66°23′N. 7°25′W.,	$^{11}/_{7}$1896.	– –	101. 1802 m.	1 specimen
67°57′N. 6°44′W.,	$^{20}/_{7}$1896.	– –	112. 2386 m.	3 –
68°27′N. 8°20′W.,	$^{21}/_{7}$1896.	– –	118. 1996 m.	1 –
67°29′N. 11°32′W.,	$^{25}/_{7}$1896.	– –	120. 1666 m.	1 –
65°00′N. 28°10′W.,	$^{19}/_{6}$1904.	"Thor" St.	152. 800 or 1000 m wire.	2 specimens
61°31′N. 19°05′W.,	$^{10}/_{7}$1904.	"Thor" St.	180. prob. 1800 m wire.	1 sp.
61°30′N. 17°08′W.,	$^{11}/_{7}$1904.	–	183. – 1800 m	1 –
57°52′N. 9°53′W.,	$^{8}/_{6}$1905.	–	72. 1500 m	4 –
48°19′N. 13°53′W.,	$^{3}/_{9}$1906.	– –	180. 1800 m wire.	3 spec.
60°59′N. 22°29′W.,	$^{29}/_{5}$1925.	"Dana" St.	2306. 2000 m wire.	1 spec.
17°02′N. 34°15′W.,	$^{27\,28}/_{6}$31.	„Dana" St.	4201. 3000 m wire	1 spec.
–	–	–	4201. 4000 m	fragm.
–	–	–	4201. 5000 m	7 spec.
–	–	–	4201. 6000 m	13 –
19°19′N. 30°22′W.,	$^{30}/_{6}$1931.	–	4203. 1000 m	2 –
53°38′N. 29°11′W.,	$^{1}/_{7}$1931.	–	4206. 600 m	1 –
–	–	–	4206. 1000 m	fragm.
62°23′N. 16°05′W.,	$^{25}/_{6}$1932.	–	1402. 2000 m	7 spec.
62°36′N. 32°48′W.,	$^{16}/_{8}$1933.	–	1687. 2000 m	7 –
63°38′N. 11°13′W.,	$^{18}/_{5}$1931.	–	5113. 1800 m	1 –
65°14′N. 6°06′W.,	$^{24}/_{5}$1931.	–	5143. 2100 m	1 –

Fewkes described this species (under the names of *Atolla bairdii* and *verrillii*) from the Gulf-Stream area off the east coast of North America between about 35 and 43° N. Roule (1896) and Browne (1906) recorded it from the Bay of Biscay. According to Vanhöffen (1906, Nordisches Plankton) it has been taken near the Faroes, "ferner von der Ingolf-Expedition unter 64° N. Br., endlich vom "Michael Sars" in einem Fange aus 1900 m Tiefe noch höher im Norden . . .," but no precise localities are given by this author. It was taken at several stations by the "Michael Sars" North Atlantic Deep-Sea Expedition in 1910 (Broch 1911) and by the Norwegian vessel "Armauer Hansen" in the north-eastern basin of the Atlantic in 1913 (Kramp 1920). Also found in several localities in the deep parts of Davis Strait (Kramp 1913a, 1914, and 1942). Bigelow records it from the area off the east coast of North America as far north as off New York, about 40° N.

Atolla has about the same world-wide distribution as *Periphylla* in the deep portions of the oceans, but it seems to be more strictly confined to the deep strata, especially in northern waters. In the North-Atlantic area it is not, like *Periphylla*, known to ascend into the upper strata and to be carried across the submarine ridges by the currents along the west coasts of Greenland and Norway. It is rather astonishing, therefore, that it was taken by the "Ingolf" expedition at four stations (St. 101, 112, 118, and 120) and also by the "Dana" (St. 5113) in the deep, cold basin of the Norwegian Sea. *Atolla* was never taken by the "Ingolf" by implements for pelagic fishery, but always in the trawl. If this had happened once or twice, one might suppose that the medusa was captured on higher levels during the hauling in of the trawl, but the fact that all the specimens, more than ten, in all the nine localities, were taken in benthonic hauls, leads us to the conclusion that they really lived near the bottom. (The specimens recorded by Roule from the Bay of Biscay were likewise taken in the trawl). In the five localities south of the ridges the depth varied between 911 and 2328 m, and the bottom temperature between 0°3 and 5°5; at the four stations in the Norwegian Sea the bottom temperature was very low, − 1°1 − + 1°0 at depths between 1802 and 2386 m; by the "Dana" a specimen was taken in a haul with 2100 m wire out, i. e. about 1600 m below the surface, at a similar low temperature, about + 0°8. We may conclude, therefore, that *Atolla* is indigenous in the deep strata of the Norwegian Sea, and this confirms the supposition that the two small medusæ described by Hartlaub (1909) as *Atolla tenella* were young specimens of *Atolla wyvillei*; they were collected by the "Belgica" in a locality between N. E. Greenland and Spitzbergen, 79°31′ N. 2°37′ W., at depths between 1200 and 1800 m. The area of distribution of this species accordingly comprises the high-arctic regions.

The material available is too small to serve as base for a discussion of the vertical distribution of the various stages of development; some of the specimens are quite small, 10–20 mm in diameter.

Geographical distribution: *Atolla wyvillei* is a true cosmopolitan deep-sea medusa, occurring in all the oceans from the

Fig. 18. Distribution in the northern Atlantic of *Atolla wyvillei*. ● new records; ○ previous records.

Antarctic northwards; in the Pacific it is found as far north as the Bering Sea; in the Atlantic area it penetrates into high-aretic regions.

Order Semæostomæ.

All the North-Atlantic species belonging to this order are inhabitants of the upper layers and only occasionally are taken in the deep strata, they will only be briefly mentioned in this paper.

Pelagia noctiluca (Forskal).

Syn. *Pelagia perla* Slabber.

Material:

62° 01′ N. 10° 50′ W. [illegible] 1893. E. Bast. 1 specimen.
59° 04′ N. 11° 52′ W. $^{6}/_{6}$ 1900. "Thor" St. 65. 1 specimen.
59° 25′ N. 12° 15′ W. $^{9}/_{6}$ 1900. " " 71. 3 "
47° 02′ N. 35° 15′ W. [illegible] 31. "Dana" St. 1201. 3000 m wire. 1 spec.
59° 40′ N. 5° 22′ W. [illegible] 1931. " 1203. 50 m 3 "

Moreover three specimens were taken by Olrik, 1860, in "Northern Atlantic on a journey to Greenland," i. e. about 60° N.

Pelagia noctiluca is a holoplanktonic medusa, independent of [illegible], very widely distributed and very common in the [illegible] Sea, the Mediterranean and the warm parts of the Atlantic, the specimens taken by the "Dana" (St. 1201) in a haul [illegible] were undoubtedly caught during the hauling of the net. During the "Michael Sars" expedition in 1910 this medusa was found in several localities across the Atlantic between the edge of the Newfoundland Bank and the mouth of the Channel, a little south of Lat. 50° N., and the two stations, where it was taken by the "Dana", are within the same range. It is very abundant in the Bay of Biscay, whence it is frequently carried into the mouth of the Channel and northwards along the western coasts of Ireland and Scotland, sometimes even right to the Norwegian coast. According to Vanhöffen (1906 p. 45) a big shoal has been observed west of the Rockall Bank, about 57–58° N. 22–28° W. The specimen mentioned above, taken by E. Bast, shows that it may even occur still farther north, at 62° N., not very far from the south coast of Iceland.

Aurelia aurita (L.).

Syn. *Aurelia flavidula* L. Agassiz 1862, non Péron & Lesueur 1809.

Material:
62° 30′ N. 8° 21′ W., N.W. of the Faroes. $^{11}/_{5}$ 1895. "Ingolf" St. 1. 10 specimens.
Thorshavn on the Faroes, $^{26}/_{5}$ 1901. "Diana". 2 specimens.
Lerwick on the Shetland Islands, $^{22}/_{6}$ 1905. "Thor". 1 specimen.
Espevikpollen, Hardangerfjord, Norway, $^{2}/_{6}$ 1927. R. Spärck. 5 specimens.

Moreover our collections contain numerous specimens from Iceland and West Greenland, previously mentioned by me (Kramp 1939 and 1942).

In my paper on the West-Greenland medusæ (1942 p. 126) I expressed the opinion that *Aurelia aurita* had probably invaded

the Greenland seas in recent time, because all the specimens collected previously proved to belong to *A. limbata*. Among the old drawings of Greenland medusæ made by H. P. C. Möller I have however found one, undoubtedly representing *A. aurita;* the locality is not stated, but the drawing was probably made somewhere in West-Greenland.

The localities mentioned above add nothing to the known area of distribution of this almost cosmopolitan species. It occurs along the entire west coast of Norway, round Iceland, and on the west coast of Greenland as far north as about 70° N., but has never been found on the East-Greenland coast.

Cyanea capillata (L.).

Syn. *Cyanea arctica* Péron & Lesueur.

Material:

58°21′N. 0°20′W., $^{12}/_{6}$1891. Hartz. (West of the Hebrides).

48°09′N. 8°30′W., $^{20}/_{6}$1905. "Thor" St. 88. (Off the mouth of the Channel).

57 36′N. 7°05′W., $^{27}/_{5}$1908. "Thor" St. 8. (At the Hebrides).

64°15′N. 12°40′W., $^{10}/_{7}$1927. "Dana" St. 3079. 700 m wire. (S. E. of Iceland).

Tyrolerfjord, $^{23}/_{6}$1929, and Nordfjord, Strindberg's peninsula, $^{30}/_{8}$1929. The Danish East-Greenland Expedition 1929. (E. Greenland).

The occurrence round Iceland and on the coasts of Greenland is dealt with in some of my previous papers (1939, 1942, 1943). The specimens from the two East-Greenland localities mentioned above were not available to me, when I wrote my paper on the medusæ in "The Zoology of East Greenland" (1943); these localities are in the Franz Joseph Fjord area, about 74° N.

Cyanea capillata is widely distributed in the coastal areas of temperate and arctic seas. In the waters west of Greenland it occurs at least as far north as in Jones Sound between Ellesmere Land and North Devon, about 76° N.; it is very common along the west coast of Greenland from Cape Farewell to Upernavik. On the east coast it has been found in several scattered localities as far north as Danmarks Havn, about 76½° N. It also occurs round Iceland, Jan Mayen, and Spitzbergen, and along the European coasts from France to northern Russia.

Order Stauromedusæ.

Besides the specimens from Greenland and Iceland of *Halimocyathus lagena*, *Haliclystus octoradiatus*, *Lucernaria quadricornis*, and *Lucernaria haeckeli* our collections in Copenhagen contain some Lucernarians from a few other localities in the North-Atlantic area, mainly from the Faroes. The collections from Greenland and Iceland are dealt with in some of my previous papers (Kramp 1939, 1942, and 1943), the others will be briefly mentioned here.

Haliclystus octoradiatus (Lamarck).

Syn. *Haliclystus auricula* Clark.

Material:

The Faroes (without further statement). 2 specimens collected by Steenstrup.

Bordovig, the Faroes, $^{22}/_{5}$ 1899. Th. Mortensen. Numerous young specimens.

This species occurs on the east coast of North America north of Cape Cod; the west coast of Greenland as far north as Thule, about 76½° N.; the south coast of Iceland; the European coasts from France to northern Norway; Spitzbergen. Moreover known from Alaska and Japan.

Lucernaria quadricornis O. F. Müller.

Material:

The Faroes. Müller. 3 specimens (identified by Steenstrup).

Bergen in Norway. Koren. 1 specimen.

69°31′N. 7°06′W., $^{21}/_{7}$1896, depth 2165 m. "Ingolf" St. 113. 1 spec.

Svino, the Faroes, $^{1}/_{9}$1897. H. Jonsson. 1 specimen.

Kvannesund, the Faroes, 1898. H. Jonsson. 1 specimen.

Bordovig, the Faroes, $^{10}/_{5}$1902. 13-28 m. "Diana", A. Ditlevsen. 1 specimen.

One of these localities, "Ingolf" St. 113, is of particular interest being situated in the Norwegian Sea, north-east of Iceland, at the considerable depth of 2465 m, which is unusual for *Lucernaria quadricornis*. It was originally referred to that species by G. M. R. Levinsen, and a careful re-examination has convinced me of the correctness of the identification. The total height of the specimen is 22 mm, the pedicel is 9 mm in length and distinctly marked off from the calyx; the perradial notches between the arms are not much broader than the interradial. Thus it is quite different from *Lucernaria bathyphila* Haeckel, which was described from deep water in the southern part of the Norwegian Sea, between the Faroes and the Shetland Islands. The specimen is mentioned in the journal of the Ingolf Expedition, so that the possibility of a confusion of labels is excluded. The capture of a large specimen in Inglefield Bay, N. W. Greenland, at a depth of 930 m, shows that also in other arctic regions this species may occasionally occur in the abyssal region.

Lucernaria quadricornis occurs on the east coast of North America north of Cape Cod and along the west coast of Greenland as far north as Inglefield Bay, 77 17′ N.; also taken in some localities on the east coast of Greenland between about 65 and 71° N. Also recorded from Spitzbergen, but never seen at the coasts of Iceland. Common along the European coasts from southern England to the White Sea.

Additions and Corrections to Parts I and II.

Since the publications on the Leptolina in "The Danish Ingolf Expedition" (Leptomedusæ 1919, Anthomedusæ 1926) I have had occasion to examine several samples of medusæ from various parts of the North-Atlantic area. I have treated most of these collections in the following papers:

1925. Les Méduses de la Norvège, by KRAMP & DAMAS. (The occurrence and distribution of the Hydromedusæ along the west coast of Norway).

1926. Occasional Notes on Coelenterata, I. (On *Cyclocanna welshi* Bigelow found in the Skagerrak).

1927. The Hydromedusæ of the Danish Waters. (Distribution, seasonal occurrence, biology, etc. of all species of Hydromedusæ found in the Danish waters).

1930. Hydromedusæ collected in the south-western part of the North Sea and in the eastern part of the Channel in 1903–1911.

1933. Occasional Notes on Coelenterata, II. (Identity of the American medusa *Melicertum campanula* A. Ag. with *M. octocostatum* (M. Sars). *Ectopleura dumortieri* (van Bened.) found in Danish waters).

1933. Leptomedusen. Nordisches Plankton. (General survey of the North Atlantic species of Leptomedusæ; *Cyclocanna welshi* found to belong to the Mitrocomidæ).

1933. Coelenterata, Ctenophora, and Chætognatha. The Scoresby Sound Committee's 2nd. East Greenland Expedition in 1932 (Some medusæ found on the east coast of Greenland).

1936. On the Leptomedusæ of the Genera *Eirene* Eschscholtz and *Helgicirrha* Hartlaub. Revision of the distribution of *Eirene cordella* (Per. & Les.) and *Helgicirrha schulzei* Hartlaub).

1937. Polypdyr, II. Gopher. Danmarks Fauna (All the medusæ occurring in the Danish waters).

1937. Medusæ, etc. The Zoology of Iceland. (Distribution of the species round Iceland).

1942. Medusæ. The "Godthaab" Expedition 1928. (All the species occurring off the west coast of Greenland).

1943. Medusæ, Siphonophora, and Ctenophora. The Zoology of East Greenland. (All the medusæ known from the east coast of Greenland).

The following records have not been published up to now:

Sarsia tubulosa (M. Sars):
63°26′N. 7°00′W., $^{17}/_{6}$1927. "Dana" St. 3040. 20m wire. 1 specimen.

Parrella antipoda (Allman):
57°55′N. 8°17′W., $^{13}/_{6}$1927. "Dana" St. 3001. 65m wire. 1 specimen.
From the entrance of the Skagerrak, not far from the south coast of Norway, the only locality in which this species had been found up to now. Off Portsmouth in the Channel.

Stauridiosarsia producta (Wright):
The hydroid (Obelia-type) was taken by Prof. JAGERSKIOLD near Gothenburg in the eastern part of the Kattegat, $^{7}/_{7}$1937. The medusa appeared from Helgoland where the hydroid has been kept living in an aquarium.

Steenstrupia nutans (M. Sars):
63°26′N. 22°28′W., $^{1}/_{8}$1927. "Dana" St. 3162. 600m wire.

Bougainvillia britannica Forbes:
Heligoland. $^{26}/_{5}$1931. S. TUXEN. Numerous specimens.

Bougainvillia principis (Steenstr.):
60°35′N. 3°45′W., $^{11}/_{8}$1926. "Dana" St. 2998. 600m wire.
57°55′N. 8°17′W., $^{13}/_{6}$1927. " " 3001. 65m "
63°26′N. 22°28′W., $^{1}/_{8}$1927. " " 3162. 600m "

Podocoryne borealis (Mayer):
Mangerfjord near Bergen, Norway, July 1932. TH. MORTENSEN. One specimen, taken near the bottom, about 300 m. – RUSSELL (1940 p. 525) and REES (1941 p. 307) have shown that the medusa *Podocoryne hartlaubi* Neppi & Stiasny (previously known only from the Gulf of Trieste) occurs in British waters together with the so-called *P. areolata* (Alder) and has probably sometimes been confounded with the latter. According to RUSSELL the hydroid known as *Podocoryne areolata* (Alder) can be the hydroid of either of the two species of medusæ, and REES is of the opinion that no connection exists between this hydroid and the medusa which up to now has carried the same name; he changes the name of the medusa to *P. borealis* (Mayer). I have re-examined our specimens from Norway and Denmark: they all belong to *P. borealis* (formerly *areolata*).

Leukartiara octona (Fleming):
57°21′N. 3°20′E., $^{11}/_{6}$1927. "Dana" St. 3006.
57°30′N. 1°58′W., $^{18}/_{6}$1927. " " 3009. 65 m wire.

Leuckartiara nobilis Hartlaub:
47°02′N. 31°45′W., $^{27}/_{6}$1931. "Dana" St. 1201. 100m wire.
49°49′N. 30°22′W., $^{30}/_{6}$1931. " " 1203. 50m "

These two localities are about midway between Newfoundland and the mouth of the British Channel; it is rather surprising to find this medusa so far out in the open sea. It was previously known from a number of localities off the western coasts of the British Isles and south of Iceland, and it has recently been recorded from Newfoundland (FROST 1937 p. 26).

Neoturris pileata (Forskål):
61°15′N. 12°40′W., $^{10}/_{7}$1927. "Dana" St. 3079. 700m wire.
63°26′N. 22°28′W., $^{1}/_{8}$1927. " 3162. 600m "
49°49′N. 30°22′W., $^{30}/_{6}$1931. " 1203. 1000m "
62°23′N. 16°05′W., $^{25}/_{6}$1932. " 1402. 50m "

St. 1203 is in the middle of the ocean, between Newfoundland and southern England; as the species has never been recorded from the western parts of the Atlantic, it is unexpected to find it in this distant locality, which marks the northern boundary of the Gulf Stream.

Tiaranna rotunda (Q. & G.):
59°21′N. 37°56′W., $^{12}/_{6}$1925. "Dana" St. 2308. 4000m wire.
62°35′N. 32°53′W., $^{27}/_{7}$1925. " " 2437. 1900m "

This bathypelagic Anthomedusa was previously known from the Straits of Gibraltar and from the North Sea and the west coast of Norway, and recently (KRAMP 1942 p. 36) I have also recorded

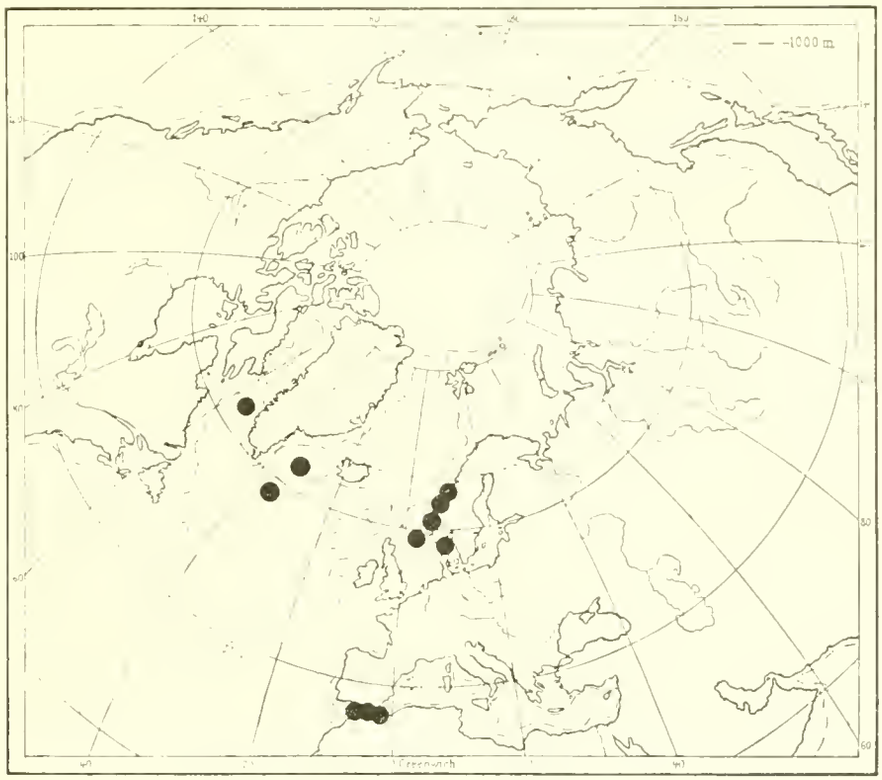


Fig. 19. Distribution of *Tiaranna rotunda*.

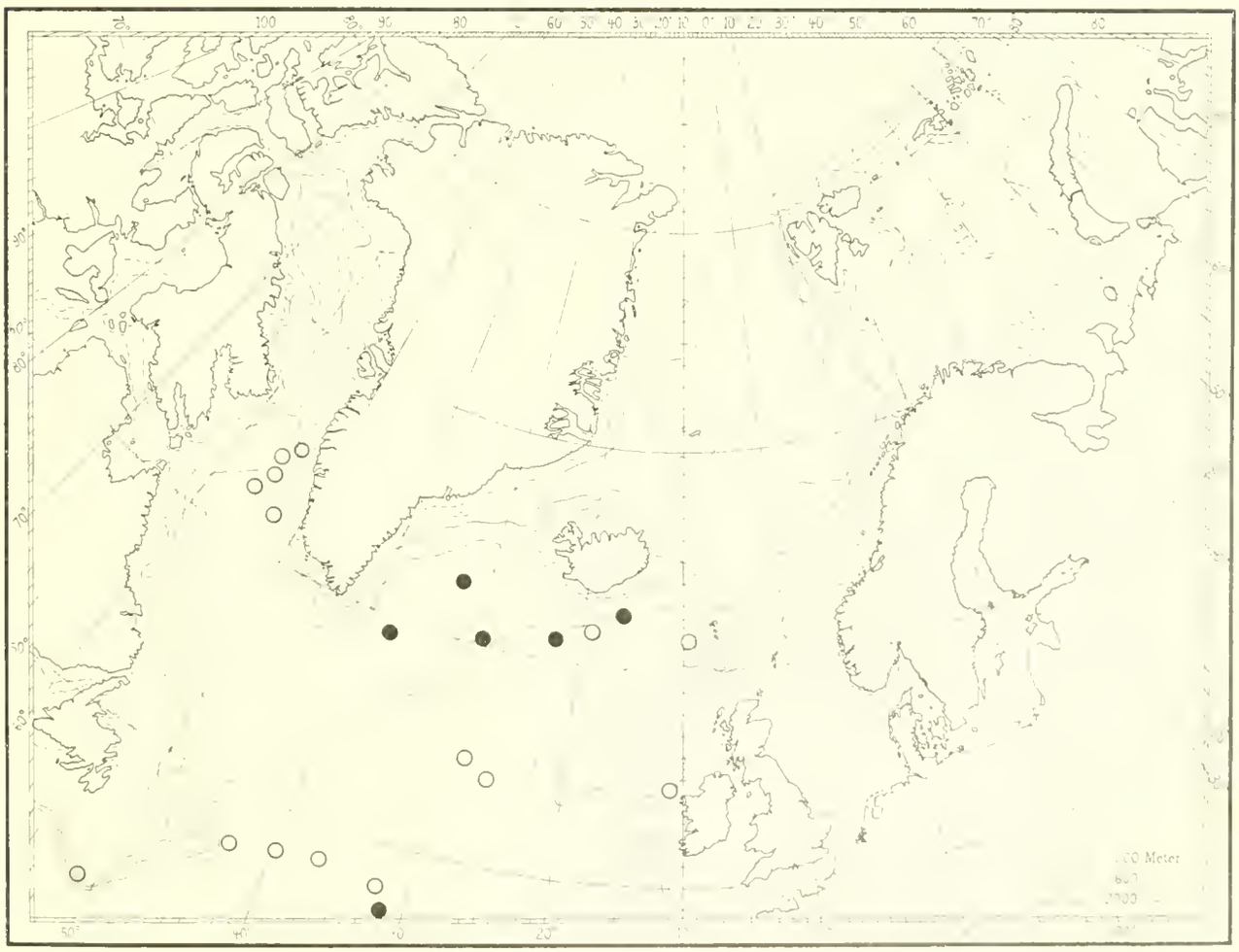


Fig. 20. Distribution in the northern Atlantic of *Chromatonema rubrum*. ● new records; previous records.

from Davis Strait west of Greenland. The two localities mentioned above are in the Irminger Sea, thus connecting the eastern and western areas of distribution.

Chromatonema rubrum Fewkes.

60°40′N. 22°20′W., [illegible] 1925. "Dana" St. 2306. 2000 m wire.
60°20′N. 20°21′W., [illegible] 1925. 2307. 1500 m
59°21′N. 17°50′W., [illegible] 1925. 2308. 3000 m
47°02′N. 51°45′W., [illegible] 1931. 1201. 3000, 1000, and 6000 m wire.
62°23′N. 16°05′W., [illegible] 1932. — — 1402. 2000 m wire.
62°06′N. 32°48′W., [illegible] 1933. 1687. 2000 m

These localities complete the conception of this species as a bathypelagic medusa generally distributed in the deep basins of the northern Atlantic until the southern slopes of the submarine ridge between Scotland, Iceland, Greenland, and Baffin Land.

The systematic position of *Chromatonema* has been much discussed. In my paper on the medusæ of West Greenland (Kramp 1942 p. 51) I still retained my original view (of 1919) that it belongs to (or is closely related to) the Laodiceidæ among the Leptomedusæ, connecting this family with the Pandeidæ among the Anthomedusæ. Since I have become acquainted with Russell's paper "On the nematocysts of Hydromedusae, III" (Russell 1940 p. 518, owing to the war this paper was inaccessible to me, until I saw it in a Swedish library in 1943), I agree with him that it should be referred to the Anthomedusæ and placed with *Tiarannella retrorsa* in a special family, the Tiarannidæ.

Colour of *Chromatonema rubrum*: As previously mentioned by me (1942 p. 51) the colour of living specimens, as I saw them in Davis Strait in 1928, differs rather considerably from the orange or brick red colours in preserved specimens. Pl. VI fig. 7 is a reproduction of a coloured sketch made by me on board the "Godthaab".

Laodicea undulata (Forb. & Goods.):
63°26′N. 22°28′W., $^{1}_{8}$1927. "Dana" St. 3162. 600 m wire.
62°23′N. 16°05′W., $^{25}_{6}$1932. — — 1402. 600, 1000, and 3000 m wire.

Ptychogena crocea Kramp & Damas:
Mangerfjord near Bergen, Norway. July 1932. Th. Mortensen. 11 specimens, taken near the bottom, about 300 m.

Staurophora mertensi Brandt:
66°27′N. 18°47′W., $^{21}_{7}$1924. "Dana" St. 2193. 700 m wire.

Mitrocomella polydiademata (Romanes):
57°21′N. 3°20′E., $^{11}_{6}$1927. "Dana" St. 3006.

Cyclocanna welshi Bigelow:
Mangerfjord near Bergen, Norway. July 1932. Th. Mortensen. 15 specimens, taken near the bottom, about 300 m.

Phialella quadrata (Forbes):
57°30′N. 1°58′W., $^{18}_{6}$1927. "Dana" St. 3009. 65 m wire.
Kühne (1937a p. 6) records "*Eucopium quadratum*" from the Baltic, *fide* Möbius, but this is erroneous.

Phialidium hemisphaericum (L.):
60°35′N. 3°15′W., $^{11}_{8}$1926. "Dana" St. 2998. 600 m wire.
64°15′N. 12°10′W., $^{10}_{7}$1927. — — 3079. 700 m
63°26′N. 22°28′W., $^{1}_{8}$1927. — — 3162. 600 m

Phialidium islandicum Kramp:
64°15′N. 12°10′W., $^{10}_{7}$1927. "Dana" St. 3079. 700 m wire.

Octocanna funeraria (Q. & G.):
57°16′N. 9°55′W., $^{1}_{9}$1905. "Thor" St. 167. 1500 m wire. 1 spec.
Outside the Mediterranean this species was hitherto only known from some of the deep fjords on the west coast of Norway; the locality mentioned above is in the Atlantic between the west coast of Scotland and the Rockall Bank.

Zoogeographical Remarks

on the Medusæ of the northern Atlantic and adjacent Waters.

In Table VIII is given a general survey of the distribution of the North-Atlantic free-swimming medusæ, and on the following pages the composition of the fauna in each of the different geographical areas will be briefly discussed. In the Table I have included the coastal area on the east coast of North America between Cape Cod and the south-east point of Newfoundland (about 42–47° N.), because its pelagic fauna bears a considerable likeness to that in higher latitudes in north-western Europe.

The first three columns in the table comprise the three deep-sea areas: the Atlantic basin (including the deep, southern part of Davis Strait), the Baffin Bay, and the Norwegian Sea. The occurrence of the bathypelagic species is mainly restricted to these areas, but some of them may also be found in the neighbourhood of the coasts, either as stray visitors, or as constant inhabitants of deep fjords, e. g. on the west coast of Norway. On the other hand, neritic species with a somewhat prolonged pelagic life-time may sometimes be carried far out into the open sea, where they may be found in the upper strata above deep water; they are marked with an S in the table. The medusæ of the genus *Obelia* cannot be specifically separated; in the table the distribution of the corresponding hydroids is given, marked H. In some other species the hydroid has been found in areas from which the free medusa has not yet been recorded; in such cases the occurrence of the species is likewise indicated by an H.

The number of species of medusæ which at present are known from the areas here dealt with (north of about 50° N.) amounts to 142; but in Table VIII are also included 14 species taken off the American coast between Cape Cod and Newfoundland, but never recorded further north.

Among the 142 species 64 are Anthomedusæ, 38 Leptomedusæ, 4 Limnomedusæ, 16 Trachymedusæ, 6 Narcomedusæ, and 14 Scyphomedusæ (see Table IX). The majority of the species are meroplanktonic and neritic. It is true that the developmental cycle is unknown in several species, but probably all of the Leptolina (Antho-, Lepto- and Limnomedusæ) have a fixed polyp stage, and all of the Trachylina (Trachy- and Narcomedusæ) are presumably holoplanktonic. Among the Scyphomedusæ 8 species are known or supposed to be meroplanktonic, and these are also neritic; but we know that *Pelagia noctiluca* is holoplanktonic, and the vertical distribution of the oceanic species *Periphylla periphylla*, *Nausithoë globifera*, *Atolla wyvillei*, and *Poralia rufescens* gives reason to believe that they are likewise destitute of a fixed bottom stage. Among the species with doubtful development is also reckoned the high-arctic *Nausithoë limpida*, which is only known from the north east coast of Greenland.

Almost all the species of Trachylina are true oceanic forms, independent of the sea-bottom; the only exception among the northern species is *Ptychogastria polaris*, which seems to spend part of its time attached to the bottom of the sea, whence it occasionally swims towards the surface. The vast majority of the Leptolina are neritic forms, derived from polyp-stages attached to the bottom in the coastal areas, but some few of them occur in deep water. Most of these medusæ are however only taken at rather short distances outside the continental shelves or in deep fjords, which indicates that their fixed polyps live on the continental slopes and not in true oceanic basins. *Paragotoea bathybia* is only known from the southern, deep part of Davis Strait; *Annatiara affinis* and *Pandea rubra* occur in the eastern parts of the Atlantic Ocean; *Bythotiara murrayi* is likewise found in the eastern Atlantic and also in the Norwegian Channel and in some of the Norwegian fjords; *Calycopsis simplex* is only known from one of the fjords on the west coast of Norway; *Tiaranna rotunda* occurs at Gibraltar, in Norwegian fjords, and in the Skagerrak, but it is also known from the Irminger Sea and Davis Strait. *Ptychogena hyperborea* is only known from Smith Sound between Greenland and Ellesmere Land and is presumably an arctic deep-sea medusa; *Ptychogena crocea* and *Cyclocanna welshi* have been taken in some of the Norwegian fjords, the latter species also in the Skagerrak and off the east coast of North America; *Octocanna funeraria* is common in the Mediterranean and in some of the fjords on the west coast of Norway, and in the present paper it is recorded from the channel between Scotland and the Rockall Bank. In contradistinction to all these species *Chromatonema rubrum* should be designated as a true oceanic species, being generally distributed over the entire North-Atlantic deep-sea area, apparently quite independent of the continental slopes (see above, the map textfig. 20).

As far as the Trachylina are concerned, it is difficult to distinguish between bathypelagic species and species belonging to the upper strata. Most of the Trachymedusæ are well marked bathypelagic forms, but *Aglaura hemistoma* and *Liriope exigua*, which are stray visitors to the European coasts, belong to the upper strata, and *Aglantha digitale* occurs almost everywhere, though as a rule it is rare at great depths as well as near the surface; in most places it has its principal occurrence some hundreds of metres below the surface; in Table IX it is listed among the species of the upper strata. The Narcomedusæ are poorly represented in the northern seas. *Solmaris corona*, *Pegantha clara*, and *Ægina citrea* have their main occurrence in the upper strata in warmer seas, but in these northern latitudes they show a marked tendency to seek deeper water. *Æginura grimaldii* is a well marked deep-sea species with a cosmopolitan distribution; *Æginopsis laurentii*, on the other hand, is an arctic species, which decidedly prefers cold water; it is therefore mainly taken in the upper strata in the waters round Greenland and in the deeper strata in the Norwegian Sea.

Table VIII.

The Medusae in the northern Atlantic N. of about 50° N. and adjacent waters	Deep-sea areas: Atlantic Ocean	Deep-sea areas: Baffin Bay	Deep-sea areas: Norwegian Sea	Coastal areas: Cape Cod – Newfoundland	Newfoundland – Ellesmere Land	West Greenland	East Greenland	S. and W. Iceland	N. and E. Iceland	Faroes	British Isles, West	Channel	North Sea and Skagerak	Kattegat and Baltic	Norway S. of Lofoten	Norway N. of Lofoten	Spitzbergen	Barents Sea and Kara Sea
ANTHOMEDUSAE																		
Sarsia eximia (Allm.)	.		..	..							×	×	.	..	×			.
brachygaster Grönberg			..	..	.												×	×
prolifera Forbes	.		..	..	.						.	×	.				.	..
tubulosa (M. Sars)			..	.	×	×	×	.	×	.	.	×	.	×	×	×	.	×
barentsi Linko	.	..	..	.	.								.	.		..	..	×
princeps Hckl.	..	..	..					..			.					..	×	×
Stauridium productum (Wright)		..	..	.				..			H	H	×	H	.	..	..	..
Purena strangulata (Allm.)		.	..	.				..			.	×	..	..	..	..	..	..
— gemmifera (Forbes)		..	.					..			×	×	.	×	×	..	..	..
Slabberia catenata Forb. & Goods.			.					..			.	..	..	..	..	..	..	..
halterata Forbes								..			×	×	×	..	..	..	..	..
Eucodonium brownei Hartl.											..	×	..	×	..	..	..	..
Plotocnide borealis Wagner			..			×						..	..	..	..	..	..	×
incerta Linko	..		..			.						..	..	..	..	..	..	×
Euphysa aurata Forbes	..					×					×	×	.	×	.	×	..	×
pendula (L. Agass.)				×							.	..	.	..	..	..	..	..
tentaculata Linko						.							..	×	..	..	..	×
— flammea (Linko)					×	.							.	..	..	×	×	×
Steenstrupia nutans (M. Sars)				.				×		.	.	.	.	×	×	..	..	..
Hybocodon prolifer L. Agass.				×	×	.		.	×	.	×	×	×	×	×	×	..	..
Ectopleura dumortieri (v. Bened.)				..	..	..				.	×	×	×	..	..	..	..	..
Paragotoea bathybia Kramp	.			..	.	.						..	..	..	..	..	..	..
Pennaria tiarella (Ayres)	.			.							..	..	..	..	..	..	..	..
Margelopsis haeckeli Hartl.				..							..	..	×	..	..	..	..	..
hartlaubi Browne											..	..	..	..	×	..	..	..
Zanclea costata Gegenb.				.							..	×	..	..	..	..	..	..
implexa (Alder)											×	×	×	..	×	..	..	..
Eleutheria dichotoma Quatref.											×	×	×	..	×	..	..	..
Cladonema radiatum Duj.				.							.	×	×	..	..	..	..	..
Bougainvillia ramosa (v. Bened.)				.		×		H			×	×	.	×	×	..	..	..
superciliaris L. Agass.				×	×	×		×	×	.	.	..	×	×	×	..	×	×
britannica Forbes				.				.		..	×	×	.	×	×	..	..	..
principis (Steenstr.)				.		.		×	×	×	.	.	×	..	.	×	..	×
pyramidata (Forb. & Goods.)								.			.		..	..	..	..	..	..
nordgaardi Browne												.	.	..	.	..	..	..
macloviana Lesson										.			.	..	..	..	..	..
Nemopsis bachei L. Agass.													.	..	..	..	..	..
[illegible] (Forb. & Goods.)											.	.	..	..	..	.	..	.
Lizzia blondina Forbes									.	.	.	.	.	.	.			
[illegible] (Hckl.)												.		..	..			..
[illegible]														..	.		..	..
[illegible] M. Sars						×	H	H			.	.	.	.	.	H		..
[illegible]												.		..	..	..		..
[illegible] (Alder)						.	.	.			.	×	×	..	×	..		..
[illegible] Mayer				.				.			.	×	..	..	×	..	..	..
[illegible] & Stanley											.	.	.	..	..	..	..	.
Rathkea octopunctata (M. Sars)				.	×	.		×	.	.	.	.	.	×	×	×		×
[illegible]											.	×	.	.	.	..	.	..
[illegible] Kramp & Damas								×			.	..	..	..	×	×		×
[illegible] (P. & L.)						.			.		.	×	..	..	..	..	.	..

Table VIII (continued).

	Deep-sea areas			Coastal areas																
	Atlantic Ocean	Baffin Bay	Norwegian Sea	Cape Cod – Newfoundland	Newfoundland – Ellesmere Land	West Greenland	East Greenland	S. and W. Iceland	N. and E. Iceland	Faroes	British Isles, West	Channel	North Sea and Skagerrak	Kattegat and Baltic	Norway S. of Lofoten	Norway N. of Lofoten	Spitzbergen	Barents Sea and Kara Sea
Amphinema rugosum (Mayer)																		
Stomotoca pterophylla Hckl.																		
Halitholus pauper Hartl.					×													
– cirratus Hartl.																		
Annatiara affinis (Hartl.)																		
Leuckartiara octona (Fleming)																		
– abyssi (G. O. Sars)						II	II						II	II			II	
– breviconis (Murb. & Sh.)																		
nobilis Hartl.	S																	
Neoturris pileata (Forskål)	S																	
Catablema vesicarium (A. Agass.)																		
– multicirrata Kishin.																		
Pandea rubra Bigelow																		
Bythotiara murrayi Günther																		
Calycopsis simplex Kramp & Damas																		
Tiaranna rotunda (Q. & G.)																		
Chromatonema rubrum Fewkes																		
LEPTOMEDUSÆ																		
Laodicea undulata (Forb. & Goods.)	S																	
Ptychogena crocea Kramp & Damas																		
– hyperborea Kramp																		
– lactea A. Agass.																		
Staurophora mertensi Brandt																		
Toxorchis kellneri Mayer																		
Dipleurosoma typicum Boeck																		
Melicertum octocostatum (M. Sars)																		
Mitrocomella brownei Kramp																		
fulva Browne																		
– polydiademata (Romanes)																		
Halopsis ocellata A. Agass.	S																	
Cosmetira pilosella Forbes																		
megalotis (Maas)																		
Cyclocanna welshi Bigelow																		
Tiaropsis multicirrata (M. Sars)																		
Obelia geniculata (L.)				II	II	II		II	II	II	II	II	II	II	II	II		
dichotoma (L.)				II				II		II	II	II	II	II	II	II		
longissima (Pallas)				II	II	II	II	II	II	II	II	II	II	II	II	II	II	II
Agastra mira Hartl.																		
Phialella quadrata (Forbes)										II								
Phialidium hemisphaericum (L.)				II														
languidum (A. Agass.)																		
bicophorum (L. Agass.)																		
islandicum Kramp																		
Octocanna funeraria (Q. & G.)																		
Eucheilota maculata Hartl.																		
hartlaubi Russell																		
ventricularis McCrady																		
Phialopsis diegensis Torrey	S																	
Eutonina indicans (Romanes)																		
Saphenia gracilis (Forbes)																		

Table VIII (continued).

	Deep-sea areas			Coastal areas																		
	Atlantic Ocean	Baffin Bay	Norwegian Sea	Cape Cod – Newfoundland	Newfoundland – Ellesmere Land	West Greenland	East Greenland	S. and W. Iceland	N. and E. Iceland	Faroes	British Isles, West	Channel	North Sea and Skagerrak	Kattegat and Baltic	Norway S. of Lofoten	Norway N. of Lofoten	Spitzbergen	Barents Sea and Kara Sea				
[illegible] (Ketorst.)																						
[illegible] (Haeckl.)																						
[illegible] Haeckel																						
[illegible] Hartl.																						
[illegible] (Per. & Les.)																						
[illegible] (Johnston)																						
[illegible] L. Agass.																						
[illegible] (Per. & Les.)																						
[illegible] Gegenb.																						
[illegible] A. Agass.																						
[illegible] A. Agass.																						
[illegible] (Modeer)																						
[illegible] L. Agass.																						
LIMNOMEDUSAE																						
[illegible] (Per.)																						
[illegible] Hartl.																						
[illegible] Gosse																						
[illegible] Mayer																						
TRACHYMEDUSAE																						
[illegible] pilaris Alln.																						
[illegible] Lewis																						
[illegible] Keferstein																						
[illegible] (Haeckl.)																						
[illegible] Browne																						
[illegible] gelatinosa Gegenb.																						
[illegible] Vanh.																						
[illegible] (Hartl.)																						
[illegible] pilgrimensis Browne																						
[illegible] Vanh.																						
[illegible] Mayer																						
[illegible] Kramp																						
[illegible] Vanh.																						
[illegible] (L. Agass.)																						
[illegible] (Per. & Les.)																						
[illegible]																						
[illegible]																						
[illegible]																						
[illegible]																						
CALYCOMEDUSAE																						
[illegible] (Ket. & Eberz.)																						
[illegible] Gegenb.																						
[illegible]																						
[illegible] Mayer																						
[illegible]																						
[illegible]																						
SCYPHOMEDUSAE																						
[illegible]																						
[illegible]																						
[illegible]																						

Table VIII (continued).

	Deep-sea areas			Coastal areas														
	Atlantic Ocean	Baffin Bay	Norwegian Sea	Cape Cod	Newfoundland	Newfoundland Ellesmere Land	West Greenland	East Greenland	S. and W. Iceland	N. and E. Iceland	Faroes	British Isles West	Channel	North Sea and Skagerrak	Kattegat and Baltic	Norway S. of Lofoten	Norway N. of Lofoten	Spitzbergen	Barents Sea and Kara Sea
Nausithoë globifera Broch	×	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Atolla wyvillei Haeckel	×	..	×	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Pelagia noctiluca (Forskål)	×	..	..	..	..	..	..	..	..	..	..	×	×	×	..	×	..	..	..
Chrysaora hysoscella (L.)	..	..	..	..	..	..	..	..	..	..	..	..	×	..	×	×	..	..	..
Cyanea capillata (L.)	..	×	..	×	×	×	×	×	..	..	..	×	×	×	×	×	..	..	×
– lamarcki Pér. & Les.	..	..	..	..	..	..	..	×	..	..	..	×	×	×	×	×	..	..	..
Discomedusa lobata	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Phacellophora ornata (Verrill)	..	..	..	×	..	..	..	..	×	..	..	..	..	..	..	..	..	..	..
Poralia rufescens Vanh.	×	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Aurelia aurita (L.)	..	..	..	×	..	..	×	..	..	..	..	×	×	×	×	×	..	..	..
– limbata (Brandt)	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Rhizostoma pulmo (L.)	..	..	..	..	..	..	..	..	..	..	..	×	×	×	×	×	×	..	..
Number of species	32	6	6	39	19	32	11	29	19	24	68	68	73	39	59	23	13	26	

Table IX. Systematic and biological survey of the pelagic Medusæ in the Atlantic Ocean and adjacent waters north of about 50° N.

	Anthomedusæ	Leptomedusæ	Limnomedusæ	Trachymedusæ	Narcomedusæ	Scyphomedusæ	Total number
Meroplanktonic species	64	38	4			8	114
Holoplanktonic species				16	6	1	23
Development doubtful						5	5
Neritic species	57	34	4	1		9	105
Oceanic species	7	4		15	6	5	37
Mainly in upper strata	57	34	4	1	5	11	113
Mainly in deep strata	7	4		12	1	3	27
Total number of species	64	38	4	16	6	11	142

The Fauna in the Different Geographical Areas.

I. Coastal Areas.

1. The coastal area between Cape Cod and Newfoundland. — The plankton fauna, and especially the medusæ, of this area has been thoroughly dealt with in several papers by H. B. Bigelow, the most important being the large volume: Plankton of the off-shore Waters of the Gulf of Maine, 1926. The area comprises the Gulf of Maine, the Bay of Fundy, the southern coasts of Nova Scotia and Newfoundland, and the Gulf of St. Lawrence. Among the 39 species recorded from the area at least 20 are meroplanktonic neritic species indigenous in the coastal waters; the following 5 species are possibly also indigenous, but as they are very rare, only met with on very rare occasions, we cannot be sure of their origin: *Pennaria tiarella*, *Bougainvillia britannica*, *Leuckartiara octona*, *Dipleurosoma typicum*, and *Phacellophora errata*; four of these were found in the Gulf of Maine, *Dipleurosoma* was taken once off Newfoundland. The holoplanktonic *Aglantha digitale* is likewise indigenous in the coastal area, but its occasional abundance in the gulfs is mainly due to influx from the North and East. The warm water of the Gulf Stream carries with it a number of species of southern origin: *Stomotoca pterophylla*, *Toxorchis kellneri*, *Tima formosa*, *Æquorea albida*, *Æquorea tenuis*, *Rhacostoma atlanticum*, *Aglaura hemistoma*, *Liriope tetraphylla*, and *Liriope scutigera*. The Gulf-Stream water is a surface stratum of warm and salt water, generally lying close outside the continental edge, but when some of the 9 species mentioned above are seen in the gulfs, they serve as indicators of an influx between or across the off-shore banks of this warm water of southern origin. A continuation of the ice-cold Labrador Current sweeps along the southern coasts of Newfoundland and Nova Scotia, whence it occasionally enters the gulfs, carrying with it some arctic visitors. When the following four species of medusæ are met with in the coastal areas here concerned, they must be considered such arctic visitors: *Sarsia princeps* (found as far south as on the south coast of Newfoundland), *Catablema vesicarium* (once taken near Halifax), *Ptychogastria polaris* (off Halifax, once), and *Ptychogena lactea* (occasionally carried further south past Cape Cod). — Almost all the indigenous species also occur in the coastal areas of north-western Europe, the only exceptions being *Euphysa pendula*, *Phialidium languidum*, and *Phialidium simplicium*, which up to now are only known from the American coast. On the other hand, with the only exception of the oceanic *Euphysa bonnetoma*, all of the southern visitors mentioned above are West Atlantic forms (*Liriope tetraphylla* also occurring in the Indo-Pacific).

2. The eastern coasts of Newfoundland, Labrador, Baffin Land, North Devon, and Ellesmere Land. — The dominating hydrographical factor of this region is the ice-cold water flowing southwards alongside the coasts from Smith Sound in the North to Newfoundland in the South, carrying with it great quantities of ice. The fauna of this inhospitable coast is imperfectly known; up to now it comprises 19 species of medusæ: the hydroid of *Obelia geniculata* occurs on the east coast of Labrador, the other species are recorded from scattered localities between Hudson Strait and Smith Sound (for details, see Dunbar 1942[1] and Kramp 1942); eight of them are decidedly arctic species, *Aglantha digitale* and *Cyanea capillata* are widely distributed in arctic as well as in boreal regions.

3. The west coast of Greenland. — The fauna of medusæ in the waters west of Greenland was thoroughly dealt with by me in a recent paper (Kramp 1942) to which I refer. In the table above (Table VIII) 32 species are listed as occurring in the West-Greenland coastal area; three of them are however only represented by their hydroids (*Leuckartiara abyssi*, *Obelia geniculata*, and *Obelia longissima*). The species are all indigenous in the area, except *Periphylla periphylla* which belongs to the deep-sea outside the southern part of the coast; it sometimes ascends to the surface layers and may then be carried by the currents into the coastal area. The great majority of the species (28) are meroplanktonic and neritic. The fauna is of a mixed character corresponding to the mixed composition of the waters; among the 28 meroplanktonic species 7 are predominantly arctic, 6 arctic-boreal, 9 northern-boreal, 2 boreal, 1 southern-boreal, and 3 cosmopolitan. The 3 holoplanktonic species are *Aglantha digitale* and the two arctic forms *Æginopsis laurentii* and *Ptychogastria polaris*. — Almost all the West-Greenland medusæ are also known from the coasts of northern Europe; the only exceptions are: *Halitholus pauper*, which occurs at Iceland but not on the coasts of the European continent (also recorded from the northern Pacific); *Catablema multicirrata* and *Aurelia limbata* which are arctic-boreal forms in the Pacific; *Eucheilota ventricularis* which is an American medusa distributed from Florida to Vineyard Sound and once taken in the southern part of the Greenland coast. The distribution of the various species along the west coast of Greenland depends on the hydrographical conditions in the various sections and is discussed by me in the paper quoted above.

4. The east coast of Greenland. — The ice-cold water of the East-Greenland Polar Current moves southwards all along the east coast of Greenland, decreasing in thickness towards the south; below it is a stratum of Atlantic water with temperatures above 0°; in the southernmost section this comparatively warm layer partly consists of water from the Irminger Current which turns westwards from Iceland, and it is possible that medusæ are sometimes carried into the coastal area of East Greenland by this current. Up to now, however, we know only 9 species of medusæ from East Greenland besides two species which are only represented

[1] Owing to the war Dunbar's paper has only quite recently been accessible to me; four species, not previously known from this area, are recorded by him from the coasts of Baffin Land, and three others were taken farther north than known before.

by their hydroids (*Leuckartiara abyssi* and *Obelia longissima*). There are the usual three arctic holoplanktonic forms, and 8 meroplanktonic, neritic species, all of which must be considered indigenous in the area. *Nausithoë limpida* was taken off North East Greenland, and its further distribution is unknown. *Cyanea capillata* is generally distributed along the coast being fairly common; the other neritic species are found in some few scattered localities. All of the East-Greenland species also occur in West Greenland and in North-European seas.

5. Iceland. — 33 species of pelagic medusæ are known to occur in the coastal waters round Iceland, including *Podocoryne carnea*, *Bougainvillia ramosa*, and the three species of *Obelia*, the presence of which is only stated by the occurrence of their hydroid polyps. The medusæ of Iceland have previously been dealt with by me in a special paper (Kramp 1939); in the table above (Table VIII) are included two species (*Paratiara digitalis* and *Ptychogastria polaris*), which had been left out in the paper quoted, because they were only taken at some distance from the coast; they are, however, considered as belonging to the fauna of the Icelandic coastal waters.

Only two of the Icelandic species of medusæ are holoplanktonic: *Aglantha digitale*, which is common everywhere, and *Ptychogastria polaris*, which has been taken in two localities north and east of the island at depths of somewhat more than 500 m. The bathypelagic *Periphylla periphylla* is rather frequently carried towards the south and west coast from the Atlantic deep-sea area. The remaining 30 species are meroplanktonic and neritic, and most of them are indigenous in the Icelandic coastal areas, but rather few are generally distributed around the island.

The northern branch of the Gulf Stream moves towards the south coast of Iceland turning westwards (the Irminger Current) and continues in a clockwise direction along the west and north coast, but it is considerably diminished in extent after turning round the north-west point of the island under the cooling influence of the Polar Current coming from the North; the main body of the Polar Current, however, follows the east coast, which therefore is the coldest part of the Icelandic coasts. Off the south-east coast there is usually a fairly sharp limit between the cold water of the Polar Current and the warm water derived from the Gulf Stream. The combined effect of the currents is, accordingly, a marked decrease of the temperature of the water from the south-east round the whole island in a clockwise direction. Species belonging to southern and boreal regions, therefore, are mainly found on the south and west coasts, occasionally carried round the corner to the north coast, whereas arctic species are only taken on the north and east coasts. The species which have a wide distribution round the island are mainly those belonging to arctic-boreal and northern-boreal tracts (for details, see Kramp 1939, especially Table III, p. 31). In the table above (Table VIII) the medusæ occurring on the south and west coast (29 species) and those taken on the north and east coast (19 species) are separated in two columns.

Specimens of meroplanktonic medusæ, especially of the larger forms with a fairly long pelagic period, may undoubtedly sometimes be carried to the southern coasts of Iceland from distant areas to mix with the indigenous population, and some decidedly southern forms, such as *Bougainvillia ramosa* (the hydroid with medusa buds taken once on the south coast), *Lizzia blondina* (taken once near Cape Horn), *Leuckartiara octona* (on the south coast, twice), and *Cyanea lamarcki* are probably not constant inhabitants of the Icelandic coastal waters, but may occasionally settle there for some time.

The Icelandic fauna of medusæ has a predominantly boreal character, and the majority of the species occur in the western as well as in the eastern parts of the North-Atlantic area. Only one species has a decidedly western distribution: the arctic medusa *Halitholus pauper*, known from the northern Pacific and from both sides of Greenland; in Iceland it has only been taken off the north-western part of the coast. On the other hand, the following seven species have never been recorded from the western Atlantic: *Lizzia blondina*, *Podocoryne areolata*, *Paratiara digitalis*, *Neoturris pileata*, *Phialidium islandicum*, *Eutonina indicans*, and *Cyanea lamarcki*. They are all inhabitants of the coastal waters in north-western Europe (*Neoturris* and *Eutonina* also known from the Pacific), and they have a predominantly boreal or southern distribution. *Phialidium islandicum* occurs all round Iceland, the others have only been taken on the southern and western coasts.

6. The Faroes. The fauna of medusæ at the Faroes is imperfectly known and has never been the subject of special treatment. The number of species recorded up to now and listed in Table VIII amounts to 20, but a closer examination of the neritic fauna around and between these small islands would certainly add several species to the list, especially such which are common to Iceland and the British Isles.

With the exception of *Aglantha digitale* the medusæ known from the immediate neighbourhood of the Faroes are all meroplanktonic and neritic, and most probably all of them are indigenous in the area, though in this respect *Bougainvillia superciliaris* and *B. principis* may perhaps be a little doubtful. Besides the three species of *Obelia*, *Phialella quadrata* is included in the list, because the corresponding hydroid has been taken at the islands, whereas the free medusa has not yet been observed.

The Faroes are washed by the Gulf Stream, and in accordance herewith their marine fauna is mainly of a boreal character. Under normal conditions a number of species with a predominantly southern distribution might also be able to occur round the islands; the cold water of the East-Iceland Polar Current, which is moving southwards along the north-eastern edge of the Wyville Thomson Ridge below the Gulf Stream, may however occasionally rise towards the shallow-water area of the Faroe plateau, and the temperature of the water around the islands is therefore subject to considerable variations, which may prevent a constant settling down of the southern species. Only two of the medusæ hitherto recorded from the Faroes (*Mitrocomella polydiademata* and *Phialella quadrata*) do not occur in the Icelandic waters, whereas all of the Faroese species are known from the British coasts and (with the exception of *Phialella quadrata*) from the southern part of the west coast of Norway.

7. Atlantic coasts of the British Isles. — The medusæ occurring off the coasts of the British Isles have invoked the interest of several British zoologists, particularly E. Forbes, E. T. Browne, and in recent years F. S. Russell. As most of their investigations have been carried out from the various marine laboratories, the different portions of the coasts have not been equally well examined. We may however suppose that almost all the species actually occurring there have really been observed. In Table VIII the British medusæ are enumerated under three different columns, because the conditions on the Atlantic coasts, in the Channel, and in the North Sea present rather considerable dissimilarities.

68 species of pelagic medusæ are recorded from the coastal areas west of the British Isles; the two bathypelagic species *Bythotiara murrayi* and *Octocanna funeraria* were however only taken in a few localities on the continental edge; they are included here, because, as mentioned above (p. 53), they are supposed to pass their fixed bottom stage on the continental slopes and not in the true oceanic basins. *Aglantha digitale* is very common, and it is mainly the comparatively small, southern form, forma *rosea*, which occurs on the British coasts. *Solmaris corona* is indigenous in the waters west of Scotland and Ireland and is mainly taken in the upper strata. The third holoplanktonic medusa is *Pelagia noctiluca*; it is probably not indigenous in British waters, but is frequently carried by the currents from more southerly

[illegible] coasts of Ireland and Scotland. The [illegible] are neroplanktonic, neritic, and probably all [illegible] in the area. 22 of these species are distributed [illegible] Ireland.

8. The English Channel. — Our knowledge of the fauna of medusæ in the Channel is mainly due to the extensive investigations from the Plymouth Marine Laboratory. A complete list of species from the Plymouth area known up to 1931 is given in the "Plymouth Marine Fauna" (1931), and some additions are made by RUSSELL (1938) in "The Plymouth offshore Medusa Fauna", in which also the seasonal distribution and the varying numerical quantities of the species are dealt with. Some species, which are not in RUSSELL's list, are recorded from other parts of the Channel.[1]

According to RUSSELL there are three different water types in the Channel, each carrying their own faunistic associations of plankton: 1) the "Channel" water, 2) the "swirl" water, derived from the cyclone swirl south of Ireland, 3) the "oceanic" water, directly originating from the ocean. The latter two types of water enter the mouth of the Channel in much varying quantities.

At present 68 species of pelagic medusæ are known from the Channel, among which 4 species are holoplanktonic; *Aglantha digitale* forma *rosea* is indigenous in the Channel, but shoals are also brought in by the "swirl" water. The three others belong to the plankton of the "oceanic" water; *Liriope exigua* is an irregular visitor particularly abundant in the autumn, *Solmaris corona* and *Pelagia noctiluca* appear on very rare occasions. The majority of the 61 meroplanktonic medusæ are undoubtedly indigenous; among the 18 meroplanktonic species listed from the Plymouth offshore area 13 are, however, designated as "visitors" by RUSSELL (1938 p. 116), mainly belonging to the "swirl" water. The Scyphomedusa *Discomedusa lobata* is a rare oceanic guest; *Turritopsis nutricula* belongs to the "Channel" water and is undoubtedly indigenous at least in the deeper parts of the Channel and even in the south-western part of the North Sea. *Gonionemus murbachi* has only been taken at Roscoff on the coast of France.

9. The North Sea and the Skagerrak. — The North Sea receives fresh supply of water partly from the English Channel through the Dover Strait, partly from the north through the channel between Scotland and the Shetland Isles and in a less degree from areas still further north.

Our knowledge of the medusa fauna off the east coast of Great Britain is mainly due to investigations carried out from the marine laboratories at St. Andrews in Scotland and Cullercoats in northern England; the English coast south of Northumberland is less thoroughly examined. The Hydromedusæ in the south-western part of the North Sea is dealt with by me in a paper (KRAMP 1930) in which special attention is paid to the influx from the Channel. The fauna in the surroundings of Heligoland in the south-eastern part of the North Sea has been carefully studied by G. HARTLAUB. The occurrence of the Hydromedusæ off the west coast of Jutland and in the Skagerrak (as also in the Kattegat and the Baltic) was thoroughly dealt with by me in 1927, with special regard to the biology of the species, their seasonal occurrence, dependence on hydrographical conditions, and drift with the currents.

75 species of pelagic medusæ are listed in Table VIII as occurring in the North Sea and the Skagerrak. Besides *Pelagia noctiluca*, which on rare occasions is carried across the northernmost part of the North Sea towards the west coast of Norway by the Gulf Stream, *Aglantha digitale* is the only holoplanktonic medusa occurring in the North Sea area; in the deep strata of the Norwegian Channel this species is represented by the large forma *typica*, whereas forma *rosea* is generally distributed throughout the entire area.

The majority of the meroplanktonic medusæ found in the North Sea area are indigenous there, but the native population of several species is also renewed by influx from outside, and in some cases it is difficult to decide, whether a species is indigenous or not.

The currents in the North Sea are rather complicated and frequently varying in extension, but the main features are as follows: One branch of the Gulf Stream moves slowly across the northern part of the North Sea into the Skagerrak constituting the deep strata of "Atlantic" water in the Norwegian Channel. Another branch of the Gulf Stream, the "North" water, goes as a surface-water current north of the Orkney Islands southwards along the east coast of Scotland and northern England about as far as Flamborough Head, whence it turns to the east. The "Channel" water enters through the Dover Strait moving northwards until it meets the "North" water in the surroundings of Dogger Bank. These two volumes of water become more or less mixed with each other and proceed together eastwards towards the west coast of Jutland as the "Jutland Current"; both currents have also been mixed up with English and Flemish coastal water. A whirl is usually formed south of the Horns Reef, forcing some of the combined bodies of water into the Heligoland Bight, but the main body of the Jutland Current moves northwards along the west coast of Jutland into the Skagerrak, mainly along the Danish coast, and further as an undercurrent into the Kattegat. The Jutland Current is particularly extensive in summer and autumn, and when entering the Danish seas it is called "southern bank water"; in winter and spring it is partly replaced by the cold "northern bank water", coming directly from the northern parts of the North Sea.

The following species of medusæ are supposed to occur in the North Sea only as visitors from the English Channel: *Phialella quadrata*, *Mitrocomella brownei*, *Æquorea forskalea*, *Æquorea vitrina*, and *Gossea corynetes*. *Slabberia halterata* and *Zanclea implexa* likewise belong to the "Channel" water, but as they have also been taken off the east coast of Scotland and Northumberland they are presumably also imported with the "North" water. *Turritopsis nutricula* is also imported from the Channel, sometimes in considerable number, but it seems to be able to breed in the south-western part of the North Sea. It is doubtful whether the shoals of *Rhizostoma pulmo*, frequently seen off the Jutland coast in the autumn, originate from the southern part of the North Sea or from the English Channel. *Chrysaora hysoscella* and *Cyanea lamarcki* are certainly indigenous in the southern part of the North Sea, whence they are carried northwards by the Jutland Current, but shoals of them are undoubtedly also brought into the North Sea from the Channel. Some of the "Channel" water medusæ never, or rarely, penetrate far into the North Sea, others, particularly the larger forms, proceed more or less regularly to the eastern parts and sometimes further north into the Skagerak.

Most of the medusæ carried in from the Atlantic by the "North" water belong to species which are indigenous in some parts of the North Sea, but some few of them are probably mere visitors. *Phialidium islandicum* has only been taken in the northernmost part of the North Sea, probably coming from the Norwegian Sea and not from the Atlantic. Another species with a predominantly northern distribution is *Staurophora mertensi*; as a rule it does not occur in the North Sea, but in certain years it may be met with even as far south as Heligoland; in the spring of 1923 it was taken in numerous localities off the west coast of Jutland and even in the northern Kattegat, evidently a population derived from polyps which had passed the previous winter on the Jutland coastal banks, certainly an exceptional case.

Among the numerous species which undoubtedly are indigenous in parts of the North Sea or the Skagerrak the following deserve some special remarks.

[1] I am grateful indebted to Mr. RUSSELL for additional information, [illegible] while the present paper was in press.

Bythotiara murrayi, *Tiaranna rotunda*, and *Cyclocanna welshi* are bathypelagic forms only found in the deep strata of the Skagerrak.

Tima bairdi probably is indigenous only on the slopes of the Norwegian Channel; during the period of its pelagic life, which lasts about a year, it spreads far around in the surrounding waters, into the Kattegat as well as towards the south and west in the North Sea, though never into the southernmost portions.

The following species are only known from a few localities, where they however seem to be indigenous: *Margelopsis haeckeli* (Belgium and Heligoland), *Eleutheria dichotoma* (Gullmarfjord on the Swedish coast of the Skagerrak), *Cladonema radiatum* (Belgium, the Limfjord in Jutland, Gullmarfjord), *Bougainvillia nordgaardi* (once observed in Oslofjord, else known only from the surroundings of Bergen), *Bougainvillia macloviana* (in the Heligoland Bight, probably transported by ships from the Antarctic), *Nemopsis bachei* (Zuider Sea), *Agastra mira* (Dover and Heligoland), *Eutima elephas* (Heligoland), *Willia stellata* (east coast of Scotland), *Pochella polynema* (one locality south of the Shetland Islands), *Gonionemus murbachi* (Oslofjord and Gullmarfjord).

A comparatively large number of the medusæ (13 species) occurring in the North Sea and Skagerrak have never been recorded from the south and west coast of the British Isles: The two deep-sea species *Tiaranna rotunda* and *Cyclocanna welshi;* the decidedly northern species *Bougainvillia superciliaris*, *Staurophora mertensi*, and *Phialidium islandicum; Leuckartiara abyssi* and *Tima bairdi* which have their proper home in the Norwegian Channel; *Eutonina indicans*, common in the North Sea except in the southern part; and the following species with a narrow distribution (see above): *Margelopsis haeckeli*, *Bougainvillia nordgaardi*, *B. macloviana*, *Nemopsis bachei*, and *Eutima elephas*.

10. The Kattegat and the Baltic. – The fauna of Hydromedusæ in the Danish waters inside the Skaw was thoroughly dealt with by me in the paper quoted above (Kramp 1927) and also in the series "Danmarks Fauna" (1937) comprising also the Scyphomedusæ (as well as the Siphonophora and the Ctenophora). To the lists given in these papers should only be added *Stauridium productum* and *Leuckartiara abyssi*, the hydroids of which have been found in the Kattegat.

The Kattegat is an interesting sea, being a transition area between the North Sea and the Baltic; the salt water of the North Sea (the Jutland Current) penetrates into the deep channels of the Kattegat as an undercurrent, still traced through the Belts into the western part of the Baltic; it is overlayered by the brackish water of the Baltic running northwards to the Skagerrak, where it is forced towards the coasts of Sweden and Norway and finally reaching the North Sea off the Norwegian coast.

39 species of pelagic medusæ occur in the Kattegat, 26 of which are indigenous there. The following 13 species are more or less regular visitors from the Skagerrak, most of them derived from the North Sea: *Bougainvillia britannica* (sometimes penetrating into the Great Belt which constitutes the principal connection between the Kattegat and the Baltic), *Leuckartiara nobilis* (found only once, in the Great Belt in 1923), *Laodicea undulata*, *Staurophora mertensi* (only under exceptional conditions), *Melicertum octocostatum*, *Mitrocomella polydiademata*, *Cosmetira pilosella*, *Eucheilota maculata*, *Saphenia gracilis*, *Eutima insignis*, *Chrysaora isosceles*, *Cyanea lamarcki*, and *Rhizostoma pulmo*. Under exceptional conditions (as in 1936) *Cyanea lamarcki* may be carried as far south as into the Belt Sea. *Chrysaora* and *Rhizostoma* are very rarely seen in the Kattegat, but in 1933 *Chrysaora* appeared in the northern part of the Kattegat, and in the same year *Rhizostoma* even occurred at the northern entrance of the Great Belt.[1]

[1] In October and Novembr 1946 *Rhizostoma* was observed in the southern Kattegat and in the Sound, even as far south as in Koge Bay south of Copenhagen.

In the Baltic 16 species have been taken, 9 of which are indigenous in the western part, whereas only 1 species (*Sarsia tubulosa*, *Halitholus cirratus*, *Cyanea capillata*, and *Aurelia aurita*) are indigenous in the Baltic proper east of the Gedser-Darsserort threshold. Of special interest are the two arctic medusæ *Euphysa tentaculata* and *Halitholus cirratus*. The former occurs in the southern Kattegat, the Belts, and the western Baltic, and besides it is only known from the Barents Sea and West Greenland; *Halitholus cirratus* is very abundant in the deep, cold basins of the Baltic proper, less common in the Belt Sea and the Kattegat, and its further distribution is purely arctic (see Table VIII); it must be designated as an arctic survivor in the Baltic.

The only holoplanktonic medusa in this area is a particularly small form of *Aglantha digitale*, indigenous in the deeper parts of the Kattegat, occasionally carried into the Baltic.

11. The west coast of Norway. – A special treatment of the Hydromedusæ occurring along the west coast of Norway is given by Kramp and Damas (1925); some few species are added to the list by Runnström (1932), Kramp (1933b), and Rees (1938 and 1941).

A branch of the Gulf Stream approaches the Norwegian coast, mainly through the Faroe-Shetland Channel; it is particularly powerful in late summer and autumn. As a rule it is separated from the coast by a belt of coastal water of lower salinity, partly derived from the Baltic Current. The Gulf Stream follows the Norwegian coast northwards and is still traced in the Barents Sea, but north of the Lofoten it is considerably cooled by the influence of the polar water, which accounts for the great difference in number of species found in the two portions of the Norwegian coastal region (59 in the southern section against 23 in the northern section). The majority of the species are meroplanktonic forms indigenous in the coastal areas. The few holoplanktonic forms are: *Ptychogastria polaris* (taken in several localities in the northern section, rarely seen in the southern), *Homoeonema platygonon* (in some of the fjords in the surroundings of Bergen), *Aglantha digitale* (generally distributed), *Solmaris corona* (rather frequently carried to the Norwegian coast by the Gulf Stream), and *Pelagia noctiluca* (a rare visitor from the Atlantic). *Periphylla periphylla*, which possibly also is holoplanktonic, is frequently carried to the Norwegian coast, and the possibility cannot be excluded that it is also indigenous in some of the deep fjords.

The following meroplanktonic species are constant inhabitants of the deep strata in some of the fjords of the southern section: *Bythotiara murrayi*, *Calycopsis simplex*, *Tiaranna rotunda*, *Ptychogena crocea*, *Cyclocanna welshi*, and *Octocanna funeraria*.

Besides the above-mentioned holoplanktonic species *Cosmetira pilosella* and *Phialidium islandicum* are probably visitors brought to the southern part of the Norwegian coast by the Gulf Stream.

When the following species occasionally are met with in the coastal water of southern Norway, they are most probably derived from the Jutland Current, which sometimes crosses the mouth of the Skagerrak: *Eutima elephas*, *Aequorea vitrina*, *Chrysaora hysoscella*, *Cyanea lamarcki*, and *Rhizostoma pulmo*.

Apparently very few of the numerous species which are indigenous in the southern section only are able to pass the boundary at Lofoten; *Laodicea undulata* and *Melicertum octocostatum* may probably be regarded as visitors from the southern section, when they occur north of the Lofoten; all the other species found in the northern section are probably indigenous there.

12. Spitzbergen. – The medusa fauna of Spitzbergen is imperfectly known. As the Gulf Stream is still traced at least on the western coasts, one might expect to find occasional visitors from southern regions, but the 13 species hitherto observed are commonly occurring also in other arctic regions. Three of the species are holoplanktonic: *Aglantha digitale* and the two decidedly arctic forms *Ptychogastria polaris* and *Aeginopsis laurentii*.

[illegible] The Barents Sea, White Sea, and Kara Sea. The [illegible] have been thoroughly studied by LINKO [illegible] on the west coast by BERNSTEIN and JASCHNOV. 26 species of [illegible] were recorded from these areas; three of them have [illegible] (*Sarsia brachygaster*, *S. barentsi*, and *Phialidium* [illegible]). Four species are holoplanktonic (see Table VIII). All the other species (except *Homoeonema platygonum*) are known from other arctic regions as well. The fauna is however not purely [illegible]. The heating effect of the Gulf Stream is still remarkable in these northern tracts, and in accordance herewith the fauna is a mixture of arctic, arctic boreal, and northern-boreal species. Of special interest, as emphasized by BERNSTEIN (1934), is the occurrence in the Kara Sea of the northern-boreal species *Mitrocomella polydiademata* and of the small Trachymedusa *Homoeonema platygonum* (see above, p. 17), both of which demonstrate the influx of water from the Barents Sea.

II. The Deep-Sea Areas.

A. The Atlantic basin north of about 50° N.

1. Meroplanktonic, neritic medusæ. – The great majority of the meroplanktonic medusæ are neritic, and the duration of their pelagic life is usually too short to enable them to be drifted far away from the coastal areas, from which they are derived. Some few of the larger species may, however, sometimes be met with at considerable distances from their place of origin. The Anthomedusæ *Leuckartiara nobilis* and *Neotarrus pileata*, and the Leptomedusa *Laodicea undulata* and *Halopsis ocellata*, all of which are common in the coastal areas of the north-eastern Atlantic, are frequently taken above deep water west of the British Isles and south of Iceland, following the circulations of the Gulf-Stream system. The Leptomedusa *Phialopsis diegensis*, which occurs in the eastern tropical Atlantic, has also occasionally been observed south-west of Ireland and in the Irminger Sea. The neritic Scyphomedusa *Nausithoë punctata*, indigenous in the warm portions of the ocean, is recorded by VANHÖFFEN (1902a p. 29) from a locality north-west of Scotland.

Very peculiar is the occurrence of three East-Atlantic neritic species in the central portion of the North Atlantic between 30 and 40° W. *Phialopsis diegensis* was taken in July 1910 by the "Michael Sars" east of the Newfoundland Bank (St. 81), 48°02′ N. 30°55′ W., in a haul with 200 m wire out. Some specimens of *Leuckartiara nobilis* were taken in June 1931 by the "Dana" somewhat further east, 47°02′ N. 31°15′ W. (St. 1201) and 49°49′ N. 30°22′ W. (St. 1203) in hauls with 100 and 50 m wire out; at St. 1203 two specimens of *Neotarrus pileata* were also found (in a haul with 1000 m wire out, possibly caught on a higher level while hauling in the net). Apart from one record of *L. nobilis* at Newfoundland (FROST 1937 p. 26) these three species were only known from the coastal areas in the eastern parts of the Atlantic area and in the waters south and south-west of Iceland. We know that irregularities of the surface-water currents in the northern Atlantic may sometimes have a disturbing influence on the habitual course of the regular currents, and one might conclude that the occurrence of the above-mentioned species in these western tracts were due to such irregular movements of surface water from the area south of Iceland towards the south-west. In all three localities the species were however taken in pure Gulf-Stream water (35.0–35.5‰ temp. about 14–15° C.) together with such [illegible] northern species as *Pelagia noctiluca*, *Rhopalonema velatum* and *Liriope exigua*. The only possible explanation seems to be that *Phialopsis diegensis*, *Leuckartiara nobilis*, and *Neotarrus pileata* are inhabitants of the American coastal waters, [illegible] with the exception of the single record of *L. nobilis* at Newfoundland, [illegible] not yet been observed there.

2. Holoplanktonic medusæ in the upper strata. – The only holoplanktonic medusa which is indigenous in the upper strata above the northern part of the Atlantic deep-sea basin, is *Aglantha digitale*. The distribution of this species is dealt with above (pp. 27 ff); it occurs throughout the area, being particularly common some hundreds of metres below the surface, less frequent in immediate neighbourhood of the surface as well as in the very deep strata. *Aglaura hemistoma* and *Solmissus incisa* are rare visitors from the south. The Narcomedusa *Solmaris corona* has only been found within the coastal areas of the British Isles.

Pegantha clara and *Ægina citrea* belong to the upper strata of warmer seas; they are occasionally met with in the northern waters, where they seem to prefer the deeper strata. *Pegantha clara* is a predominantly West-Atlantic form, and the free medusa has not been met with east of 30° W. in the northern section, whereas parasitic larvæ, probably belonging to this species, were taken south-west of Iceland (see p. 33). *Ægina citrea* occurs in the entire tropical and subtropical belt of the Atlantic Ocean and penetrates far towards the north in the north-eastern Atlantic, being recorded from deep water in localities not far from the south coast of Iceland (see p. 36).

Four species of *Liriope* enter the northern seas as visitors from the warm portions of the Atlantic, but three of them have only been taken in the coastal areas: *L. tetraphylla* and *scutigera* along the American coast into the Gulf of Maine, *L. exigua* along the European coasts reaching as far as the English Channel as an occasional visitor. Only one species of this genus, *L. eurybia*, has been found above deep water in the northern Atlantic; it is distributed right across the tropical Atlantic, and some few specimens were taken by the "Dana" (St. 1201 and 1203) in the Gulf-Stream water about midway between Newfoundland and Ireland (see p. 32). *Pelagia noctiluca*, which is widely distributed in the warm portions of the Atlantic, is frequently met with along the northern border of the Gulf Stream between the edge of the Newfoundland Bank and the British Isles, and in the north-eastern Atlantic it may even on rare occasions be carried as far north as 62°, not far from the south coast of Iceland, following the northernmost branch of the Gulf Stream (see p. 18).

Rhopalonema velatum has a similar distribution in the North Atlantic as *Pelagia noctiluca*, following the Gulf Stream towards the northern parts of the British Isles, but in the central portion of the North-Atlantic basin it is not restricted to the surface water, several specimens being taken even in the deepest hauls (with 1000–5000 m wire out) at "Dana" St. 1201 (see p. 13).

3. Bathypelagic medusæ. – The following two species should be excluded from the discussion, because their distribution is imperfectly known: The Anthomedusa *Paragotoea bathybia* was taken in deep water in the southern part of Davis Strait by the "Godthaab" expedition (KRAMP 1942)[1]). The Scyphomedusa *Poralia rufescens* is known from deep water in a few scattered localities in the Pacific, Indian, and Atlantic Oceans, and one specimen was taken in 1910 by the "Michael Sars" about midway between Newfoundland and the British Channel.

The meroplanktonic medusæ *Annatiara affinis*, *Pandea rubra*, *Bythotiara murrayi*, *Tiaranna rotunda*, and *Octocanna funeraria* only seem to occur in the neighbourhood of the continental shelves, and probably their fixed hydroid stages live on the continental slopes, whence the free medusæ are not likely to be carried much farther out into the deep-sea basins, the currents being slow in the deep and intermediate strata, where these species occur.

Most of the other deep-sea medusæ of the northern Atlantic are known or supposed to be holoplanktonic (see p. 53), and the majority of them are generally distributed in the North-Atlantic deep-sea basin until the submarine ridges Scotland–Iceland–Greenland–Baffin Land, a few of them penetrating more or less north of the ridges.

[1]) I have found a very similar medusa, apparently the same species, in a sample of medusæ taken by the "Dana" expedition 1930 near Cape of Good Hope in South Africa!

Two species have only been taken in the eastern portion of the area: the Scyphomedusa *Nausithoë globifera* occurs in the deep-sea basin east of the Mid-Atlantic ridge from about 45° N. until the channels west of Scotland, and in the present paper it is also recorded from deep water south of Iceland. The Trachymedusa *Rhopalonema funerarium* is widely distributed in the Tropics, and in the eastern Atlantic it occurs as far north as off the south-west coast of Ireland, where it has been taken in deep water; in the western part of the North Atlantic it was met with in a locality outside the Gulf of Maine, where it occurred in the Gulf-Stream water less than 300 m from the surface, but it has never been observed in the North-West Atlantic deep-sea.

Among the bathypelagic medusæ, which are distributed throughout the deep-sea basins of the North Atlantic, the following species have a world-wide distribution in the great oceans: the Trachymedusæ *Halicreas minimum*, *Botrynema brucei*, *Colobonema sericeum*, and *Pantachogon haeckeli;* the Narcomedusa *Æginura grimaldii* (which however is rare in the South Atlantic), and the Scyphomedusæ *Periphylla periphylla* and *Atolla wyvillei*. All these are found in the entire deep-sea basins in the northern Atlantic, with the exception of *Colobonema sericeum*, which has not been observed in the Labrador Sea and Davis Strait.

Three of these species may also be met with north of the submarine ridges. *Periphylla periphylla* rather frequently ascends towards the upper strata in colder seas and may therefore be carried across the ridges by the currents; but it avoids the very cold bodies of water and has never been taken in the deep, cold strata of the Baffin Bay and the Norwegian Sea; its distribution north of the ridges follows the Gulf Stream and its off-shoots to the west coast of Norway and the southern and western coasts of Iceland, and it is likewise carried northwards along the west coast of Greenland, but not very far, mainly following the comparatively warm water moving northwards outside the edges of the off-shore banks. *Pantachogon haeckeli* is more strictly confined to the deep and intermediate bodies of true Atlantic water, but occasionally it ascends into higher levels; the record of a specimen from Spitzbergen (Maas 1904) is doubtful. West of Greenland some few specimens were taken by the "Godthaab" in deep water, about 800 and 1750 m, in Baffin Bay, about 70° N., at temperatures between 0°3 and $+0°4$, probably carried directly across the ridge (which in its central part rises to about 700 m below the surface), afterwards sinking into the deep strata of Baffin Bay (Kramp 1942 pp. 78 and 140). – *Atolla wyvillei* is a well marked bathypelagic species, at any rate in the northern seas. It has been found in five localities in the Norwegian Sea, preferably near the bottom at depths between 1600 and 2400 m and at temperatures about $+1°$, and some young specimens, probably belonging to the same species, are recorded from deep water between north-east Greenland and Spitzbergen. The occurrence of this species in the deep-water of the Norwegian Sea can hardly be due to transportation by the currents across the Wyville Thomson Ridge; it must be indigenous in the Norwegian Sea. It has never been observed in Baffin Bay.

Whereas all these species have an almost cosmopolitan distribution in the deep parts of the great oceans, there are three bathypelagic species which are confined to the northern parts of the Atlantic Ocean (partly found also in the Pacific). All of them are generally distributed in the deep-sea on both sides of the Mid-Atlantic ridge, their southern limit of distribution being at 30° or 10° N. Towards the north they all reach the continental slope south of Iceland and the submarine ridges between Scotland, Iceland, and East Greenland. *Haliscera bigelowi* has been found east of the Newfoundland Bank, but not in the Labrador Sea and Davis Strait; *Chromatonema rubrum* and *Crossota rufobrunnea* also occur in the deep part of Davis Strait south of the ridge between West Greenland and Baffin Land. The occurrence of these North-Atlantic species in the northern basins of the Atlantic is thus quite similar to that of the cosmopolitan species mentioned above. They are equally adapted to the conditions in these northern waters, and the reasons why the three last-mentioned species do not penetrate into the southern seas should be considered in connection with the question of the evolution of species within the various genera. Some genera, as e. g. *Atolla*, *Periphylla*, *Æginura*, *Colobonema*, and *Halicreas*, comprise only one species each, all of which are cosmopolitan; others, like *Pantachogon* and *Botrynema*, contain one cosmopolitan species and one or more species of restricted distribution; *Haliscera*, *Crossota*, and *Chromatonema* are split up in a number of species, each with its particular area of distribution; *Haliscera bigelowi* and *Crossota rufobrunnea*, which are common in the northern Atlantic, also occur in the Pacific.

B. The arctic basins.

Very few medusæ are indigenous in the deep basins of Baffin Bay and the Norwegian Sea. Some of the neritic species may occasionally drift out above the deep-sea areas; they will not be considered here. The Narcomedusa *Æginopsis laurentii* is a well-marked arctic species which prefers the coldest water; in Baffin Bay it is mainly found in the upper strata in the neighbourhood of the coasts, but in the Norwegian Sea it avoids the comparatively warm surface water and sinks into the cold, deep strata. *Aglantha digitale*, which occurs over the entire areas, is rare in the deep strata in Baffin Bay, whereas in the Norwegian Sea it may be taken in great abundance at least as far down as 1600 m below the surface (see p. 29). The Leptomedusa *Ptychogena hyperborea* has only been taken in Smith Sound; it is probably a bathypelagic species. *Sminthea arctica* is a doubtful species, taken in deep water west of Spitzbergen (Hartlaub 1909). *Pantachogon haeckeli* is a stray Atlantic visitor in Baffin Bay (see above). The cosmopolitan deep-sea medusa *Atolla wyvillei* is indigenous in the deep, cold strata of the Norwegian Sea, but has not been found in Baffin Bay (see above).

There are, however, two decidedly arctic deep-sea medusæ; one of them, *Botrynema ellinorae*, is very abundant in Baffin Bay about 1000–1800 m below the surface at temperatures between 0° and $+0°4$ and has also been taken in deep water between Spitzbergen and Greenland and north of Norway. Among the medusæ this is the only species which confirms the supposed resemblance between the deep-sea faunas of Baffin Bay and the Norwegian Sea. In the deep, cold strata of the Norwegian Sea, 1000–2000 m below the surface, we also find *Crossota norvegica*, which has not been observed anywhere else.

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PLATES

Plate 1.

Figs. 1–4 *Ptychogastria polaris* Allman.

Figs. 1–3. Tentacles with adhesive disk. – Figs. 1–2 × 45, fig. 3 × 120.

Fig. 4. Optical section of filiform tentacle. – × 70.

Figs. 5–8. *Halicera bigelowi* n. sp.

Fig. 5. Male individual. × 6.

Fig. 6. Stomach, showing the circular mouth opening; one of the radial canals with female gonad.

Fig. 7. Part of umbrella margin. *c. v.* circular vessel, *n. r.* nerve ring, *r. c.* radial canal, *v.* velum. × 19.

Fig. 8. Distal end of a juvenile tentacle, – × 300.

Fig. 9. *Botrynema brucei* Browne.

Fig. 9. Young tentacle, *a* near base, *b* middle portion, *c* distal part. – × 135.

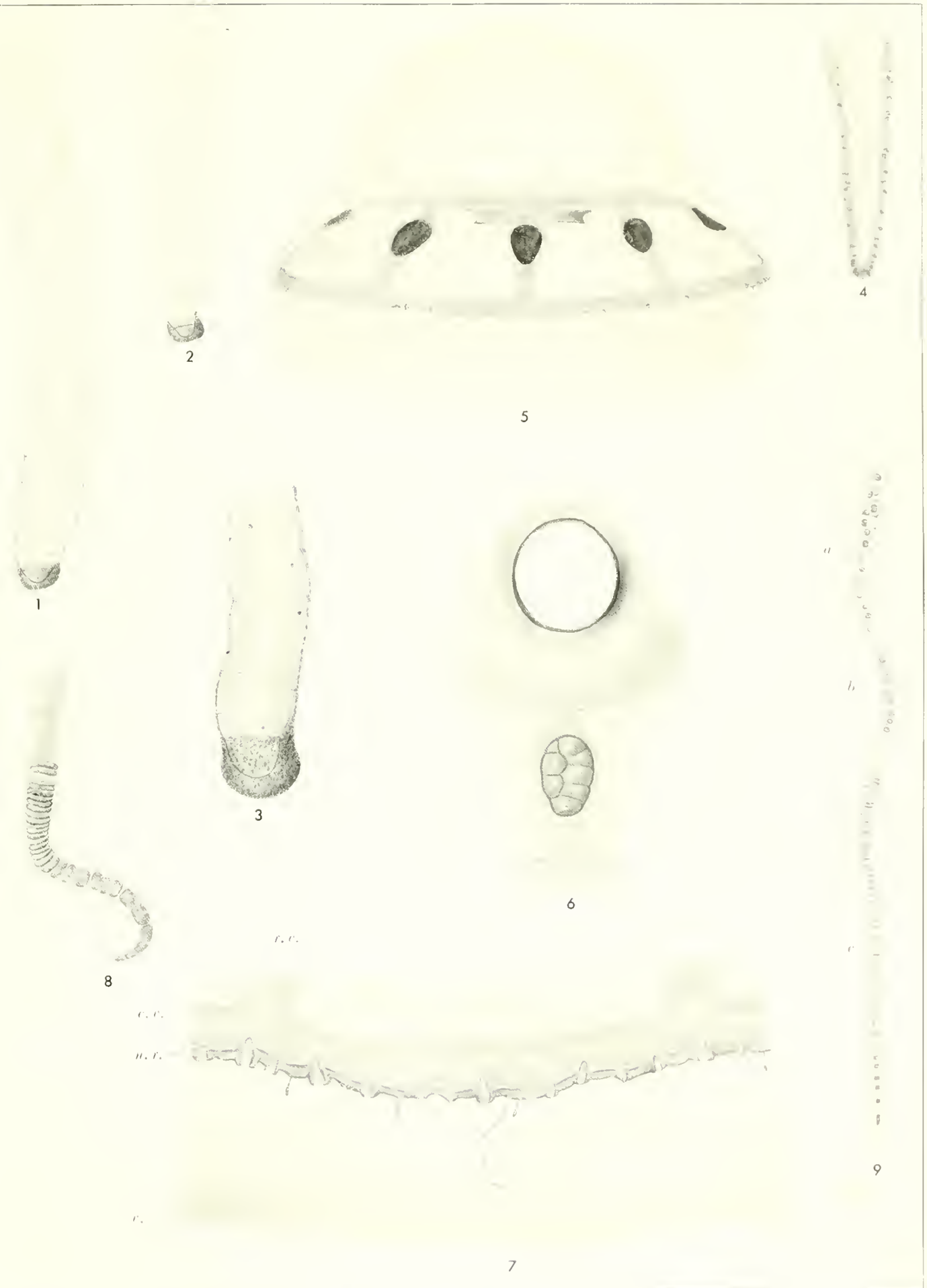
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Plate II.

Figs. 1–2. Statocysts of *Haliscera bigelowi* n. sp. – · 180.

Fig. 3. Statocyst of *Botrynema brucei* Browne. – · 180.

Figs. 4–5. *Rhopalonema funerarium* Vanhöffen.

Fig. 4. Manubrium. Specimen from "Thor" stat. 181(06).

Fig. 5. Interradial cirrus. – ·. 225.

Fig. 6. *Homoeonema platygonon* Browne, stomach and male gonads, seen from the exumbrella. – · 70.

Figs. 7–8. Statocysts of *Pantachogon haeckeli* Maas. – ·. 675.

Figs. 9–10. *Crossota rufobrunnea* Kramp.

Fig. 9. Transverse section of radial canal. *ex.* exumbrella, *end. l.* endoderm lamella, *m.* circular muscle fibres, *sub.* subumbrella. – · 70.

Fig. 10. Part of radial canal with its surroundings. On the right hand side part of the ectodermal muscular epithelium is removed, disclosing the cells of the endoderm lamella; through an opening in the subumbrella wall of the radial canal the pigmented cells of its exumbrella wall are seen. For further explanation, see the text p. 24. – · 135.

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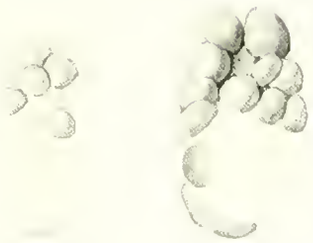

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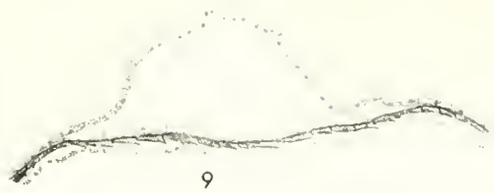

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m.

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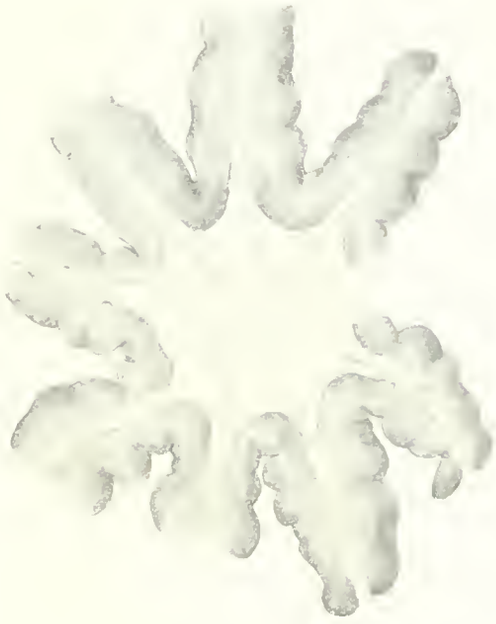

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Plate III.

Crossota rufobrunnea Kramp.

Fig. 1. Manubrium, external view.

Fig. 2. Manubrium, internal view, showing the two whorls of invaginated pouches and one of the longitudinal grooves; *g.* gonad.

Fig. 3. Transverse section of one corner of the mouth tube, showing the string of large, vacuolated endoderm cells.

Fig. 4. Transverse section of proximal part of the stomach, through the upper whorl of invaginated pouches (cfr. textfig. 9, p. 25).

Figs. 5–6. Longitudinal sections of stomach; for further explanation, see p. 24.

Fig. 7. Longitudinal section of radial canal; *ex.* exumbrella, *m.* circular muscle fibres, *p.* pigmented endodermal epithelium, *n. p.* non-pigmented endodermal epithelium of radial canal, *sub.* subumbrella.

Fig. 8. Meridional section of umbrella; *end. l.* endoderm lamella, *m.* layer of circular muscle fibres, *sub.* subumbrella.

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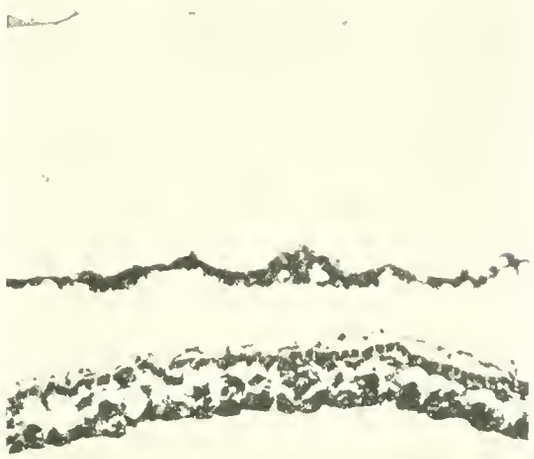

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m.

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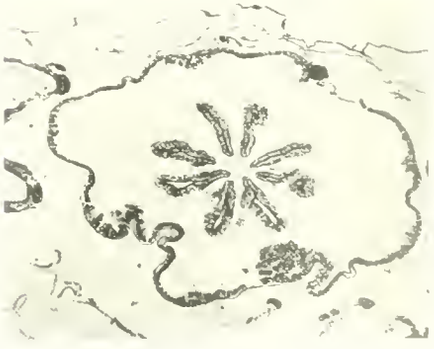

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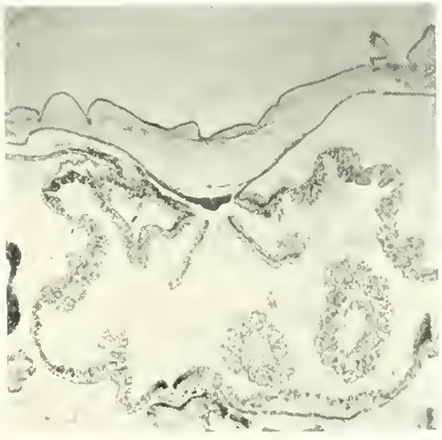

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Plate IV.

Figs. 1–4. *Crossota rufobrunnea* Kramp.

Fig. 1. Umbrella margin, abaxial aspect.

Fig. 2. Umbrella margin, adaxial aspect (velum removed); *c. r.* circular vessel, *n. r.* nerve ring, *sub.* subumbrella.

Figs. 3–4. Statocysts, longitudinal sections. – × 500.

Figs. 5–6. *Crossota norvegica* Vanhöffen.

Fig. 5. Specimen from "Ingolf" stat. 120. – × 4.

Fig. 6. Manubrium of a specimen with 11 radial canals, "Ingolf" stat. 120.

Fig. 7. *Pegantha clara* R. P. Bigelow.

Fig. 7. Larvæ in the gastric cavity of *Periphylla periphylla*, "Godthaab" stat. 1. – × 4.

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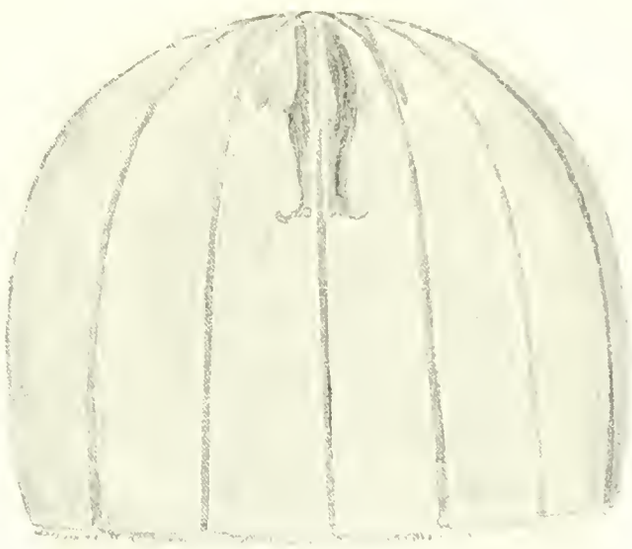

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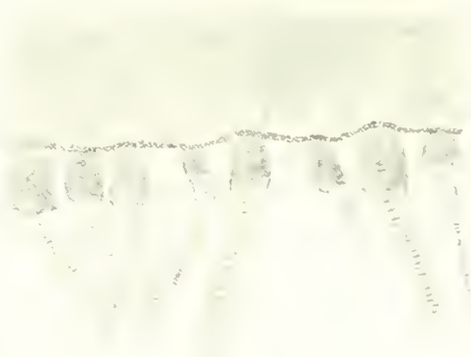
sub.

c. r.

u. r.



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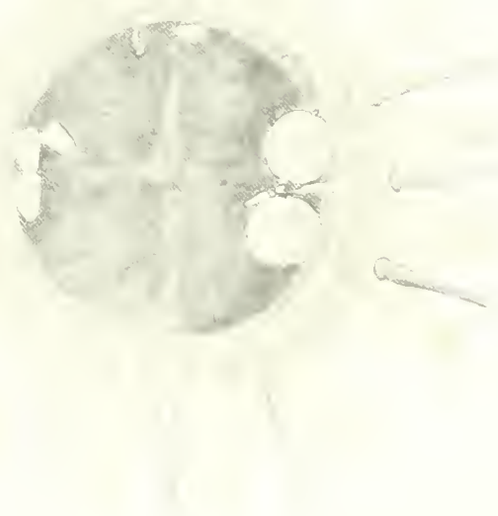

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Plate V.

Larvae of *Peqantha clara* R. P. Bigelow.

Figs. 1–2. Primary polyps (I) with actinula buds in successive stages of development (II and III).

Fig. 3. Chain of actinula buds in successive stages (I–IV).

Fig. 4. Young actinula with two well-developed and two small tentacles; without statocysts, and without aboral collar.

Figs. 5–6. Two actinulae, each with four tentacles almost equally developed, and with 20 statocysts on the rim of the aboral collar.

Fig. 7. Part of aboral surface of actinula, showing otoporpae and peronia (tentacles cut off at their base).

Figs. 8–9. Aboral view of medusae, showing the four tentacles and the long otoporpae.

Fig. 10. Oral view of medusa, showing four peronia, twenty statocysts, and the first trace of mouth opening.

All figures × 40.

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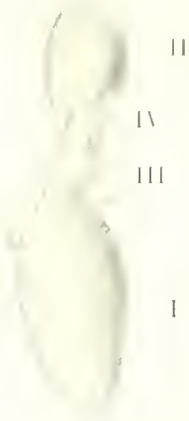

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Plate VI.

Figs. 1–2. *Ptychogastria polaris* Allman. Coloured sketches made on board the "Ingolf" stat. 126, by C. F. Wandel.
Fig. 3. *Halicreas minimum* Fewkes.
Fig. 4. *Boreomema brucei* Browne.
Fig. 5. *Crossota rufobrunnea* Kramp.
Fig. 6. *Aglantha digitale* (O. F. Müller).
Fig. 7. *Chromatonema rubrum* Fewkes.

Figs. 3–7 are reproductions of coloured sketches drawn from life by the author on board the "Godthaab" in Davis Strait 1928.

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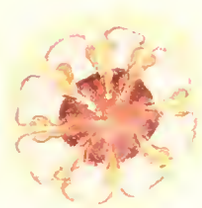

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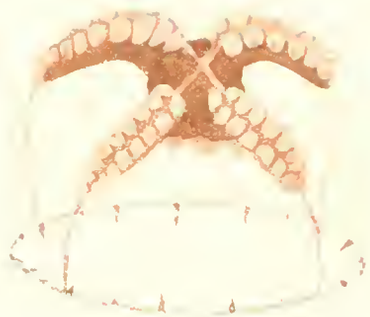

7

THE INGOLF-EXPEDITION

1895—1896

THE LOCALITIES, DEPTHS, AND BOTTOMTEMPERATURES OF THE STATIONS

Station Nr.	Date	Lat. N.	Long W.	Depth in m	Bottom-temp.	Station Nr.	Date	Lat. N.	Long W.	Depth in m	Bottom-temp.	Station Nr.	Date	Lat. N.	Long W.	Depth in m	Bottom-temp.
	1895												1896				
1	11 - V	62° 30′	8° 21′	249	7°2	24	25 - VI	63° 06′	56° 00′	2258	2°4	45	11 - V	61 32′	9° 43′	1211	4 17
2	12 -	63° 04′	9° 22′	493	5°3	25	26 -	63 30′	51° 25′	1096	3 3	16	- -	61 32′	11 36′	1356	2 40
3	- -	63° 35′	10° 24′	542	0°5			63 54′	53 03′	256		47	12 -	61 32′	13° 40′	1789	3 23
4	13 -	64° 07′	11° 12′	446	2°5	26	- -	63° 57′	52° 41′	64	0°6	48	- -	61° 32′	15° 11′	2165	3 17
5	- -	64 40′	12° 09′	292				64 37′	54° 24′	205		19	13 -	62° 07′	15° 07′	2109	2 91
6	16 -	63° 43′	14° 31′	170	7°0	27	1 - VII	61° 54′	55° 10′	740	3°8	50	- -	62 43′	15° 07′	1921	3 13
7	17 -	63° 13′	15° 41′	1130	4°5	28	- -	65° 14′	55° 42′	791	3°5	51	15 -	64 15′	14 22′	128	7 32
8	19 -	63° 56′	24 40′	256	6°0	29	5 -	65° 34′	54° 31′	128	0°2	52	- -	63 57′	13° 32′	791	7 87
9	20 -	64° 18′	27° 00′	555	5°8	30	10 -	66° 50′	54° 28′	41	1°05	53	16 -	63° 15′	15 07′	1497	3 08
10	- -	64 24′	28° 50′	1484	3°5	31	11 -	66° 35′	55° 54′	166	1°6	54	18 -	63° 08′	15° 40′	1301	3 9
11	21 -	64 34′	31° 12′	2448	1°6	32	11 -	66° 35′	56° 38′	599	3°9	55	19 -	63 33′	15° 02′	595	5 9
12	22 -	64° 38′	32° 37′	1958	0°3	33	12 -	67° 57′	55° 30′	66	0°8	56	- -	61° 00′	15 09′	128	7 57
13	- -	64° 47′	34° 33′	1171	3°0	34	18 -	65° 17′	51 17′	104		57	20 -	63° 37′	13 02′	659	3 4
14	- -	64 45′	35° 05′	331	4°4	35	- -	65° 16′	55 05′	682	3°6	58	- -	64 25′	12 09′	397	0 8
15	4-VI	66 18′	25° 59′	621	0°75	36	28 -	61° 50′	56° 21′	2702	1 5	59	- -	65° 00′	11 16′	584	0 1
16	5 -	65° 43′	26° 58′	471	6 1	37	29 -	60 17′	54 05′	3229	1°4	60	21 -	65° 09′	12 27′	231	0 9
17	16 -	62° 49′	26° 55′	1403	3 4	38	30 -	59° 12′	51 05′	3521	1 3	61	- -	65 03′	13° 06′	101	0 4
18	17 -	61° 44′	30° 29′	2137	3°0	39	9-VIII	62° 00′	22° 38′	1629	2°9	62	31 -	63° 18′	19 12′	136	7 92
19	18 -	60° 29′	34° 14′	2949	2°4	40	- -	62° 00′	21° 36′	1591	3 3	63	1-VI	62° 40′	19 05′	1506	1°0
20	20 -	58° 20′	40° 48′	3192	1°5	41	12 -	61° 39′	17 10′	2315	2°0	64	- -	62 06′	19 00′	1960	3 1
21	21 -	58° 01′	41° 45′	2505	2°4	42	14 -	61° 41′	10 47′	1177	0 4	65	2 -	61 33′	19 00′	2051	3 0
22	22 -	58° 10′	48° 25′	3474	1°4	43	- -	61 42′	10° 11′	1215	0°05	66	- -	61 33′	20° 13′	2124	3 3
23	24 -	60 43′	56° 00′	Only the Plankton-Net used		44	- -	61 42′	9 36′	1026	1 8	67	3 -	61 30	22 30	1836	3 0

Station Nr.	Date	Lat. N.	Long. W.	Depth in m	Bottom-temp.	Station Nr.	Date	Lat. N.	Long W.	Depth in m	Bottom-temp.	Station Nr.	Date	Lat. N	Long W.	Depth in m	Bottom-temp.
68	1 VI	62° 00′	22° 33′	1587	3·4	92	25 - VI	64° 41′	32° 52′	1838	1·4	118	21 - VII	68° 27′	8° 20′	1996	1·0
69	- -	62° 10′	22° 17′	1109	3·9	93	26 -	64° 24′	35° 14′	1444	1·46	119	25 -	67° 53′	10° 19′	1902	1°0
70	1 -	63° 09′	22° 05′	252	7·0	94	- -	64° 56′	36° 19′	384	4·1	120	- -	67° 29′	11° 32′	1666	—1°0
71	- -	63° 46′	22° 03′	87				65° 31′	30° 45′	401		121	- -	66° 59′	13° 11′	996	—0°7
72	8 -	63° 12′	23° 04′	371	6·7	95	27 -	65° 14′	30° 39′	1416	2·1	122	26 -	66° 42′	14° 44′	217	1°8
73	- -	62° 58′	25° 28′	915	5·5	96	28 -	65° 24′	29° 00′	1384	1·2	123	28 -	66° 52′	15° 40′	273	2°0
74	9 -	62° 17′	24° 36′	1309	1·2	97	- -	65° 28′	27° 39′	847	5°5	124	- -	67° 40′	15° 40′	932	—0°6
		61° 57′	25° 35′	1133		98	- -	65° 38′	26° 27′	260	5°9	125	29 -	68° 08′	16° 02′	1373	—0°8
		61° 28′	25° 06′	1561		99	7 - VII	66° 13′	25° 53′	352	6·1	126	- -	67° 19′	15° 52′	552	—0·5
75	11 -	61° 28	26° 25′	1169	4·3	100	9 -	66° 23′	14° 02′	111	0·4	127	2 - VIII	66° 33′	20° 05′	83	5·6
76	12 -	60° 50′	26° 50′	1518	4·1	101	10 -	66° 23′	12° 05′	1011	—0·7	128	- -	66° 50′	20° 02′	365	0·6
77	- -	60° 10′	26° 59′	1791	3·6	102	- -	66° 23′	10° 26′	1412	—0·9	129	3 -	66° 35′	23° 47′	220	6°5
78	13 -	60° 37′	27° 52′	1505	4·5	103	- -	66° 23′	8° 52′	1090	—0·6	130	8 -	63° 00′	20° 40′	636	6°55
79	- -	60° 52′	28° 58′	1230	4·4	104	11 -	66° 23′	7° 25′	1802	—1·1	131	- -	63° 00′	19° 09′	1314	4°7
80	- -	61° 02′	29° 32′	1761	4·0	105	- -	65° 34′	7° 31′	1435	—0·8	132	- -	63° 00′	17° 04′	1407	4·6
81	14 -	61° 41′	27° 00′	913	6°1	106	12 -	65° 34′	8° 54′	842	—0·6	133	9 -	63° 14′	11° 24′	433	2°2
82	- -	61° 55′	27° 28′	1552	4·1			65° 29′	8° 40′	878		134	- -	62° 31′	10° 26′	563	4·1
83	- -	62° 25′	28° 30′	1717	3·5	107	- -	65° 33′	10° 28′	926	—0·3	135	10 -	62° 48′	9° 48′	508	0°4
		62° 36′	26° 01′	889		108	13 -	65° 30′	12° 00′	183	1·1	136	- -	63° 01′	9° 11′	482	4·8
		62° 36′	25° 30′	755		109	18 -	65° 29′	13° 25′	72	1·5	137	- -	63° 14′	8° 31′	559	—0·6
84	17 -	62° 58′	25° 21′	1192	4·8	110	19 -	66° 14′	11° 33′	1471	—0·8	138	- -	63° 26′	7° 56′	887	—0·6
85	- -	63° 21′	25° 21′	320		111	20 -	67° 14′	8° 48′	1619	—0°9	139	- -	63° 36′	7° 30′	1322	—0°6
86	23 -	65° 03′6	23° 17′6	143		112	- -	67° 57′	6° 44′	2386	—1·1	140	11 -	63° 29′	6° 57′	1469	—0°9
87	- -	65° 02′3	23° 56′2	207		113	21 -	69° 31′	7° 06′	2465	—1·0	141	- -	63° 22′	6° 58′	1279	0°6
88	- -	64° 58′	24° 25′	143	6·9	114	22 -	70° 36′	7° 29′	1456	—1·0	142	- -	63° 07′	7° 05′	1105	—0·6
89	24 -	64° 45′	27° 20′	584	8·1	115	23 -	70° 50′	8° 29′	162	0·1	143	- -	62° 58′	7° 09′	731	—0°4
90	- -	64° 45′	29° 06′	1070	4·4	116	- -	70° 05′	8° 26′	699	—0·4	144	- -	62° 49′	7° 12′	520	1·6
91	25 -	64° 11′	31° 00′	2328	3·1	117	24 -	69° 13′	8° 23′	1889	—1·0						