THE CARLSBERG FOUNDATION'S
OCEANOGRAPHICAL EXPEDITION ROUND THE WORLD 1928—30
AND PREVIOUS "DANA"-EXPEDITIONS
UNDER THE LEADERSHIP OF THE LATE PROFESSOR JOHANNES SCHMIDT

DANA-REPORT No. 46.

THE HYDROMEDUSAE OF THE ATLANTIC OCEAN AND ADJACENT WATERS

BY

P. L. KRAMP
ZOOLOGICAL MUSEUM, COPENHAGEN

WITH 2 PLATES AND 335 FIGURES IN THE TEXT

PUBLISHED BY THE CARLSBERG FOUNDATION

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CONTENTS

INTRODUCTION

The present paper is divided into three sections: *A*, Systematic account of the collected species, *B*, a survey of the hydromedusae occurring in the Atlantic Ocean and adjacent waters, *C*, Zoogeography.

Section *A* is an account of the species which have been collected during the expeditions in the Atlantic by the "Dana" and other vessels, from which collecting was carried out by request of the "Dana" Committee, in so far as they have not been published before. For each species are given: the most important references to previous literature, a list of the new localities with numbers of specimens collected, morphological and systematical remarks, and geographical distribution. The following new species are described: *Pennaria pauper*, *Gotoea similis* and *Toxorchis polynema*; moreover a new subspecies, *Sibogita geometrica* Maas, subsp. *occidentalis*.

The collections are deposited in the Zoological Museum, Copenhagen.

Section *B* is a survey of all the hydromedusae which up to now have been found in the Atlantic Ocean and adjacent waters, with diagnoses of the orders, families, genera and species, and with keys for identification. As far as possible the diagnosis of each species is accompanied by a figure derived from the available literature, many of them redrawn from the original figures by Mr. Poul H.Winther. Systematic discussions are occasionally added. Various doubtful species are mentioned in the text but omitted from the keys. Species from the Black Sea are included in this section. Further remarks are given in the introduction to the section.

In section *C* I have tried to describe the composition of the fauna of hydromedusae within each of the zoogeographical regions into which the Atlantic area may be divided, to connect the faunas with the hydrographical conditions, and to compare the faunas of the different regions with each other and with the faunas in other oceans. The Black Sea is omitted from this discussion because its fauna is insufficiently known. The species will be divided into four ecological groups: neritic species, slope species, epipelagic-oceanic species, and bathypelagic-oceanic species, and each of these groups will be treated separately to be followed by some concluding remarks. I have previously, from 1913 onwards, dealt with the faunas of medusae in several different areas, and the results are published in a number of papers to which I refer for details. I am quite aware that every zoogeographical discussion must be provisional, because several geographical areas are insuffiently investigated, and new information may lead to alterations of the views derived from our present knowledge. The extensive collections dealt with in the present paper, however, have provided us with great and important additions to our previous knowledge, so much so that I have dared to deliver a general account of the Atlantic fauna of hydromedusae from zoogeographical points of view, an account which I hope may direct the attention of other marine biologists towards these interesting and important problems.

P. L. Kramp,
Zoological Museum, Copenhagen.

A. SYSTEMATIC ACCOUNT OF THE COLLECTED SPECIES

Anthomedusae.

Fam. **Pennariidae.**

Pennaria pauper n. sp.

Pl. I fig. 1.

Material:

St. 4005. 12.III.1930. 13°31′ N. 18°03′ W. S 150, 1000 m wire. 1 specimen.

Description: Umbrella almost cylindrical, 7.2 mm. high, 3.7 mm. in diameter, with fairly thin lateral walls and a small conical apical projection. Velum narrow. Manubrium very large, almost completely filling the spacious subumbrellar cavity, gonad ring-shaped, covering the entire surface of the manubrium. A narrow apical canal issues from the stomach reaching to the top of the umbrella. Four radial canals and ring canal very narrow. No traces of marginal bulbs, and no ocelli.

This species is considerably larger than any other species of *Pennaria* described up to now, and it is further distinguished by the complete absence of marginal bulbs and by the possession of a well-developed apical canal.

The locality is near Cape Verde.

Fam. **Tubulariidae.**

Euphysora furcata Kramp.

Euphysora furcata Kramp 1948 b p. 19. Pl. figs. 7, 8.
Euphysora furcata Kramp 1955 p. 247.
Euphysora furcata Kramp 1957 p. 5. Pl. 1 fig. 2.

Material:[1]

St. 844 24.IV.20
25°49′ N. 51°55′ W.
P 150 100 m. w. **1**

St. 849 3.VI.20
19°00′ N. 63°53′ W.
300 m. w. **1**

St. 850 4.VI.20
20°39′ N. 61°48′ W. **1**

St. 1294 18.IV.22
17°43′ N. 64°56′ W.
S 200 100 m. w. **1**

St. 3975 31.I.30
35°42′ S. 18°37′ E.
S 150 2500 m. w. **1**

St. 3978 13.II.30
30°15′ S. 13°15′ E.
S 200 600 m. w. **2**

St. 3980 17.II.30
23°26′ S. 3°56′ E.
S 150 3000 m. w. **1**

St. 3998 1.III.30
7°34′ S. 8°48′ W.
S 200 100 m. w. **4**
S 150 2000 m. w. **4**
S 150 4000 m. w. **2**

St. 4000 4.III.30
0°31′ S. 11°02′ W.
E 300 1000 m. w. **1**
S 150 1000 m. w. **1**
S 150 2000 m. w. **24**
S 150 5000 m. w. **1**

St. 4003 9.III.30
8°26′ N. 15′11′ W.
S 150 4000 m. w. **1**

St. 4005 12.III.30
13°31′ N. 18°03′ W.
S 150 2500 m. w. **3**
S 150 3500 m. w. **1**

St. 4007 15.III.30
18°22′ N. 18°14′ W.
S 200 300 m. w. **1**

St. 4009 18.III.30
24°36.5′ N. 17°27′ W.
S 150 3000 m. w. **1**

For discriptions of nets (P 150, S 150, S 200 etc.) cf. Dana-Report no. 1 pag. 18. All gears have been towed horizontally. The depth where the nets have fished has been estimated at about 1/3 of the length of wire out (m.w.) when this did not exceed 1.000 metres and one half of the wire length in deeper hauls.

[1]) In this and following lists of material heavy figures denote numbers of specimens.

Distribution: This remarkable little medusa, which is characterized by the double bifurcation of its main tentacle, was first described from the northern Atlantic, south of the Newfoundland Bank, and recently recorded from two localities off the west coast of Africa, one near Tristan da Cunha, and one in the Indian Ocean off Somaliland. The "Dana" has taken it both in the West-Indian waters, and in several localities off the west coast of Africa from the Cape of Good Hope almost to the Canary Islands.

Some of the specimens were taken in the upper strata, but at most of the stations the medusa was taken in the deep hauls, whereas it was missing in the hauls made in the upper layers at the same stations. Though we must consider the possibility that specimens may have been captured during the hauling in of the open nets, this seems to indicate that the species really lives in the deep as well as in the upper strata and accordingly has a very considerable vertical distribution. See particularly St. 4000, where 24 specimens were taken with 2000 m. wire, one with 5000, two with 1000 m., and none in the surface-water hauls. On the other hand, almost all the localities are fairly near the coastal areas. Presumably, therefore, it has a fixed hydroid stage attached to objects on the bottom in fairly deep water, probably on the continental slopes. This is confirmed by measurements of the specimens; in the deep hauls specimens of all sizes were found, from 2 mm. upwards in height of the umbrella, whereas all the specimens from the upper strata are 4—6 mm. high.

Gotoea similis n. sp.

Pl. II fig. 1.

Material:

St. 3996. 25.II.30. 15°41′ S. 5°50′ W. S 150, 1500 m wire. 1 specimen.

Description: Umbrella 3.5 mm. high, 3 mm. wide, with flat top and almost perpendicular sides, gelatinous substance very thin; exumbrella with scattered nematocysts. Manubrium with a broad base, tapering downwards, somewhat longer than the bell cavity, mouth with an indication of four broad and very short lips, oral margin with nematocysts. Gonad with four large, pendent, interradial sacs hanging downwards from the upper part of the manubrium, of unequal size, the largest reaching as far down as to the level of the bell opening, the others decreasing in size in an anti-clockwise direction. Four radial canals and ring canal narrow. Four large marginal bulbs, one of them bearing a long, stiff tentacle, almost twice as long as the height of the umbrella. The tentacle is hollow and terminates in a large spherical knob of nematocysts. The marginal bulbs are large, somewhat elongated swollen pads, covered with nematocysts, prolonged downwards beyond the margin of the umbrella and upwards on the exumbrella; they are of unequal size, the smallest being the one bearing the tentacle; the bulb opposite the tentacular bulb is more than twice as large, the two others of intermediate size and both alike. No ocelli.

It is only provisionally that I describe this medusa as a new species. It is very similar to *Gotoea typica* which was described by Uchida (1927 p. 195, fig. 31) from two specimens taken at the Seto Marine Biological Station, Japan. It is of about the same size as the one described above, its marginal bulbs are much smaller, the tentacle short and thick, which may be due to contraction. Future studies may show that the two species are identical, but owing to the great geographical distance I think we had better keep them separate until more specimens have been found.

The specimen described above was taken near St. Helena.

Paragotoea bathybia Kramp.

Paragotoea bathybia Kramp 1942 p. 26, fig. 7.

Material:

St. 3975. 31.I.30. 35°42′ S. 18°37′ E. S 150, 2000 m. w. 1 specimen.

The specimen is 2 mm. high, 3 mm. wide, somewhat crumpled, but details of the structure are well preserved and agree in every respect with the original specimen, which was taken in deep water in Davis

Strait west of Greenland. I compared the type specimen with *Gotoea typica* Uchida and stated as follows: "the manubrium is somewhat damaged and irregularly crumpled; it is evidently completely surrounded by the gonad which forms some broad dilatations, but a regular arrangement of four interradial processes cannot be discerned". In the present specimen the manubrium is in a better state, and I can state with certainty that it has no traces of interradial, pendent sacs like those of *Gotoea*. As mentioned above the single tentacle of *Gotoea* is hollow; in *Paragotoea* it is solid, with the endoderm forming a single core of disk-shaped cells. Moreover the structure of the marginal bulbs is entirely different in the two genera. We may state, accordingly, that *Gotoea* and *Paragotoea* are two distinct genera.

In the present specimen the tentacle is slightly longer and somewhat more slender than in the type specimen, and the umbrella has a slightly elevated conical apex, which may be due to the state of contraction. The agreement between the two specimens is, however, so complete that in spite of the great geographical distance I refer them without any doubt to the same species. In both localities it was taken in deep water, and there is every reason to believe that the species is evenly distributed in the deep strata of the Atlantic Ocean, where this tiny medusa may easily have escaped attention.

Distribution: Originally described from deep water in Davis Strait west of the southern part of Greenland; the present specimen was taken near the Cape of Good Hope.

? **Steenstrupia** sp.

Pl. I fig. 2.

Material:

St. 4158. 18.VI.30. 46°28′ N. 8°01′ W. S 150, 2000 m. w. 1 specimen.

Description: Umbrella (without the apical projection) 1.5 mm. high, 0.9 mm. wide, with almost perpendicular sides, gelatinous substance thin. With a very long and slender, pointed apical projection as long as the height of the umbrella, containing a narrow central core of vacuolated endoderm cells from the stomach almost to the top of the gelatinous projection. Manubrium consisting of two parts separated by a slight constriction: a cylindrical stomach, somewhat shorter than the height of the subumbrellar cavity, and a "mouth tube" of about the same length as the stomach, tapering in thickness and terminating in a blunt point without any mouth opening. Some remnants of sexual tissue indicate that the stomach has been completely surrounded by a thick, ring-shaped gonad from its base to the annular constriction between the stomach proper and the "mouth tube".

There are four very narrow radial canals and four very small, quite rudimentary, perradial marginal bulbs without pigmentation. A narrow ring canal seems to be present. No velum. Some small groups of nematocysts are scattered over the exumbrella.

Since the remnants of gonads are mature this specimen cannot be a young stage, but owing to the complete absence of tentacles and mouth opening it must be designated as an abortive medusa. It bears some resemblance to the medusa from North Carolina figured by Mayer (1910 Pl. I fig. 7) under the name of "*Steenstrupia rubra*" which, however, is provided with a mouth opening and one very long tentacle. I provisionally refer the present specimen to *Steenstrupia*, leaving the final determination to future studies of more specimens.

Distribution: Deep water in the Bay of Biscay.

Fam. **Zancleidae.**

Zanclea costata Gegenbaur 1856.

Syn.: *Z. implexa* (Alder 1857), *gemmosa* McCrady 1857, *cladophora* (A. Agassiz 1865), ? *orientalis* Browne 1916.

Material:

St. 4003. 9.III.30. 8°26′ N. 15°11′ W. S 200, 50 m. w. 1 specimen.

A single specimen was taken off Sierra Leone on the west coast of Africa.

Distribution: Coastal waters of north-western Europe; Mediterranean; Red Sea; Nicobars, Malayan Archipelago; western tropical Pacific; Pacific coast of Mexico; West Indies; Florida; New England. Now for the first time taken off the west coast of Africa.

Fam. **Cytaeidae.**

Cytaeis tetrastyla Eschscholtz 1829.

Pl. I figs. 3—6.

Material:

"Ingolf"
St. 257 9.III.11
30°05′ N. 52°58′ W.
S 150 25 m. w. **7**
S 100 47 m. w. **3**

St. 258 11.III.11
32°54′ N. 46°44′ W.
S 150 25 m. w. **22**
S 100 47 m. w. **1**

St. 259 12.III.11
33°55′ N. 43°40′ W.
S 150 25 m. w. **3**

St. 260 13.III.11
34°39′ N. 40°54′ W.
S 150 25 m. w. **2**

St. 261 14.III.11
35°27′ N. 37°18′ W.
S 100 47 m. w. **2**

"St. Croix"
St. 272 22.II.11
30°30′ N. 49°57′ W.
S 150 116 m. w. **1**

St. 290 12.V.11
37°31′ N. 35°24′ W.
S 200 28 m. w. **2**
S 150 56 m. w. **1**

St. 293 18.VI.11
26°35′ N. 53°59′ W.
S 150 66 m. w. **10**

"Agent Petersen"
St. 299 13.VI.11
37°05′ N. 54°34′ W.
S 100 34 m. w. **4**

St. 303 16.VI.11
39°31′ N. 49°39′ W.
S 100 38 m. w. **1**

"St. Thomas"
St. 334 8.VII.11
38°10′ N. 40°50′ W.
S 200 16 m. w. **2**

"Ingolf"
St. 403 3.XI.11
27°10′ N. 21°53′ W.
S 200 surface **6**
S 150 56 m. w. **1**

St. 405 5.XI.11
24°42′ N. 24°50′ W.
S 200 surface **4**

"Dana"
St. 839 26.IV.20
24°31′ N. 46°46′ W.
P 150 surface **6**

St. 845 30.IV.20
24°46′ N. 54°08′ W.
P 150 50 m. w. **1**

St. 847 2.V.20
22°34′ N. 57°07′ W.
P 150 150 m. w. **1**

St. 848 2.VI.20
18°00′ N. 64°41′ W.
P 150 50 m. w. **1**

St. 849 3.VI.20
19°00′ N. 63°53′ W.
P 150 200 m. w. **2**

St. 850 4.VI.20
20°39′ N. 61°48′ W.
P 150 50 m. w. **8**
P 150 100 m. w. **30**

St. 855 9.VI.20
29°15′ N. 59°45′ W.
S 200 24 m. w. **1**

St. 882 13.VII.20
33°00′ N. 54°02′ W.
S 200 50 m. w. **1**
S 200 100 m. w. **1**

St. 894 31.VII.20
37°32′ N. 74°15′ W.
S 200 100 m. w. **1**

St. 1165 9.XI.21
12°11′ N. 35°49′ W.
E 300 1000 m. w. **1**

St. 1216 28.I.22
18°22′ N. 78°38′ W.
E 300 1000 m. w. **1**

St. 1320 27.IV.22
23°18′ N. 56°58′ W.
S 200 100 m. w. **1**

St. 3998 1.III.30
7°34′ S. 8°48′ W.
S 200 50 m. w. **1**

St. 4005 12.III.30
13°31′ N. 18°03′ W.
S 50 surface **2**
S 200 50 m. w. **2**
S 200 600 m. w. **2**
S 150 3500 m. w. **2**

St. 4007 15.III.30
18°22′ N. 18°14′ W.
S 200 50 m. w. **49**
S 200 100 m. w. **2**
S 200 300 m. w. **4**
S 200 600 m. w. **2**
S 150 1000 m. w. **1**
S 150 2000 m. w. **1**
S 150 2500 m. w. **1**
S 150 3000 m. w. **1**

St. 4009 18.III.30
24°36.5′ N. 17°27′ W.
S 50 surface **1**

St. 4195 22.VI.31
41°55′ N. 32°22′ W.
S 200 100 m. w. **1**

St. 257—334 and 839—882 are between the Azores and the West-Indian Islands, St. 894 near Cape Hatteras on the east coast of North America, St. 1216 and 1320 in the West-Indian waters, St. 4195 N.W. of the Azores; the others are off the west coast of Africa.

On a previous occasion (Kramp 1953 p. 263) I have maintained the view that the original specimens of *Cytaeis vulgaris* from the Fiji Islands (Agassiz & Mayer 1899) may provisionally be retained as a distinct species, whereas all other specimens from the Pacific previously referred to that species probably belong to *C. tetrastyla*.

Asexual propagation.

In my recent paper in the Discovery Reports (KRAMP 1957 p. 12) I have described the peculiar asexual propagation in *Bougainvillia platygaster,* in which polypoid hydranths may be produced by budding from the corners of the stomach of the medusa (see also below, p. 11). Asexual production of polypoid structures from the tissues of a medusa was previously known in only two other species, the Leptomedusa *Phialidium mccradyi* (BROOKS) and the Limnomedusa *Proboscidactyla ornata* (MCCRADY). In the "Dana" collection of *Cytaeis tetrastyla* I have found a fourth instance of this peculiar form of asexual propagation which, accordingly, is not so unique among the hydromedusae as formerly supposed.

Some of the specimens of *Cytaeis tetrastyla* from "Dana" Stat. 1216, 4005, 4007 and 4009 have medusa buds developing on the stomach wall in the usual and well-known way. But in some of these specimens a number of small polyps were also observed, likewise situated on the stomach wall between the medusa buds. They were found in specimens from St. 4005 (surface and with 50 m. wire out) and St. 4007 (50 and 600 m. wire). When I made this surprising discovery I examined the whole extensive collection of *Cytaeis* in our museum looking for other specimens with polypoid buds which might have been overlooked, but I only found them in a few specimens from the "Atlantide" expedition, St. 33, 17°11′ N. 24°52′ W., north of the Cape Verde Islands, 7.XII.1945.

When polypoid buds are present in *Cytaeis tetrastyla* they are always situated on the proximal portion of the stomach wall, usually surrounded by numerous medusa buds as seen in Pl. I fig. 3. The polyps are somewhat larger than the medusa buds, cylindrical, with a broad proboscis and with a whorl of 5—7 short tentacles. They resemble the hydranths of *Cytaeis "japonica"* as described and figured by KOMAI (1931 pp. 255—258) who was the first to discover the hydroid stage of *Cytaeis.* It formed creeping colonies on the shells of living gastropods, *Nassarius livescens,* near Misaki in Japan. The hydranths were more elongated and had some more tentacles, up to 10, than seen in the polypoid buds observed by me in the medusae from West Africa. None of these polypoid buds are, however, fully developed, the tentacles are fairly short, and the mouth opening has not yet broken through; Pl. I fig. 4 shows a longitudinal section of a specimen in which the mouth is on the point of penetrating the terminal end of the proboscis. Pl. I fig. 5 shows a transverse section of a hydranth; it will be observed that the uniserial core of endoderm cells in the tentacles is separated from the endoderm of the gastral cavity by a distinct lamella of mesosarc as in other hydroid polyps of Anthomedusae.

The longitudinal section (Pl. I fig. 6) clearly shows that the polyps are developed as direct outgrowths from the stomach wall, their cellular tissues as well as their supporting lamella being confluent with the corresponding tissues of the medusa. Accordingly they are neither parasites nor actinulae, but asexual, polypoid offspring of the medusa produced by budding from the external wall of the stomach.

Thus a medusa of *Cytaeis tetrastyla* is able to produce polypoid as well as medusoid offspring by asexual propagation. Owing to the ability to produce medusa buds, the occurrence of this species is not limited to the coastal waters, but the fate of the polypoid buds during their further development remains a riddle.

Distribution: Widely distributed in the warm parts of all the oceans, including the Mediterranean. The corresponding hydroid, which has been described from Japan (KOMAI 1931 p. 255, as *C. japonica*) probably lives in shallow water, but the ability of the medusa to propagate asexually by budding enables it to obtain an oceanic distribution. It belongs to the surface water, and specimens taken in the deep hauls may have been captured during the hauling in of the nets (see above, St. 4007).

Fam. **Clavidae.**

Oceania armata KÖLLIKER.

Oceania armata KÖLLIKER 1853 p. 323.
Turritopsis armata HAECKEL 1879 p. 65.
Callitiara polyophthalma HAECKEL 1879 p. 67, Pl. 3 fig. 1—5.
Oceania armata MAYER 1910 p. 147, fig. 81.

Material:

St. 1192	15.XII.21	St. 4009	18.III.30	St. 4017	27.III.30
17°43.4′ N.	64°54.3′ W.	24°36.5′ N.	17°27′ W.	29°11′ N.	14°14′ W.
S 200	300 m. w. **2**	S 150	2500 m. w. **1**	S 200	50 m. w. **1**
S 200	600 m. w. **1**			S 200	100 m. w. **1**
				S 200	300 m. w. **5**

Distribution: Common in the Mediterranean and adjacent parts of the Atlantic: Portugal, the Canary Islands, and S.W. of the Azores. Also recorded from southern Japan (Uchida 1927 p. 219). The present specimens were taken south and north of the Canary Islands. The species belongs to the upper strata, and the specimen taken in a deep haul at St. 4009 has probably been captured during the hauling in of the net.

Turritopsis nutricula McCrady.

Oceania (*Turritopsis*) *nutricula* McCrady 1856 pp. 1—36, Pl. 4 fig. 1—10.
Oceania polycirrha Keferstein 1862 p. 26, Pl. 2 fig. 11—13.
Turritopsis nutricula var. *pacifica* Maas 1909 p. 14, Pl. 1 fig. 6—8, Pl. 2 fig. 9.
Turritopsis nutricula Mayer 1910 p. 143, Pl. 14 fig. 10—13, Pl. 15 fig. 10—13; text-fig. 77—79.
Turritopsis pacifica Mayer 1910 p. 722.
Turritopsis nutricula Russell 1953 p. 115. Pl. 5 fig. 1—5, Pl. 29 fig. 1—3; text-fig. 54 A—C, 55, 56.
Turritopsis nutricula Kramp 1955 p. 248.

Material:

St. 4003	9.III.30	St. 4005	12.III.30	St. 1360	4.VI.22
8°26′ N.	15°11′ W.	13°31′ N.	18°03′ W.	26°56′ N.	53°09′ W.
S 200	50 m. w. **2**	S 200	600 m. w. **1**	E 300	1000 m. w.
S 200	300 m. w. **1**	S 150	2500 m. w. **1**	1 specimen, determination uncertain.	
S 150	1000 m. w. **1**				
S 150	2000 m. w. **1**				

We may now state with certainty that all species of *Turritopsis* described belong to one species, except *T. lata* v. Lendenfeld which is a distinct species; I have seen the type specimen from Australia.

Distribution: East coast of North America from northern parts of New England to the West Indies; southern parts of the North Sea and the British coasts; tropical west coast of Africa; Mediterranean; Red Sea; Indian Ocean; western Pacific from Japan to New Zealand. It belongs to the upper strata.

Fam. **Bougainvilliidae.**

Bougainvillia platygaster (Haeckel).

Hippocrene platygaster Haeckel 1879 p. 91.
Bougainvillia platygaster Mayer 1910 p. 165.
Bougainvillia niobe Vanhöffen 1912 *a* p. 359.
Bougainvillia platygaster Thiel 1938 p. 299.
Bougainvillia niobe Kramp 1948 *a* p. 4.
Bougainvillia platygaster Kramp 1957 p. 9, Pl. 3 fig. 1—6.

Material:

"Ingolf"		St. 254	6.III.11	St. 255	7.III.11	St. 256	8.III.11
St. 252	4.III.11	26°45′ N.	59°35′ W.	27°42′ N.	58°00′ W.	28°55′ N.	55°25′ W.
23°53′ N.	61°36′ W.	S 150	25 m. w. **6**	S 100	47 m. w. **4**	S 150	25 m. w. **27**
S 150	25 m. w. **14**	S 100	47 m. w. **5**			S 100	47 m. w. **7**
S 100	47 m. w. **3**						

St. 257 9.III.11
30°05′ N. 52°58′ W.
S 150 25 m. w. **1**

St. 260 13.III.11
34°39′ N. 40°54′ W.
S 100 47 m. w. **1**

"St. Croix"
St. 272 22.II.11
30°30′ N. 49°57′ W.
S 150 116 m. w. **1**

St. 292 17.V.11
25°00′ N. 55°59′ W.
S 200 47 m. w. **17**
S 150 66 m. w. **1**

"St. Jan"
St. 329 20.VII.11
25°32′ N. 52°08′ W.
S 200 35 m. w. **1**

"St. Thomas"
St. 334 8.VII.11
38°10′ N. 40°50′ W.
S 200 16 m. w. **1**

St. 336 9.VIII.11
22°40′ N. 60°00′ W.
S 200 16 m. w. **1**

"St. Croix"
St. 346 11.IX.11
38°22′ N. 35°50′ W.
S 150 48 m. w. **1**

"St. Thomas"
St. 390 5.XI.11
26°09′ N. 55°15′ W.
S 200 28 m. w. **2**

"Ingolf"
St. 405 5.XI.11
24°42′ N. 24°50′ W.
S 200 surface **1**

"Dana"
St. 839 6.IV.20
24°31′ N. 46°46′ W.
P 150 surface **4**
P 150 50 m. w. **4**
P 150 100 m. w. **2**

St. 840 27.IV.20
25°16′ N. 48°05′ W.
P 150 surface **4**
P 150 100 m. w. **8**

St. 841 27.IV.20
25°42′ N. 48°59′ W.
P 150 50 m. w. **1**
P 150 100 m. w. **11**

St. 842 28.IV.20
25°48′ N. 49°22′ W.
P 150 100 m. w. **4**
P 150 200 m. w. **2**
P 150 300 m. w. **3**

St. 844 29.IV.20
25°49′ N. 51°55′ W.
P 150 150 m. w. **1**

St. 845 30.IV.20
24°46′ N. 54°08′ W.
P 100 surface **1**
P 150 50 m. w. **7**
P 150 100 m. w. **4**
P 150 150 m. w. **7**
P 150 200 m. w. **1**
P 150 300 m. w. **1**

St. 846 1.V.20
23°40′ N. 55°22′ W.
P 150 150 m. w. **3**

St. 847 2.V.20
22°34′ N. 57°07′ W.
P 150 100 m. w. **1**
P 150 150 m. w. **2**

St. 848 2.VI.20
18°00′ N. 64°41′ W.
S 200 300 m. w. **1**

St. 849 3.VI.20
19°00′ N. 63°53′ W.
P 150 surface **1**
P 150 100 m. w. **2**

St. 850 4.VI.20
20°39′ N. 61°48′ W.
P 150 50 m. w. **35**
P 150 100 m. w. **3**
S 200 150 m. w. **4**
S 200 300 m. w. **1**

St. 851 5.VI.20
22°23′ N. 60°46′ W.
P 150 50 m. w. **11**

St. 853 7.VI.20
25°52′ N. 59°25′ W.
P 150 100 m. w. **2**

St. 854 8.VI.20
27°53′ N. 59°23′ W.
S 200 150 m. w. **7**

St. 855 9.VI.20
29°15′ N. 59°45′ W.
S 200 24 m. w. **10**
P 150 300 m. w. **1**
S 200 300 m. w. **1**

St. 866 23.VI.20
28°32′ N. 56°38′ W.
S 200 50 m. w. **12**
S 200 100 m. w. **1**
P 150 150 m. w. **1**

St. 867 24.VI.20
28°15′ N. 56°29′ W.
P 150 100 m. w. **1**

St. 868 24.VI.20
27°10′ N. 55°52′ W.
S 150 125 m. w. **2**

St. 869 25.VI.20
27°54′ N. 55°50′ W.
P 150 200 m. w. **2**

St. 870 26.VI.20
27°29′ N. 59°20′ W.
S 150 50 m. w. **4**
S 150 100 m. w. **7**
S 200 100 m. w. **1**

St. 875 1.VII.20
28°58′ N. 67°09′ W.
S 150 100 m. w. **6**
S 150 150 m. w. **2**

St. 883 14.VII.20
30°53′ N. 54°07′ W.
S 200 50 m. w. **2**

St. 884 15.VII.20
28°49′ N. 54°10′ W.
S 200 100 m. w. **9**

St. 885 16.VII.20
26°46′ N. 54°14′ W.
S 200 3 m. w. **1**
S 200 50 m. w. **18**

St. 886 17.VII.20
24°40′ N. 54°19′ W.
P 150 25 m. w. **4**
S 150 50 m. w. **20**
P 150 150 m. w. **2**

St. 891 24.VII.20
29°28′ N. 69°25′ W.
S 150 50 m. w. **5**
S 200 100 m. w. **6**

St. 892 25.VII.20
30°49′ N. 73°30′ W.
S 150 100 m. w. **3**

St. 1223 1.II.22
22°06′ N. 84°58′ W.
E 300 1000 m. w. **2**

St. 1238 11.II.22
26°13′ N. 78°48′ W.
E 300 800 m. w. **3**

St. 1240 13.II.22
25°35′ N. 74°45′ W.
E 300 1000 m. w. **1**

St. 1242 14.II.22
24°05′ N. 74°36′ W.
E 300 1000 m. w. **1**
E 300 4000 m. w. **1**

St. 1243 16.II.22
21°04′ N. 73°48′ W.
E 300 1000 m. w. **2**

St. 1245 17.II.22
19°35′ N. 73°27′ W.
E 300 1000 m. w. **1**

St. 1250 26.II.22
17°54′ N. 67°30′ W.
E 300 1000 m. w. **1**

St. 1261 9.III.22
19°04′ N. 65°43′ W.
E 300 4500 m. w. **1**

St. 1266 13.III.22
17°45′ N. 64°55,5′ W.
E 300 1000 m. w. **1**

St. 1273 25.III.22
17°43′ N. 64°56′ W.
E 300 1000 m. w. **1**

St. 1294 18.IV.22
17°43′ N. 64°56′ W.
S 200 300 m. w. **1**
S 200 600 m. w. **2**

St. 1334 7.V.22
27°28′ N. 59°29′ W.
E 300 1000 m. w. **1**

The affinities of this medusa have recently been discussed by me in a paper on the Hydromedusae of the "Discovery" expeditions (KRAMP 1957) in which I compared *B. platygaster* with *B. carolinensis* (MCCRADY), *B. niobe* MAYER and *B. fulva* AGASSIZ & MAYER. I came to the conclusion that they are four distinct species, and this is confirmed by the examination of the present collections.

In the same paper I described the very peculiar asexual propagation of *B. platygaster*. In several specimens I found that medusa buds are developed on the pedicels of typical hydranths produced by asexual budding from the corners of the stomach of the parent medusa; these hydranths are provided with a mouth opening surrounded by tentacles, and they are even able to catch food like the hydranths of an ordinary, fixed hydroid colony. Numerous budding specimens are observed in the present collection; moreover larvae of Narcomedusae are found in specimens from St. 256, 845, 846, 849, 850, 885, 886, 1223, and 1294; they will be described further below.

Most of the specimens in the present collection are 7—9 mm. in diameter, but some few smaller individuals, 4—5 mm. wide, were found at St. 1243 (1000 m. wire), St. 1261 (4500 m. wire) and St. 1294 (300 and 600 m. wire). The collections were made between 1st February and 7th May, but the medusa may also be taken at other seasons, e. g. in October (by the "Discovery").

All previous records of *B. platygaster* are from the upper strata; it is peculiar, therefore, that some of the specimens in the "Dana" collection were taken in hauls with 1000 m. wire out, or more. They may either have been captured at higher levels during the hauling in of the nets, or they may really occur in deeper water layers.

Distribution: (see the map, fig. 327): Previously recorded from the Canary Islands and at considerable distances west and north-west of the Cape Verde Islands; off the east coast of Brazil; off the east coast of Africa between Port Elisabeth and Zanzibar. Now taken in several localities in West-Indian waters.

Bougainvillia niobe MAYER.

Bougainvillia niobe MAYER 1894 p. 236, Pl. 1 fig. 2.
Bougainvillia niobe MAYER 1910 p. 166, Pl. 18 fig. 1—3; text-fig. 90.
Bougainvillia niobe BIGELOW 1918 p. 368.
Bougainvillia niobe BIGELOW 1938 p. 104.
Bougainvillia niobe MOORE 1949 p. 6.

Material:

St. 1188 7.XII.21
17°43.7′ N. 64°57′ W.
S 200 300 m. w. **3**

St. 1190 12.XII.21
17°58.5′ N. 64°45′ W.
S 200 50 m. w. **1**
S 200 100 m. w. **3**

St. 1192 15.XII.21
17°43.4′ N. 64°54.3′ W.
S 200 50 m. w. **9**
S 200 100 m. w. **5**
S 200 300 m. w. **140**
S 200 600 m. w. **3**

St. 1241 13.II.22
25°18′ N. 74°00′ W.
S 150 50 m. w. **1**

St. 1243 16.II.22
21°04′ N. 73°48′ W.
S 200 50 m. w. **4**

St. 1272 23.II.22
17°43′ N. 64°56′ W.
S 200 100 m. w. **2**

St. 1294 18.IV.22
17°43′ N. 64°56′ W.
S 200 100 m. w. **150**

St. 1321 28.IV.22
24°13′ N. 54°36′ W.
S 200 500 m. w. **1**

St. 1352 21.V.22
35°42′ N. 73°43′ W.
S 200 200 m. w. **1**

St. 1360 4.VI.22
26°56′ N. 53°09′ W.
S 200 100 m. w. **2**
E 300 1000 m. w. **1**

St. 1361 4.VI.22
27°07′ N. 51°10′ W.
E 300 1000 m. w. **1**

In this species medusa buds are developed directly on the lateral sides of the stomach of the medusa, not in clusters as in *B. platygaster*. Sexually mature specimens of *B. niobe* have eight adradial gonads, whereas in *B. platygaster* the gonads are interradial. Moreover the oral tentacles of *B. niobe* have a fairly long unbranched basal trunk before the first bifurcation, in contradistinction to *B. platygaster* where they bifurcate immediately at their points of issue from the mouth tube. The extensive material of both species in the present collection has enabled me to state with certainty that the two species are distinct. In *B. carolinensis*, which is a small medusa, well described by MAYER (1910 p. 165, Pl. 16 fig. 7—9, Pl. 17 fig. 7) the gonads are interradial as in *B. platygaster*, but the manubrium is long and narrow, and the oral tentacles have a long, undivided trunk as in *B. niobe*. *B. carolinensis* partly occurs in the same area as *B. niobe*. *B. fulva*, which occurs in the Indian and Pacific Oceans, is very similar to *B. platygaster* in size and general appearance, but its gonads are distinctly adradial, widely separated in the interradii.

The specimens of *B. niobe* collected by the "Dana" are 2—7 mm. in diameter. Medusa buds are present in specimens from St. 1188 (300 m. w.), 1192 (50, 100 and 300 m. w.), 1243 (50 m. w.), 1272 (100 m. w.), 1352 (200 m. w.), and 1361 (1000 m. w., probably captured during the hauling in of the net). Two of the specimens from St. 1192 (600 m. w.) have gonads with large, ripe eggs. Some of the other specimens.may also have had mature gonads, but owing to the state of preservation this cannot be stated with certainty.

Distribution (see the map, fig. 326). Previously recorded from Chesapeake Bay, Bermuda, Bahamas, and Florida. The "Dana" found this species among the Bahamas, near the Virgin Islands (in great abundance), and far at sea S.E. of Bermuda (St. 1360 and 1361); St. 1352 is outside Chesapeake Bay.

Fam. **Pandeidae.**

Paratiara digitalis KRAMP & DAMAS.

Paratiara digitalis KRAMP & DAMAS 1925 p. 273, fig. 18—20.
Paratiara digitalis KRAMP 1926 p. 66.

Material:

St. 851. 5.VI.20. 22°23′ N. 60°46′ W. P 150, 50 m. w. 1 specimen.
St. 891. 24.VII.20. 29°28′ N. 69°26′ W. S 150, 50 m. w. 1 specimen.

These localities, north-east of the Bahamas and the West-Indian Islands, are far away from the waters where this species has previously been observed. A direct comparison with specimens from Norway and Iceland show, however, that the present specimens agree with the others in every regard, except that the manubrium is not so distinctly twisted. The specimen from St. 851 is 4.5 mm. high and 4 mm. wide, with large, mature eggs; the specimen from St. 891 is 6 mm. high and 4 mm. in diameter.

Distribution: Northern Norway; east of the Shetland Islands; south of Iceland. Now found to occur in warm water in the western Atlantic.

Cnidotiara gotoi UCHIDA.

Pl. I fig. 7—8.

Cnidotiara gotoi UCHIDA 1927 p. 204, fig. 33.

Material:

St. 303. 16.VI.11. 39°31′ N. 49°39′ W. S 100, 38 m. w. 4 specimens.

It was a great surprise to find this Japanese species in the Atlantic Ocean. The diameters of the specimens are 3, 4, 5 and 7 mm, the two largest specimens are considerably crumpled, especially the apical gelatinous projection is much shrunk. The two smaller specimens are in good condition, twice as high as wide, with a pointed-conical apical projection which makes up about two-fifths of the total height of the umbrella. The lateral walls of the umbrella are fairly thin. The stomach has a broad, quadratic or slightly cruciform base

and is attached to the subumbrella by a slight indication of a peduncle; mesenteries are entirely absent. The stomach is barrel-shaped, the mouth tube slightly constricted, prismatic, the mouth-rim slightly thickened and everted, entire and simple, without indications of lips. In the largest specimen the manubrium extends to the level of the velum, in the others it is one-half to two-thirds the length of the bell cavity. The eight adradial gonads have a smooth surface without folds or pits, but in female gonads the large eggs may be somewhat protruding; the gonads are distinctly separated perradially as well as interradially. Radial canals and ring canal narrow and straight, except in the two crumpled specimens, where the radial canals are sinuated. There are four perradial tentacles which in the best preserved specimens are about half as long as the height of the umbrella, evenly tapering from their base outwards. In one of the large specimens some of the tentacles are broken and have attained an appearance very similar to that in UCHIDA's figure. The tentacle bulbs are fairly narrow, each with an abaxial spur partly grasping over the umbrella margin and with an abaxial ocellus, and each with a large, spherical, adaxial knob of nematocysts, which is the most characteristic feature of this species. There are no indications of any more tentacles developing on the umbrella margin. Velum narrow.

Distribution: UCHIDA found a single specimen of this characteristic medusa at Seto Marine Biological Station in Japan; the present four specimens were taken in the North Atlantic about midway between the Azores and the east coast of North America.

Amphinema rugosum (MAYER).

Stomotoca rugosa MAYER 1900 *a* p. 4, Pl. 2 fig. 5.
Stomotoca rugosa MAYER 1910 p. 112, Pl. 10 fig. 5—6, Pl. 11 fig. 1—2.
Amphinema rugosum RUSSELL 1953 p. 183, Pl. 10 fig. 3, Pl. 11 fig. 2, 4; text-fig. 90 A, B.

Material:

St. 1214. 26.I.22. 14°21′ N. 76°50′ W. S 150, 50 m. w. 1 specimen.

The specimen is 3 mm. high and wide, badly preserved in alcohol. The rudimentary tentacles, 4—5 in each quadrant between the radial canals, are very small and slender. Nevertheless it undoubtedly belongs to *A. rugosum*.

Distribution: North-western Europa; east coast of North America from Florida to Newport, Rhode Island; Japan. The present specimen was taken in the Caribbean Sea.

? **Amphinema** sp.

Pl. I fig. 9.

Material:

St. 1323. 1.V.22. 27°17′ N. 54°35′ W. S 200, 100 m. w. 1 specimen.

The umbrella is 1 mm. high and wide, the gelatinous substance extremely thin, which may be due to the preservation in alcohol; there is no trace of an apical projection. The manubrium is large, longer than the height of the umbrella; the base of the stomach is broad, cruciform, but there are no mesenteries connecting the radial canals with the corners of the stomach. The gonads are interradial, smooth and thick, covering the stomach from its base to somewhat beyond the level of the umbrella margin; they contain large eggs; the specimen is accordingly not a young stage. The mouth is broadly dilatated, about quadrangular, with smooth edges. There are four narrow radial canals and two opposite tentacles with very large, elongated, conical bulbs, each with a small but distinct abaxial spur; no ocelli. The filiform part of the tentacles is moniliform, provided with six ring-shaped clusters of nematocysts. There are no rudimentary tentacles, neither opposite the two radial canals nor in the spaces between the radial canals.

I cannot refer this specimen with certainty to any known genus or species, but owing to the state of preservation I hesitate to describe it as a new species.

It was taken in the open ocean far south-east of Bermuda.

Annatiara affinis (HARTLAUB).

Tiaranna affinis HARTLAUB 1913 p. 269, fig. 220, 221.
Tiaranna affinis KRAMP 1920 p. 6, Pl. 1 fig. 1.
Tiaranna affinis KRAMP 1926 p. 68, Pl. 1 fig. 15—17.
Tiaranna affinis RANSON 1934 *b* p. 436.
Annatiara affinis RUSSELL 1940 p. 518.
Annatiara affinis RUSSELL 1953 p. 200, fig. 101—103.
Annatiara affinis KRAMP 1955 p. 251, fig. 3.
Annatiara affinis KRAMP 1957 p. 15.

Material:

St. 178 2.IX.06
48°04′ N. 12°40′ W.
Y 330 1000 m. w. **2**

St. 855 9.VI.20
29°15′ N. 59°45′ W.
S 200 500 m. w. **2**

St. 1165 9.XI.21
12°11′ N. 35°49′ W.
E 300 1000 m. w. **1**

St. 1363 7.VI.22
30°25′ N. 44°46′ W.
E 300 1000 m. w. **1**

St. 4000 4.III.30
0°31′ S. 11°02′ W.
S 200 300 m. w. **1**
S 200 600 m. w. **2**
S 150 1000 m. w. **2**
E 300 1000 m. w. **4**

St. 4005 12.III.30
13°31′ N. 18°03′ W.
S 200 600 m. w. **2**
S 150 1000 m. w. **1**

St. 4007 15.III.30
18°22′ N. 18°14′ W.
S 200 300 m. w. **11**
S 200 600 m. w. **5**

St. 4009 18.III.30
24°36.5′ N. 17°27′ W.
S 150 2000 m. w. **1**
S 150 2500 m. w. **1**

St. 4158 17.VI.30
46°28′ N. 8°01′ W.
S 150 1500 m. w. **1**

St. 4192 19.VI.31
39°57′ N. 24°59′ W.
S 200 600 m. w. **1**

The only specimen which is in a tolerable condition is the one from St. 4192; it is 18 mm. in diameter and has about 48 tentacles; the gonads are well developed and complexly folded. The other specimens are about 10—15 mm. in diameter.

Distribution: This species belongs to the deep and intermediate strata. It has an extensive distribution from north to south in the eastern parts of the Atlantic Ocean, from north-west of Scotland to the Cape of Good Hope, 60° N. to 34° S. The above-mentioned stations 855, 1165 and 1363 are considerably farther west than known before.

Eutiara mayeri BIGELOW.

Eutiara mayeri BIGELOW 1918 p. 374, Pl. 1 fig. 1—5, Pl. 3 fig. 6.
Neoturris mayeri RANSON 1936 pp. 40, 74—75.

Material:

St. 1294. 18.IV.22. 17°43′ N. 64°56′ W. S 200, 300 m. w. 1 specimen.

The specimen is somewhat crumpled, but otherwise quite typical in every respect; in its present condition it is 10 mm. high and 7 mm. in diameter. I have nothing to add to the original description.

Distribution: This is the first time the species has been found since it was described from near Chesapeake Bay on the Atlantic coast of North America. The present specimen was taken in the Caribbean Sea near the Virgin Islands.

Leuckartiara octona (FLEMING 1823).

Leuckartiara octona HARTLAUB 1913 p. 285, fig. 239—253.
Leuckartiara octona RUSSELL 1953 p. 188, Pl. 11 fig. 5, 6, Pl. 12 fig. 3, Pl. 31; text-fig. 91, 92, 93 A, B, 94, 95, 96.

Material:

St. 4007. 15.III.30. 18°22′ N. 18°14′ W. S 200, 600 m. w. 1 specimen.

Distribution: This species has its principal occurrence in the coastal waters of the boreal parts of Europe and North America; it is also common in the Mediterranean, and it is recorded from several scattered localities in the Pacific and Indian Oceans. It has previously been found in some localities on the tropical west coast of Africa, and the specimen taken by the "Dana" was found near Cape Verde.

Neoturris pileata (Forskål 1775).

Neoturris pileata Hartlaub 1913 p. 326, fig. 270—281.
Neoturris pileata Russell 1953 p. 203, Pl. 12 fig. 1; text-fig. 104—106.

Material:

St. 3988 23.II.30
5°52′ S. 6°02′ W.
S 200 50 m. w. **1**

St. 3998 1.III.30
7°34′ S. 8°48′ W.
S 200 50 m. w. **3**
S 200 100 m. w. **6**

St. 4007 15.III.30
18°22′ N. 18°14′ W.
S 200 50 m. w. **10**
S 200 100 m. w. **7**
S 200 300 m. w. **5**
S 200 600 m. w. **14**
E 300 1000 m. w. **1**
S 150 1000 m. w. **1**
S 150 2000 m. w. **2**
S 150 2500 m. w. **3**
S 150 3000 m. w. **10**
S 150 3500 m. w. **5**
E 300 4000 m. w. **4**

St. 4009 18.III.30
24°36.5′ N. 17°27′ W.
S 200 100 m. w. **2**
S 200 300 m. w. **1**

St. 4019 30.III.30
33°08′ N. 10°22′ W.
S 200 50 m. w. **1**
S 200 100 m. w. **2**
S 200 300 m. w. **1**
S 200 600 m. w. **3**
S 150 2000 m. w. **1**
S 150 3000 m. w. **2**

Specimens of very different sizes were found, varying from 1.5 to 30 mm. in height of bell, apparently without relation to geographical latitude or depth of the hauls. All the localities are off the west coast of Africa, the two southernmost very far from the coast; nevertheless the specimens taken at these two stations are comparatively small; they were taken in the upper water layers. The number and size of specimens taken in hauls with different length of wire may be summarized as follows:

Length of wire m	Number of specimens	Height of bell mm
50	15	3—27
100	17	1½—22
300	7	4—30
600	17	7—29
1000	2	10—27
2000	3	9—12
2500	3	13
3000	12	4—14
3500	5	10
4000	4	6—24

This complete lack of regularity confirms the supposition that all the specimens taken in the deep-sea hauls were captured during the setting out and hauling in of the nets through the upper strata, in which this species generally occurs.

Distribution: *Neoturris pileata* is a common medusa in the north-eastern Atlantic until as far north as Iceland and in the Mediterranean. One very large specimen is recorded from off the southern part of the west coast of Africa (Kramp 1957, p. 17); the five stations, where the species was taken by the "Dana", bridge the gap between that isolated locality and the areas of common occurrence. It has never been observed in the western parts of the Atlantic, and a record from the Philippine Islands may provisionally be regarded as doubtful.

Pandea conica (Quoy & Gaimard).

Dianaea conica Quoy & Gaimard 1827 p. 182, Pl. 6 fig. 3, 4.
Pandea conica Lesson 1843 p. 288.
Pandea conica Mayer 1910 p. 118, fig. 63.
Pandea conica Hartlaub 1913 p. 338, fig. 286, 287.
Pandea conica Picard 1956 pp. 1—11, fig. 1—3.

Material:

St. 845 30.IV.20
24°46′ N. 54°08′ W.
P 150 200 m. w., **5** young stages

St. 850 4.VI.20
20°39′ N. 61°48′ W.
S 200 150 m. w., **1** young stage

St. 851 5.VI.20
22°23′ N. 60°46′ W.
P 150 50 m. w. **1**

St. 855 9.VI.20
29°15′ N. 59°45′ W.
S 200 24 m. w. **5**

St. 882 15.VII.20
33°00′ N. 54°02′ W.
S 200 50 m. w. **2**

St. 891 24.VII.20
27°28′ N. 69°26′ W.
S 200 100 m. w. **1**

St. 1336 9.V.22
28°15′ N. 63°40′ W.
P 150 500 m. w. **1**

St. 4050 2—3.V.30
38°48′ N. 12°06′ W.
S 200 150 m. w. **3**
S 200 150 m. w. **2**
S 200 200 m. w. **1**
S 200 250 m. w. **3**

St. 4192 19.VI.31
39°57′ N. 24°59′ W.
S 200 50 m. w. **1**
S 200 500 m. w. **1**

St. 4197 25.VI.31
43°39′ N. 24°04′ W.
S 200 50 m. w. **2**

St. 845—1336 are in the western Atlantic north and north-east of the West Indies, St. 4050 is west of the coast of Spain, St. 4192 and 4197 east of the Azores.

The specimens from St. 845 and 850 are young stages, 1.5—2.0 mm. in height and width, strongly spherically contracted, exumbrella with about 16 or more meridional ridges. They have about 16 tentacle bulbs which, owing to the almost complete constriction of the umbrella margin, are pressed firmly together, so that each of them has attained a trapezoid shape, each with a tentacle which is short (? broken) in five of the specimens, whereas long and filiform tentacles are present in one of the largest specimens. The stomach is large and broad, with irregular gonadial folds and pits; mouth with folded lips.

Distribution (see the map, fig. 328 p. 249): This is a very common medusa in the Mediterranean, and it has also been found in several localities in the Atlantic Ocean between about 45° S. and 40° N., mainly in the eastern parts of the ocean, but also in some parts of the western Atlantic. Its partly oceanic distribution is due to its hydroid being attached to shells of the Pteropod *Cleodora cuspidata*, as recently discovered by Picard (1956). The hydroid was described by Gegenbaur (1854) as *Campaniclava cleodorae*. The medusa is also recorded from the Philippines and southern Japan. It mainly occurs in the upper strata.

Pandeid, gen. et sp. indeterm.

Material:

St. 4000. 4.III.30. 0°31′ S. 11°02′ W. S 150, 5000 m. w. 1 specimen.

The umbrella is barrel-shaped, with thin walls, 3 mm. high and 2.5 mm. wide; the manubrium is much mutilated, but seems to have been very large, connected with the four radial canals by very long mesenteries. Traces of several tentacles can be seen.

Fam. **Calycopsidae.**

Heterotiara anonyma Maas.

Pl. I fig. 10.

Heterotiara anonyma Maas 1905 p. 19, Pl. 3 fig. 19—21.
Heterotiara anonyma Bigelow 1909 *a* p. 216, Pl. 41 fig. 12, 13.
Heterotiara anonyma Vanhöffen 1911 p. 211, Pl. 22 fig. 3, 4.
Heterotiara anonyma Bigelow 1913 p. 25.
Heterotiara anonyma Bigelow 1918 p. 382.
Heterotiara anonyma Bigelow 1938 p. 108.
Heterotiara anonyma Kramp 1948 *b* p. 21.
Heterotiara anonyma Moore 1949 p. 6.

Material:

St. 303 16.VI.11
39°31′ N. 49°39′ W.
S 100 38 m. w. **3**

St. 842 28.IV.20
25°48′ N. 49°22′ W.
P 150 200 m. w. **1**

St. 892 25.VII.20
30°49′ N. 73°30′ W.
S 150 100 m. w. **4**

St. 1190 12.XII.21
17°58.5′ N. 64°45′ W.
S 200 50 m. w. **2**

St. 1192 15.XII.21
17°43.4′ N. 64°54.3′ W.
S 200 50 m. w. **25**
S 200 100 m. w. **31**
S 200 600 m. w. **1**

St. 1269 15.III.22
17°13′ N. 64°58′ W.
E 300 4500 m. w. **1**

St. 1294 18.IV.22
17°43′ N. 64°56′ W.
S 200 100 m. w. **8**
S 200 300 m. w. **2**
S 200 600 m. w. **3**

St. 3978 13.II.30
30°15′ S. 13°15′ E.
S 150 4000 m. w. **1**

? St. 4009 18.III.30
24°36.5′ N. 17°27′ W.
S 200 600 m. w.
1 juvenile specimen.

St. 303 and 842 are in the central part of the Atlantic between the Azores and North America, St. 892 north of the Bahamas, St. 1190—1294 near the Virgin Islands in the West Indies; most of the specimens taken in this region are 3—7 mm. in height of bell; one is 10 mm. high (St. 303); another is 8 mm. high; it was taken at St. 1269 in a haul with 4500 m. wire out, but has undoubtedly been captured at some higher level during the hauling in of the net. The same applies to the specimen from St. 3978 which is off the southern part of the west coast of Africa, thus in quite another geographical area, where this species has never been observed before. The specimen is fairly large, 8.5 mm. high, and its number of tentacles does not exceed 12. There can be no doubt, therefore, that it belongs to *H. anonyma* and not to *H. minor* which has a greater number of tentacles, usually 16—24.

A very small medusa taken at St. 4009, south of the Canary Islands, may possibly be a young stage of *Heterotiara anonyma*, but it cannot be identified with certainty before a series of older stages are found to connect it with well-developed specimens. It is 2.5 mm. high, 1.5 mm. wide, somewhat conical, with a small, hollow apical projection. The manubrium is half as long as the height of the umbrella cavity, broad and apparently with a smooth surface. The four radial canals are fairly broad and are not connected with the stomach by mesenteries. There are four rather thick and stiff, hollow tentacles with a thick mesogloea, each terminating in a knob of nematocysts; the tentacles are of unequal length, their basal part is not adnate to the exumbrella but is provided with a small basal bulb with nematocysts. The shape of the umbrella and its apical projection may be due to shrinkage by the preservation in alcohol. In the hope that future investigations may lead to an identification of this specimen, I give a drawing of it in Pl. I fig. 10.

Distribution: *Heterotiara anonyma* has a rather peculiar distribution. It is recorded from the Malayan Archipelago west of New Guinea (Maas) and the west coast of Sumatra (Vanhöffen); from the coast of Peru (Bigelow 1909 *a*) and from six localities in the northern Pacific between the Queen Charlotte Islands in British Columbia and Kamchatka (Bigelow 1913). Moreover it has been found in the western Atlantic: Florida, Bahamas and Bermuda (Bigelow 1918 and 1938, Moore 1949) and between Newfoundland and the Azores (Kramp 1948 *b*). It is no wonder, therefore, that numerous specimens were taken near the Virgin Islands and in other localities in the western Atlantic by the "Dana", whereas it was more surprising to find it off the South-African coast. It is mainly found in the upper water layers.

Bythotiara murrayi GÜNTHER.

Bythotiara murrayi GÜNTHER 1903 p. 424, Pl. 10 fig. 4, 5.
Bythotiara murrayi MAAS 1910 p. 2.
Bythotiara murrayi KRAMP 1924 p. 12, fig. 8—11.
Bythotiara murrayi RANSON 1936 p. 93, Pl. 1 fig. 12.

Material:

St. 1157 27.X.21
21°57′ N. 22° 58′ W.
E 300 1000 m. w. **1**

St. 3996 25.II.30
15°41′ S. 5°50′ W.
S 200 600 m. w. **1**

St. 4007 15.III.30
18°22′ N. 18°14′ W.
S 150 1000 m. w. **2**
E 300 4000 m. w. **1**

St. 4050 2—3.V.30
38°48′ N. 12°06′ E.
S 150 2000 m. w. **1**

St. 4158 17.VI.30
46°28′ N. 8°01′ W.
S 200 950 m. w. **1**
S 150 2000 m. w. **1**
S 150 4500 m. w. **1**
S 150 5000 m. w. **2**

St. 4050 is in the Mediterranean N.W. of Sicily, St. 1157, 3996 and 4007 west of Africa, St. 4158 in the Bay of Biscay.

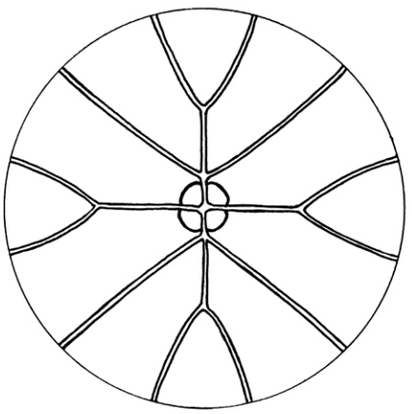


Fig. 1. *Bythotiara murrayi*. Schematic representation of abnormal branching of radial canals in a specimen from "Dana" St. 1157.

Abnormalities in the course of the radial canals are frequently seen in this species, also in some of the present specimens. Normally each of the four primary radial canals is bifurcated once near its origin from the stomach so that eight canals open into the ring canal. Among the specimens from St. 4007 one has 13 terminal branches of the canals, another has 14. A special and rather uncommon abnormality is seen in the specimen from St. 1157 (text-fig. 1); in this specimen the canals are branched in such a way that two crosswise planes of bilateral symmetry are formed. Most of the specimens are in too bad a condition to allow a description of the course of their radial canals.

Distribution: The occurrence of this species seems to be restricted to the Mediterranean and the eastern parts of the Atlantic from 32°45′ S. (north-east of Tristan da Cunha) to 60°35′ N. on the west coast of Norway. The westernmost locality in the Atlantic is west of the Azores, about 40° W. An isolated record from Nias Island in the Indian Ocean west of Sumatra (VANHÖFFEN 1911) may be regarded as doubtful.

Genus **Calycopsis** FEWKES.

The revision of the genus *Calycopsis* carried out by H. B. BIGELOW in a series of papers and summarized in 1940 (pp. 290 ff.) affords a great help in our attempts to identify the species of this difficult genus. The present collection, however, gives occasion to some additions and corrections.

Calycopsis is a genus which by geographical speciation has been divided into a considerable number of species. As emphasized by BIGELOW (1940 p. 292) each species has a somewhat restricted area of distribution. When a *Calycopsis* was found in a new geographical area, it was frequently necessary to describe it as a new species, or it might with some doubt be referred to a species already described but differing from the typical form in certain respects. Most of the species have been found only on one or a few occasions, and some of them present a considerable range of variation, especially in number of canals and tentacles. In the following pages I shall describe some specimens, the affinities of which have cost me a lot of consideration.

Among the genera of the family Calycopsidae, *Calycopsis* is characterized by the possession of four primarily undivided radial canals and a varying number of centripetal canals issuing from the ring canal; they may or may not come to fuse either with the cruciform base of the manubrium or with the radial canals, and then always close to the base of the stomach. The gonads are interradial and transversely folded, usually

forming a double series of regular transverse folds. The four oral lips may be small and simple or large and complexly folded. The basal part of the tentacles is adnate to the wall of the exumbrella until some distance above the ring canal and may be deeply sunk into the gelatinous substance of the umbrella margin. Fully developed tentacles are long, destitute of nematocysts except in a bulbous swelling at their terminal end. The gelatinous substance of the umbrella is usually very firm and rigid, but sometimes rather soft and limp which, however, in certain cases seems to be due to preservation. The umbrella is frequently somewhat laterally compressed, so that one diameter is much larger than the other, and the flattening is sometimes perradial, sometimes interradial. BIGELOW has discussed this peculiarity and concluded that it is the result of temporary contraction or of preservation. It may, however, occur in living specimens. While on board the "Discovery II" in the autumn of 1955 I found a specimen resembling *C. geometrica*; though evidently moribund, its umbrella still made slight rythmical pulsations, and already in this condition it showed a lateral compression, which became still more pronounced after preservation in formalin.

The species of *Calycopsis* may be arranged in an approximately progressive series from the simplest to the most complicated structure. Ten species were recognized by BIGELOW (1940) and well characterized by him, but it may be useful to recapitulate their diagnostic features, to which a few supplementary remarks may be added, and at the same time the identifications of the specimens collected by the "Dana" will be discussed.

Calycopsis simplex KRAMP & DAMAS.

Calycopsis simplex KRAMP & DAMAS 1925 p. 282, fig. 23—25.

Umbrella globular, 8 mm. high and wide. Gonads in few transverse folds. Four blind, interradial centripetal canals. Eight tentacles all alike. — Norway, in deep water.

Calycopsis borchgrevinki (BROWNE).

Sibogita borchgrevinki BROWNE 1910 p. 17, Pl. 2 fig. 1—5.
Calycopsis borchgrevinki VANHÖFFEN 1911 p. 215, Pl. 22 fig. 7, text-fig. 10 a, b.
Calycopsis borchgrevinki VANHÖFFEN 1912 *a* p. 364.
Calycopsis borchgrevinki KRAMP 1957 p. 20.

Umbrella about 20 mm. high, slightly higher than wide, jelly very thick and firm. Four interradial centripetal canals, blind or joining base of manubrium. 8—16 tentacles. The most characteristic feature of this species is that the gonads are not in exterior folds, but in pockets and embedded in the wall of the stomach, with definite openings to the exterior. Such gonads are not found in any other species of the genus. — Antarctic and subantarctic, circumpolar.

Calycopsis bigelowi VANHÖFFEN.

Calycopsis bigelowi VANHÖFFEN 1911 p. 218, fig. 12.
Calycopsis bigelowi KRAMP 1957 p. 21.

Umbrella almost globular, up to 16 mm. high and wide, jelly very thick; gonads with about 10 transverse folds in each row. Four blind, interradial centripetal canals. Eight large tentacles opposite the canals and numerous, up to 40, small tentacles, but of the same structure as the large ones. Originally described from deep water in the Gulf of Aden (VANHÖFFEN), later on recorded from two localities west of the Cape of Good Hope, likewise in deep water (KRAMP), collected by the "Discovery". According to VANHÖFFEN the stomach is red, but in the specimens from South Africa the gonads have a characteristic yellow-green colour; moreover their gelatinous substance is remarkably soft.

Calycopsis simulans (Bigelow).

Sibogita simulans Bigelow 1909 *a* p. 213, Pl. 5 fig. 4, 5; Pl. 41 fig. 8, 9; Pl. 43 fig. 1, 2; text-fig. 2.
Calycopsis typa var. *simulans* Bigelow 1919 p. 292, Pl. 40 fig. 8; Pl. 41 fig. 1.
Calycopsis simulans Bigelow 1940 p. 293.

Umbrella dome-shaped, up to 30 mm. high and 25 mm. wide, jelly thick. Gonads with about 15 transverse folds in each row. Eight adradial centripetal canals, blind or joining base of manubrium. Twelve large tentacles opposite the twelve canals and occasionally some small tentacles between the canals. Recorded by Bigelow from three localities: Gulf of Panama at the surface of the water (1909), Sulu Sea (1919) and off the Pacific coast of Colombia (1940). Besides some variation in the colour of the gonads, which are described as reddish-brown (Panama), pale brownish-yellow (Sulu Sea) and pale ochre (Colombia), there is a remarkable difference between the South-American specimens, in which all the centripetal canals are blind, and the number of tentacles does not exceed twelve, and the Philippine specimen which, in spite of its smaller size (16 mm. wide) had eight small supplementary tentacles and in which seven of the eight centripetal canals joined the base of the manubrium.

Calycopsis papillata Bigelow.

Calycopsis typa Vanhöffen 1912*a* p. 364.
Calycopsis papillata Bigelow 1918 p. 378, Pl. 2 fig. 1—7; Pl. 3 fig. 1.
Calycopsis papillata Kramp 1955 p. 252, Pl. 1 fig. 2, 3.

This species was collected by the "Dana" in the following localities:

Material:

St. 1192. 15.XII.21. 17°43.4′ N. 64°54.3′ W. S 200, 300 m. w. 1 specimen.
St. 1261. 9.III.22. 19°04′ N. 65°43′ W. E 300, 4500 m. w. 1 specimen.

C. papillata differs from all other species of *Calycopsis* by the presence of a group of well-marked, prominent gelatinous papillae on the lobes of the umbrella margin between the deep furrows in which the basal parts of the tentacles are imbedded. The type specimen, which was described from the Straits of Florida by Bigelow (1918) was 27 mm. high and 26 mm. wide; two somewhat smaller specimens were taken among the Bahamas. The gelatinous substance of the medusa is very thick and rigid, the manubrium small with small, simple lips, about 14—15 folds of gonads in each row. There are eight centripetal canals adradially placed, blind in the younger specimens, partly joining the base of the manubrium in the largest, and twelve tentacles. Three specimens, recorded by Vanhöffen (1912*a*) as *C. typa* were supposed by Hartlaub (1913 p. 360) to belong to *C. valdiviae* Hartlaub, but they undoubtedly belong to *C. papillata*. They were not thoroughly described, but two of them differ from the original specimens in having only 9 tentacles and 9 or 10 canals. They were collected in the following localities: Indian Ocean, 26° S. 58° E., central Atlantic, 0° N. 16° W., and near Cape Verde Islands, 14° N. 28° W. (see Kramp 1955 p. 253). Moreover a large specimen, 33 mm. high and 21 mm. wide, was recently described by me (Kramp 1955 p. 252) from the west coast of Africa off Angola. It differs from the other specimens in the position of the centripetal canals; in each of the four quadrants there is one interradial and one adradial canal, all of them blind but extending almost to the base of the manubrium, and it has only eight tentacles, four perradial and four interradial, whereas there are no tentacles opposite the adradial canals. All the specimens were taken near the surface of the water. The two specimens collected by the "Dana" were taken in the West Indies, near the Virgin Islands; they are 10—13 mm. high and agree in every respect with Bigelow's original specimens, having 12 tentacles and 12 canals; the centripetal canals are adradial and terminate blindly at a short distance from the manubrium. One of them was taken in a deep haul with 4500 m. wire out, but may have been captured during the hauling in of the net. *C. papillata* apparently has a very extensive geographical distribution, occurring in the western as well as the eastern parts of the tropical Atlantic and also in the western part of the Indian

Ocean. We cannot exclude the possibility, however, that VANHÖFFEN's remark on the warts on the lobes of the umbrella between the tentacle bases does not apply to the specimen from the Indian Ocean, so that this specimen may have belonged to another species.

Calycopsis nematophora BIGELOW.

Calycopsis nematophora BIGELOW 1913 p. 23. Pl. 2 fig. 8, Pl. 3 fig. 1—3.
Calycopsis nematophora BIGELOW 1918 p. 377.
Calycopsis nematophora BIGELOW 1940 pp. 290—293.

This species differs from all the other species of *Calycopsis* by the possession of stalked nematocyst knobs on the edges of the complexly folded oral lips. Moreover the gonads have a peculiar structure, in so far as the two series of folds are less precise and less crowded than in most other species and are supplemented by a number of intervening folds. The umbrella may attain a height of 31 mm. and a diameter of 30 mm.; the gelatinous substance is thick. There are usually three centripetal canals in each quadrant, and as a rule all of them join the cruciform base of the stomach, but occasionally some of them are blind. The number of tentacles is somewhat variable, 8—16 large tentacles being associated with canals and in addition a number of small tentacles in the spaces between the canals. The total number of tentacles is usually 32—48, but in the largest specimen as many as 57 were counted.

Several specimens were found in seven localities in the Bering Sea, among the Aleutian Islands, off Kamchatka, and in the Sea of Okhotsk, mainly in the upper water layers, and the species has not been found since it was described from this area.

Calycopsis typa FEWKES.

Calycopsis typa FEWKES 1882 p. 304, Pl. 1 fig. 34.
Sibogita nuarchus BIGELOW 1909 *c* p. 206, Pl. fig. 1—8.
Calycopsis typa BIGELOW 1913 p. 21.
Calycopsis typa BIGELOW 1915 p. 316.
Calycopsis typa BIGELOW 1922 p. 159.
Calycopsis typa BIGELOW 1940 pp. 290—293.

None of the specimens identified as *C. typa* by VANHÖFFEN (1911 and 1912*a*) belong to this species.

Three specimens were collected by the "Dana" in the following locality, near Cape Verde, very far from the area, from which this species was previously known:

Material:

St. 4007. 15.III.30. 18°22′ N. 18°14′ W. S 200, 600 m. w. 1 specimen. E 300, 4000 m. w. 2 specimens.

Moreover two doubtful specimens, which will be described below, were taken in the West Indies:

St. 1250. 26.II.22. 17°54′ N. 67°30′ W. E 300, 1000 m. w. 2 specimens.

Calycopsis typa, the type species of the genus, had been described by FEWKES from the Gulf Stream off the New England coast; it was found again in the same area by BIGELOW (1909*c*) who described his specimens as a new species, *nuarchus*, but later on (1913) he realized that they belonged to *C. typa*. It was recorded again by BIGELOW (1915 and 1922), and up to now the species has been found only within a restricted area along the continental slope off the New England coast, taken in open nets hauled from between 500 and 300 metres to the surface.

According to BIGELOW's description (1909) and later notes this species is first of all characterized by the presence of a deep funnel-shaped depression in the apical jelly, not seen in any other species of the genus. The largest specimen observed was 37 mm. in height and 40 mm. in diameter, with a pronounced disposition to lateral compression. The gelatinous substance of the bell is firm, but not very thick. There are usually three

or four blind centripetal canals in each quadrant, the greatest total number of canals observed by BIGELOW being 21. The total number of tentacles varies from 16 to 30. It is also characteristic that the manubrium is comparatively large and broad with fairly large, folded oral lips. There are numerous transverse gonadial folds, and in addition, irregular projecting lobes of gonads may be developed. The colour of the gonads is described as deep brownish-red, and the basal bulbs and terminal knobs of the tentacles are pale yellowish.

The specimens taken by the "Dana" at St. 4007 near Cape Verde on the west coast of Africa differ from the American specimens in one respect only, their jelly is remarkably soft and limp, which may be the result of bad preservation. The apical depression characteristic of the species is very pronounced, deep. The height of the umbrella is 19—21 mm., the width cannot be measured with any accuracy. Besides the four radial canals there are 12 centripetal canals, apparently all blind. Corresponding to the 16 canals there are 16 large tentacles and moreover about 16 very small tentacles between the large ones, but no indication of a further increase of the number of tentacles. These three specimens seem to me to agree so well with the descriptions of the American form that I am sure they belong to the same species; the geographical distance is no objection to this supposition, since many other American species of medusae have been recorded from the African coast (see KRAMP 1955).

On the other hand, I am much in doubt of the identification of the two specimens collected by the "Dana" at St. 1250, near Porto Rico. They are about 14—16 mm. high in their present crumpled condition, the jelly is fairly rigid, but owing to a considerable shrinkage it is thin and flexible. There is no trace of an apical depression! The manubrium is broad as in *C. typa*, in the largest specimen 6 mm. long and 7 mm. broad, the mouth is large with broad, complexly folded lips with smooth edges, no trace of nematocyst knobs like those of *C. nematophora*. The rows of gonads are widely separated in the perradii, in the largest specimen there are about 18 gonadial folds in each row, and there are some instances of egg-shaped projecting lobes of gonads like those described in *C. typa*. One of the specimens has about 30, the other 34, canals; the centripetal canals extend to the base of the stomach, but I am not sure whether they join the stomach, apparently they do not. There is one tentacle opposite each canal, most of them large and of equal size, but some few tentacles, placed off particularly narrow (young) canals are small. Moreover there is one very small, hook-shaped tentacle in each space between the canals. The gonads are bright orange-red, and there is a group of orange pigment spots inside the base of each of the larger tentacles.

In several respects these specimens resemble *C. typa* and, at any rate, they cannot be referred to any other species of *Calycopsis* described up to now. The greater number of tentacles and canals as compared with *C. typa* of even larger size might be due to geographical variation. What makes me hesitate to refer the specimens with certainty to *C. typa* is the absence of a funnel-shaped depression in the apex of the umbrella.

Calycopsis valdiviae HARTLAUB.

Calycopsis typa VANHÖFFEN 1911 p. 214, Pl. 22 fig. 6.
Calycopsis valdiviae HARTLAUB 1913 p. 360.

A single specimen of a large and beautiful medusa was taken in the Agulhas Current off the south coast of Africa, 34°31′ S. 26°00′ E. VANHÖFFEN referred it to *Calycopsis typa*, but HARTLAUB realized that it could not belong to that species, and he established a new species, *C. valdiviae*, for this specimen; he was mistaken, however, in referring some specimens taken by the German South Polar Expedition in the tropical Atlantic and Indian Oceans, and likewise identified by VANHÖFFEN (1912*a*) as *C. typa*, to the same species; they belong most probably to *C. papillata* (see above).

According to VANHÖFFEN's description and coloured drawing *C. valdiviae* may be characterized as follows: Umbrella 38 mm. high and 30 mm. wide, somewhat oblique, jelly thick and rigid. Manubrium fairly large, 14 mm. long, with gonads in 19—22 regular transverse folds in each row, mouth with folded lips. About 60 canals of somewhat different width, 24 of them designated as main canals ("Hauptkanäle") joining the base of the manubrium, and between them are about 36 canals which are narrower ("Zwischenkanäle"), some of

which terminate blindly near the base of the stomach. There are 24 large tentacles opposite the 24 main canals and occasionally small rudiments of tentacles opposite the narrow canals. The gonads are red, oral lips, canals and tentacles colourless.

The affinity of this medusa will be discussed below.

Calycopsis chuni VANHÖFFEN.

Calycopsis chuni VANHÖFFEN 1911 p. 217, Pl. 22 fig. 8.

Two specimens were collected by the "Valdivia" Expedition, one near Cape Guardafui, 9°06′ N. 53°41′ E., another in the Gulf of Aden, 13°03′ N. 46°42′ E. The former was 28 mm. high and 25 mm. wide, the latter was 26 mm. high and wide. In general shape they resemble *C. valdiviae*, though the umbrella is not oblique. According to the coloured figure, the base of the stomach is more pronouncedly cruciform than in *C. valdiviae*. The smaller specimen has 27 canals, usually one narrow "centripetal" canal (blind?) between two successive "main canals", and 16 tentacles. In the larger specimen there are 36 canals, somewhat irregularly distributed, and 17 tentacles. VANHÖFFEN lays much stress on the different colouration in the two species; in *C. chuni* the entire manubrium is brownish-red, and in the specimen from Cape Guardafui the canals and the tentacles are red, whereas they are colourless in the specimen from Aden. Evidently, therefore, the colour is not such a relevant specific character as emphasized by VANHÖFFEN.

The specimens collected by the "Dana" may serve to elucidate the relation between *C. valdiviae* and *chuni*; if they are identical, which I think they are, *chuni* takes priority over *valdiviae*.

Calycopsis chuni VANHÖFFEN.

Syn. *Calycopsis valdiviae* HARTLAUB (see above).

Material:

St. 1283	5.IV.22	St. 3998	1.III.30	St. 4017	27.III.30	St. 4019	30.III.30
14°38′ N.	61°16′ W.	7°34′ S.	8°48′ W.	29°11′ N.	14°14′ W.	33°08′ N.	10°22′ W.
E 300	1000 m. w. 1	S 200	300 m. w. 1	S 200	600 m. w. 1	E 300	4000 m. w. 1

Though the first of these localities is in the West Indies and the others off the west coast of Africa, the specimens are remarkably alike. All of them have a rigid and fairly thick, though somewhat shrunken jelly, and in their present condition they are strongly laterally compressed, the one from St. 1283 according to an interradial plane, the others perradially. Their sizes are as follows:

Station no.	1283	3998	4017	4019
Height of bell, mm	31	33	25	22
Greatest diameter, mm	25	34	24	21

In the two largest specimens (St. 1283 and 3998) the manubrium is about 15 mm. long, and in all the specimens the gonads are in about 25 transverse folds in each row; the oral lips are short and simple, and the base of the stomach is distinctly cruciform. In all the specimens there are 32 canals, all of which communicate with the stomach, usually directly joining the cruciform base of the stomach, but sometimes fused with a neighbouring canal close by the manubrium. Some irregular anastomoses are seen in the specimen from St. 3998. The number of tentacles is likewise the same in all the four specimens; there are 16 large tentacles and 16 very small, hook-shaped, all the 32 tentacles placed opposite the canals. There are no indications of a further number of tentacles being developed. The canals terminating at the small tentacles are usually slightly narrower than the others.

Stomach and gonads are light yellowish in all the specimens, and inside the base of the large tentacles of the specimen from St. 3998 there is a group of bright orange-red pigment spots, whereas the tentacle bases of the three other specimens are yellow.

We cannot ascribe much importance to the colours of the various organs of preserved medusae for distinction between species. In morphological and numerical respects the present specimens differ from *Calycopsis chuni* only in the presence of 16 small tentacles between the 16 large ones, which may be the outcome of further development. BIGELOW has shown that in certain species of *Calycopsis* the tentacles develop before the corresponding canals appear, but in other species the opposite sequence may occur. The absence of young tentacles corresponding to the last series of 16 canals in VANHÖFFEN's specimens of *C. chuni*, therefore, presents no severe obstacle against the supposition that the Atlantic specimens described above belong to that species. The fact that all the centripetal canals join the base of the stomach in the Atlantic specimens, whereas some of them are blind in VANHÖFFEN's specimens, is likewise only a developmental feature. In other species with more than four centripetal canals (*simulans, papillata, nematophora,* see above) they are blind in some specimens, preferably young, fused with the manubrium in others.

In accordance with these statement I see no reason to retain *C. valdiviae* as a distinct species. It has about the same total number of tentacles as the Atlantic specimens of *C. chuni* (24 large and some small), and it has almost twice as many canals, somewhat more than half of them being narrower (younger) that the others. It seems to me that *C. valdiviae* must be regarded as a far advanced stage of development of *C. chuni.* Through the Atlantic specimens we have a progressive series of stages: In VANHÖFFEN's specimens of *C. chuni* from East Africa the number of canals has increased to about 32, whereas the number of tentacles is still only about 16; in the Atlantic specimens 16 new small tentacles have appeared, and in the particularly large specimen from South Africa some of these tentacles have grown to full size, and a new series of centripetal canals have been developed.

Calycopsis chuni thus has an extensive, though continuous geographical distribution, occurring in the West Indies and off the western, southern and eastern coasts of Africa. The bathymetrical distribution of the species is somewhat uncertain. VANHÖFFEN's specimens were taken in vertical hauls from 2000, 1800 and 1200 metres to the surface; some of the Atlantic specimens were taken in deep hauls, 1000 m. wire (St. 1283 in the West Indies), 4000 m. wire (St. 4019 off Morocco) and 600 m. wire (St. 4017 near the Canary Islands); but the specimen from St. 3998, near the island Ascension, was taken in the upper strata in a haul with only 300 m. wire out. Upwelling of deep-sea water cannot be expected to occur in this locality, so evidently the medusa is able to live in the upper water layers; but apparently it has its principal occurrence in the deep and intermediate layers. All the localities where the medusa has been found are near the coasts; presumably, therefore, the corresponding hydroid is an inhabitant of the deeper parts of the continental slopes.

Speciation of Calycopsis.

The following discussion is given with due reservation, because most species of *Calycopsis* are known from only few localities, and future investigations may alter our present conception of their geographical distribution. On the other hand, the distribution of the various species as known up to now is so characteristic that it must invoke our attention (see the maps, figs. 2—3).

The genus has a very extensive distribution in the oceans, but it has been divided into several species, most of which occur within restricted and widely separated areas. In each of these areas the population has developed into a separate species with its own characteristic features, not merely in numerical respect but frequently also showing structural peculiarities.

C. simplex is a small species with a very simple structure; it is known only from one of the fjords on the west coast of Norway, where it was found in deep water.

C. borchgrevinki, like *C. simplex,* has only one centripetal canal in each quadrant; its distribution is circumpolar in antarctic and subantarctic waters, where no other species of *Calycopsis* are found, and it has acquired a special structure of the gonads, not seen in any other species (see above, p. 19).

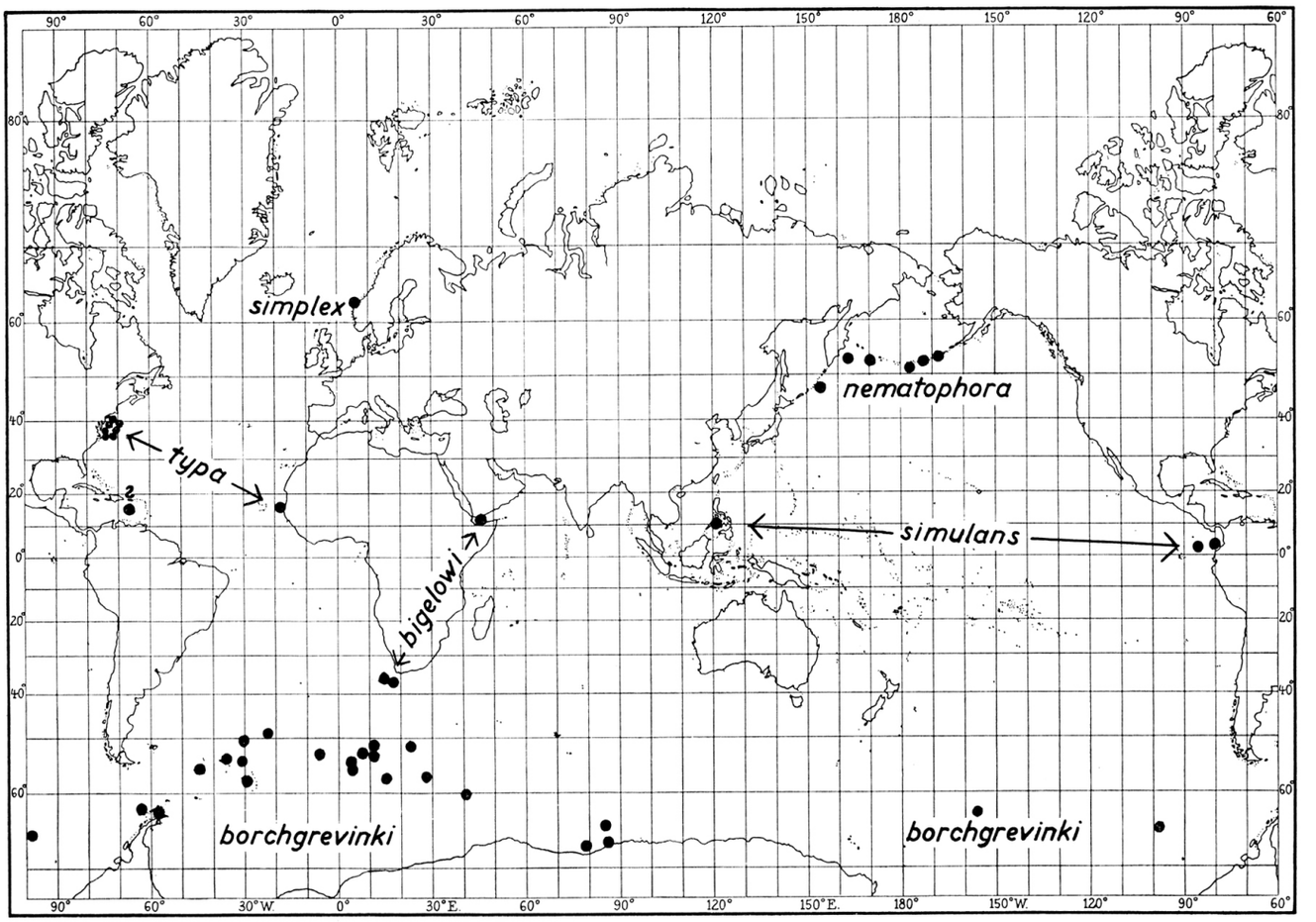


Fig. 2. Geographical distribution of six species of *Calycopsis*.

C. simulans, with two centripetal canals in each quadrant, is the only species which occurs in the tropical Pacific, in the eastern as well as in the western parts, and apparently certain differences have arisen in the two widely separated populations (see above, p. 20).

C. nematophora, which has three centripetal canals in each quadrant, has an isolated occurrence in the northernmost parts of the Pacific, and it differs from all the other species in the presence of stalked nematocyst knobs on the oral lips.

C. bigelowi occurs off East and South Africa; it is one of the species with only one centripetal canal in each quadrant, but it is characterized by the development of several small tentacles between the eight large tentacles corresponding to the eight canals.

C. typa has a greater number of tentacles and canals than the preceding five species; it occurs off the coast of New England and near Cape Verde in West Africa, perhaps also in the West Indies, where an aberrant form has been found. This species also has acquired a structural character unknown in any other species of the genus, *viz.* a deep funnel-shaped depression in the apical jelly.

These six species, which occur in as many widely separated areas, seem to be typical examples of geographical speciation. This impression is, however, complicated by the distribution of two other species, *papillata* and *chuni*, which occur partially within the same areas as *typa* and *bigelowi*. *C. papillata* differs from all the other species by its gelatinous papillae on the lobes of the umbrella margin, and *C. chuni* is a large species characterized by its great number of canals and tentacles. Both of them have a rather extensive distribution; *C. papillata* occurs in the tropical Atlantic from Florida and the West Indies to the west coast of Africa, probably also in the western part of the Indian Ocean; the distribution of *C. chuni* comprises the coasts of Africa

from the Gulf of Aden around South Africa to Morocco, and it has also been found in the West Indies. Both species are subject to some variation which, however, does not seem to be geographically determined.

The development of the six first-mentioned species has proceeded under different environmental conditions within six areas which are widely separated geographically but are in open connection with each other, and they have been so since the cretaceous period; these species are typically allopatric. In addition two other species, *papillata* and *chuni*, have arisen in the tropical Atlantic. They have attained a high degree of development and a wide distribution ranging from the western Atlantic to the western part of the Indian Ocean. From the beginning the four species now occurring in the Atlantic may have arisen in separate areas, their populations later on having extended their distribution. *C. typa* seems to have its principal occurrence off New England spreading eastwards to West Africa. *C. papillata* may likewise have originated in the western Atlantic, but in the Caribbean region, whence it has extended its distribution eastwards to West Africa and somewhat

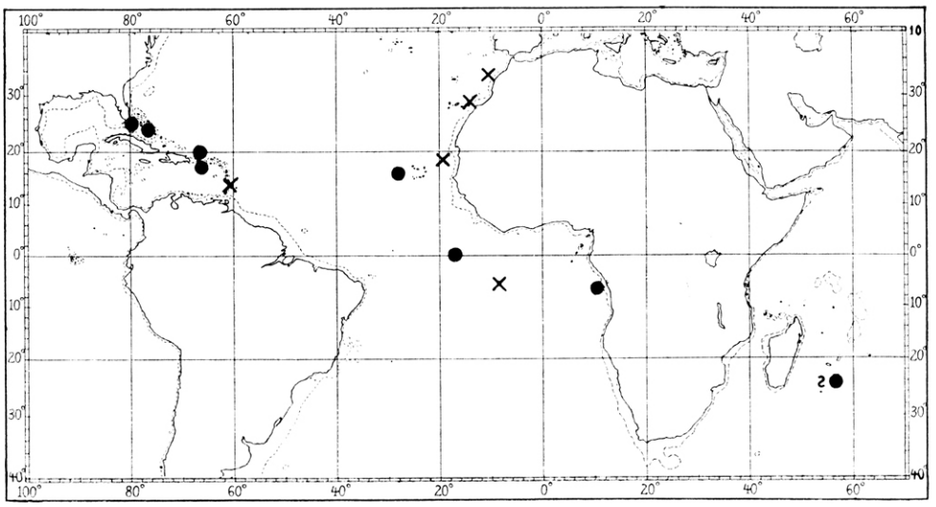


Fig. 3. Geographical distribution of *Calycopsis papillata* (●) and *C. chuni* (×).

into the Indian Ocean. *C. chuni* apparently belongs to the African coasts, being recorded only once from the western Atlantic; and as far as we know the distribution of *C. bigelowi* is still restricted to East and South Africa.

It seems probable, therefore, that the present condition, where the areas of distribution of *papillata* and *chuni* partially coincide with the distribution of *typa* and *bigelowi*, is secondary. If this be true, the eight existing species of *Calycopsis* all have arisen in separate geographical areas, and the division of the genus into different species is a typical geographical speciation.[1])

Genus **Sibogita** Maas.

The genus *Sibogita* was established by Maas (1905 p. 16) for the species *S. geometrica* which was taken by the Siboga Expedition in the Malayan Archipelago. The generic name was adopted by Bigelow (1909*a*) for *S. nuarchus* (which later on was found to be identical with *Calycopsis typa* Fewkes) and for *S. simulans* (1909*a*), and also by Browne (1910) for *S. borchgrevinki*. Vanhöffen (1911 p. 214 and 1912 p. 364) retained the name *Sibogita* for *S. geometrica*, but referred *borchgrevinki* and his own two new species *chuni* and *bigelowi* to the genus *Calycopsis* Fewkes together with the specimens which he erroneously identified as *Calycopsis typa* Fewkes. He based the distinction between the two genera on the conformation of the centripetal canals which in *Calycopsis* are simple and partly terminating blindly, whereas in *Sibogita* they join the "main-canals". In later papers by Bigelow the two genera are united; he found that the new species *Calycopsis papillata* bridges the gap; in one of the specimens some of the centripetal canals join the radials, some the manubrium

[1]) After the above was written two more species, *C. gara* and *C. krampi* have been described from the northern Atlantic. They will be briefly mentioned in Section B.

so that "some of its quadrants would belong to one genus, others to the other, were both to be recognized" (BIGELOW 1918 p. 377).

This view is fully justified under the assumption that the canals between the four primary radial canals really are centripetal, proceeding upwards from the ring canal, in *geometrica* as well as in the other species. But I am not convinced of the correctness of this statement. Two specimens of *Sibogita geometrica* are described, one by MAAS (1905), one by BIGELOW (1919); and three specimens from the Atlantic Ocean will be described below. None of the canals are blind in any of these specimens; accordingly their "branches" may as well have been developed from above as from below. If some time in the future a specimen is found, in which some of the canals have not finished their development one way or the other, we may state whether they issue from the ring canal growing upwards to join one of the preceding canals at some higher level on the subumbrella, or whether they issue from the canals already present growing downwards towards the ring

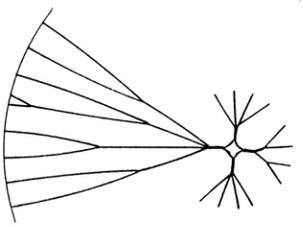


Fig. 4. *Sibogita geometrica occidentalis*. Schematic representation of branching of radial canals, "Dana" St. 1380.

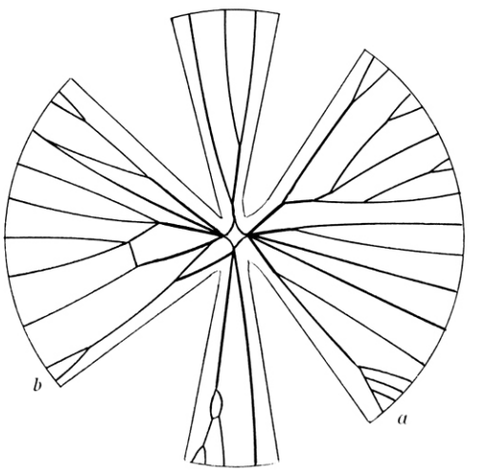


Fig. 5. *Sibogita geometrica occidentalis*. Schematic representation of branching of radial canals, "Dana" St. 1371. Umbrella radially incised.

canal. I cannot answer the question with certainty, but since I have seen the three Atlantic specimens I am much inclined to think that the development of the canals has proceeded in the latter way.

The appearance of the canals in *Sibogita* seems to me to contradict the supposition that all of them, except four primary radial canals, are developed centripetally from the ring canal; several points in their conformation cannot be explained under that supposition. Even a superficial view of the canals in the three Atlantic specimens (Pl. I fig. 11—12, Pl. II fig. 2—3, and text-fig. 4—5) and gives the impression that the branching is the result of repeated bifurcation during the growth of the canals from the central part of the umbrella towards the margin. In none of these specimens can any of the canals be pointed out as primary radial canals; this is especially evident in the specimen from "Dana" St. 1380 (text-fig. 4), in which four groups of canals issue from the corners of the stomach, each group consisting of four canals diverging from each other immediately outside the base of the stomach, each of them to be bifurcated further down. In the two other specimens the course of the canals is more irregular, but also here they diverge from each other immediately outside the stomach, and at acute angles. In the specimen from "Dana" St. 1371 (text-fig. 5) one of the canals (marked *a*) proceeds straight to the margin, but at a short distance from the ring canal it sends off three lateral branches, all to the same side, which join the ring canal very near each other; I can hardly believe that these have been emitted from the ring canal, and the canal marked *b* has undoubtedly issued from a corner of the stomach and come to join the adjacent canal during its outward growth. In all the specimens some of the canals are bifurcated immediately before reaching the ring canal, which is easily understood from the point of view that the development has taken place downwards towards the umbrella margin.

Another point of some importance is that the canals and their branches, though narrow throughout their

length, are slightly wider in their proximal parts than further below. This likewise indicates that the development takes place in a downward direction.

Notwithstanding the direction of the development of the canals *Sibogita geometrica* and the Atlantic form described below differ in one remarkable way from all species of *Calycopsis*. The centripetal canals in *Calycopsis* are either permanently blind or they join the cruciform base of the stomach or the radial canals in close vicinity to the manubrium; in *Sibogita* the canals join each other at various levels. This seems to be a difference of so much importance that it justifies a distinction into two genera (abnormalities in the form of anastomoses and other irregularities may occur in both genera but are of no taxonomic value). I therefore revive the old genus *Sibogita* with the following diagnosis:

Genus *Sibogita* MAAS: Calycopsidae with radial canals which branch repeatedly at various levels; gonads transversely folded. Type species *S. geometrica* MAAS.

Sibogita geometrica MAAS.

Sibogita geometrica MAAS 1905 p. 17, Pl. 3 fig. 16—18.
Sibogita geometrica MAYER 1910 p. 186, fig. 99.
Sibogita geometrica VANHÖFFEN 1911 p. 214.
Calycopsis geometrica BIGELOW 1918 p. 377.
Calycopsis geometrica BIGELOW 1919 p. 290, Pl. 40 fig. 5—7, Pl. 41 fig. 2.
Calycopsis geometrica BIGELOW 1940 p. 293.

The original specimen, described by MAAS, was found north-east of Celebes. The umbrella is 38 mm. high, laterally compressed, average diameter 20 mm., gelatinous substance thick and rigid. Manubrium slender, somewhat less than half as long as the depth of the subumbrella cavity, mouth with four folded lips; gonads in about 13 transverse folds in each of the eight rows. Four distinct radial canals which give off lateral branches at various levels, the branches being further divided, so that altogether 32 canals open into the ring canal. 16 long tentacles corresponding to as many canals. No ocelli.

Another specimen was described by BIGELOW (1919) and referred with some doubt to the same species. It was found in the Sulu Sea. The umbrella is 20 mm. wide. The canals are branched in a way similar to MAAS's specimen, 22 extending to the margin. Corresponding to the canals there are 22 tentacles, five of which are small and spur-like, and, moreover, there are three small tentacles unconnected with any canals. At the base of every large tentacle there is a dense group of red pigment granules.

The presence of three small tentacles unconnected with canals in BIGELOW's specimen is of some interest for a comparison with the Atlantic specimens which will be described below and which have given me occasion for much consideration and some doubt.

Sibogita geometrica MAAS, **occidentalis** nov. subsp.

Plate I fig. 11—12, Pl. II fig. 2—3.

Material:

St. 1371. 13.VI.22. 36°41′ N. 26°21′ W. E 300, 1000 m. w. 1 specimen.
St. 1380. 19.VI.22. 39°26′ N. 21°51′ W. S 150, 600 m. w. 1 specimen.

Moreover a beautiful specimen was taken in the Bay of Biscay while I was on board the English research ship "Discovery II" in the autumn of 1955:[1])

"Discovery II" St. 3332. 47°04′ N. 7°08′ W. 1.X.55. 2 m. ringtrawl, 600 m. wire, oblique haul from about 300 m. to the surface.

[1]) I am greatly indebted to Dr. N. A. MACKINTOSH for permission to publish the description of this specimen in the present paper.

Description of the specimens. All the specimens have lost the distal portions of the tentacles which presumably have had a terminal knob of nematocysts. The specimens collected by the "Dana" are somewhat crumpled and mutilated, but details are sufficiently well preserved to allow an examination. The Discovery-specimen was still alive when it was brought into the laboratory of the ship; the umbrella made faint rhythmical pulsations, and after careful preservation in formalin it retained its original shape almost unaltered.

"Dana" St. 1371. Height of bell about 32 mm., the greatest diameter of the umbrella, which is somewhat laterally compressed, is about 26 mm. The manubrium (Pl. I fig. 11) is 5 mm. long, with a distinctly cruciform base, mouth with four short, crenulated lips. The gonads are of the Calycopsis-type, with about six transverse folds in each row. The canals (text-fig. 5) are somewhat irregularly branched; as seen from the figure they arise from the corners of the stomach in four unequal groups. In each group 2—5 canals diverge from each other immediately outside the corner of the stomach, a few of them proceed undivided to the ring canal, most of them bifurcate one or several times, some of them immediately before reaching the ring canal; occasional anastomoses occur. Altogether 34 canals open into the ring canal, including the small peripheral bifurcations. The bell margin is somewhat mutilated; as a rule there is one large tentacle opposite each terminal end of the canals, and in tolerably well preserved parts of the margin there is one very small tentacle and two minute, wart-like protuberances between two successive fully developed tentacles. The total number of tentacles cannot be stated.

"Dana" St. 1380. Height of bell about 26 mm., greatest diameter about 28 mm. The manubrium is lost, its basal attachment to the subumbrella is discerned as a regular cross of narrow lines (text-fig. 4), which alone represent the four primary radial canals. Each of them gives rise to four diverging canals, each of which is bifurcated about midway between its point of origin and the bell margin and sometimes once again before reaching the ring canal. Apart from one or two anastomoses the branching of the canals is very regular in this specimen. Altogether 35 canals join the ring canal. The marginal organs are as in the specimen described above.

"Discovery II" St. 3332 (Pl. I fig. 12, Pl. II fig. 2—3). Umbrella 30 mm. in height, somewhat laterally compressed, the degree of compression being only slightly more pronounced after preservation, greatest diameter 40 mm. The gelatinous substance firm and rigid, 6 mm. thick at the apex, 5 mm. in the lateral sides. The manubrium is remarkably small, 4 mm. long, slender, mouth with four small and simple lips; gonads are not developed. Though the stomach is distinctly square in cross section, its base is somewhat irregular, giving rise to 12 canals which diverge from each other immediately outside the base of the stomach, most of them bifurcated once or twice, some of them three or four times before reaching out to the ring canal; in two instances two neighbouring canals run together and become united immediately above the ring canal. Altogether 43 canals join the ring canal; about midway between the apex and the margin of the umbrella 30 canals may be counted. The proximal parts of the canals, nearest to the manubrium, are slightly broader than the distal parts, which are particularly narrow after repeated bifurcation. There are 27 fully developed tentacles, all of them broken at a short distance from their base (Pl. I fig. 12); their basal portion is deeply sunk into a narrow furrow in the umbrella margin; the tentacles have no basal swellings, and no accumulations of pigment granules are seen. Everyone of the large tentacles is placed opposite a radiating canal, and between each pair of successive large tentacles there is one very small tentacle (rarely two) and two tiny wart-like protuberances, presumably vestiges of a third series of tentacles. The small tentacles and warts are placed independently of radiating canals. The arrangement of the tentacles in this well-preserved specimen is thus in accordance with that observed in the parts of the margins of the two other specimens in which an examination was possible. The velum is narrow. The living specimen was completely colourless, except the manubrium which was faintly yellow.

I have been much in doubt of the specific identification of these three specimens. We have seen above some examples of variation in number and arrangement of canals and tentacles and the relation between tentacles and canals in various species of *Calycopsis* (*simulans, papillata, typa, chuni*), in some cases due to different stages of development, in other cases mere individual variations; some of the variations may perhaps be designated as geographical variations. All these variations, however, are so slight that they do not justify a

distinction between different species or subspecies. On the other hand, the specimens of *Sibogita* collected in the Atlantic by the "Dana" and the "Discovery II" differ from the Malayan specimens described by MAAS and BIGELOW in certain characteristic ways which render it necessary to provide them with a proper name. Their manubrium is remarkably small with only some few gonadial folds. In the Malayan specimens the four primary radial canals run straight from the manubrium to the umbrella margin sending out lateral branches towards both sides, the branches giving rise to other lateral branches of second and third order; in the Atlantic specimens the four primary radial canals are much reduced, and immediately outside the corners of the stomach they are divided into diverging branches which further down are dichotomously branched. Moreover the Atlantic specimens have a second series of small tentacles almost regularly alternating with the first series of large tentacles and in addition a third series of minute marginal warts. In the type specimen described by MAAS no small tentacles were observed, and the large tentacles were only half as numerous as the terminal ends of the radiating canals. In the specimen described by BIGELOW, however, there was a tentacle opposite every one of the canals, and moreover some few small tentacles were present between the others and unconnected with canals. To some degree, therefore, BIGELOW's specimen bridges the gap between the type specimen and the Atlantic specimens. This makes me hesitate to describe the Atlantic form as a new species, but it differs so much from the typical, Malayan form that it may be regarded as a distinct geographic race or subspecies of *Sibogita geometrica*. In spite of the much better state of preservation of the "Discovery" specimen I designate the specimen from "Dana" St. 1371 as the type specimen of this new subspecies, because it has a manubrium with well-developed gonads, whereas the "Discovery" specimen is immature.

Fam. **Russelliidae.**

Russellia mirabilis KRAMP.

Russellia mirabilis KRAMP 1957 p. 24, Pl. 4 fig. 1—6.

Material:

St. 1245. 17.II.22. 19°35′ N. 73°27′ W. E 300, 1000 m. w. 3 specimens.

This species was recently described by me in the Discovery Reports; four specimens were found in antarctic waters, and the species was so peculiar that it had to be described not merely as a new genus and species but as representative of a new family, probably related to the Calycopsidae but differing from that family in several important characters.

The present specimens are 13, 16 and 16 mm. high, and they agree with the original specimens in every structural detail, so I have nothing to add to the description. Unfortunately the "Dana" specimens as well as the "Discovery" specimens have lost the distal portions of all the tentacles, so we do not know whether they have had a terminal nematocyst knob, which might have given a clue to the determination of the systematical position of the family.

Distribution: The original specimens were taken in four localities in antarctic waters, west of Graham Land, near the South Shetlands, and east of South Georgia. It was a surprise, therefore, to find the same species in West-Indian waters, between Haïti and Cuba. Most of the antarctic specimens were taken in the upper strata, thus at very low temperatures. It is quite resonable, therefore, that the species avoids the high temperature of the surface layers in the West-Indian waters, where it was taken in a haul with 1000 m. wire out.

Fam. **Tiarannidae.**

Tiaranna rotunda (QUOY & GAIMARD).

Tiara rotunda MAYER 1910 p. 124.
Tiaranna rotunda HARTLAUB 1913 p. 266, fig. 218, 219.
Tiaranna rotunda KRAMP 1920 p. 6, Pl. 1 fig. 2—4.

Material:

St. 4025. 9.IV.30. 35°57′ N. 5°30′ W. S 200, 50 m. w. 2 specimens. S 200, 100 m. w. 4 specimens.

This locality is in the Straits of Gibraltar, the classical locality of the species, whence it was described by QUOY and GAIMARD in 1827. All the specimens taken by the "Dana" are young, 3—11 mm. in diameter; their state of preservation is not sufficiently good for a description of these developmental stages.

Distribution: Recorded from several localities in the northern Atlantic: Davis Strait, Irminger Sea, the North Sea, and the west coast of Norway; Straits of Gibraltar and adjacent parts of the Mediterranean and Atlantic; recently (KRAMP 1957) also recorded from the Gulf of Guinea, off Patagonia, and from two localities in the warm deep water of the Antarctic south of Australia. It mainly belongs to the deep and intermediate strata, but in the Straits of Gibraltar it may evidently ascend into the surface layers of the water.

Chromatonema rubrum FEWKES.

Chromatonema rubrum FEWKES 1882 p. 305, Pl. 1 fig. 41.
Thaumantias rubrum MAYER 1910 p. 199.
Chromatonema rubrum KRAMP 1919 p. 7, Pl. 1 fig. 1—8, text-fig. 3, 4 a.
Chromatonema rubrum KRAMP 1947 p. 52, Pl. 6 fig. 7.
Chromatonema rubrum KRAMP 1957 p. 25.

Material:

St. 1209. 17.I.22. 7°15′ N. 78°54′ W. E 300, 3500 m. w. 1 specimen.

The specimen is about 18 mm. in diameter; it is somewhat mutilated, but the determination is doubtless. It is the first time that this species has been found in the Pacific, *viz.* in the Gulf of Panama, and it confirms the supposition that *C. erythrogonon* (BIGELOW), which is recorded from the Gulf of California to Peru, belongs to the same species.

Distribution: Generally distributed in the deep parts of the northern Atlantic from the Bermudas and the Azores northwards to Iceland and the Davis Strait; recently (KRAMP 1957) recorded from South Africa and from several localities in the Atlantic and Indian sectors of the Antarctic Ocean. It is a bathypelagic species.

Leptomedusae.

Fam. **Dipleurosomidae.**

Dichotomia cannoides BROOKS.

Dichotomia cannoides BROOKS 1903 p. 11, Pl. 1 fig. 1—3.
Dichotomia cannoides MAYER 1910 p. 223, fig. 116.
Dichotomia cannoides MOORE 1949 p. 6.

Material:

"Pennsylvania"
St. 355 9.X.11
38°45′ N. 69°56′ W.
S 200 32 m. w. **2**

"Dana"
St. 845 30.IV.20
24°46′ N. 54°08′ W.
P 150 150 m. w. **2**

St. 848 2.VI.20
18°00′ N. 64°41′ W.
S 200 300 m. w. **6**

St. 850 4.VI.20
20°39′ N. 61°48′ W.
S 200 150 m. w. **1**

St. 867 24.VI.20
28°15′ N. 56°29′ W.
S 200 150 m. w. **1**

St. 875. 1.VII.20
28°58′ N. 67°09′ W.
S 150 150 m. w. **1**

St. 1294 18.VI.22
17°43′ N. 64°56′ W.
S 200 300 m. w. **1**

St. 848 and 1294 are near the Virgin Islands in the West Indies, the other localities are north and northeast of the West-Indian islands as far north as off Delaware Bay. Previously recorded from the Bahamas (BROOKS) and the Bermudas (MOORE).

The 14 specimens in the present collection are 3—8 mm. in diameter, most of them 4—5 mm., usually slightly higher than wide. They agree quite well with the original description of the species, except that the branching of the radial canals is not always as regular as described by BROOKS. In most of the specimens the four main radial canals arise in pairs from the ends of a short transverse canal (as in the type), and in some of them they are regularly dichotomously branched two or three times, so that 28—32 terminal branches open into the ring canal. In others the branching is more or less irregular, as seen in the figures (text-figs. 6*a*—*b*). In the specimen from St. 1294 (fig. 6*a*) each of the four canals is divided into two widely diverging

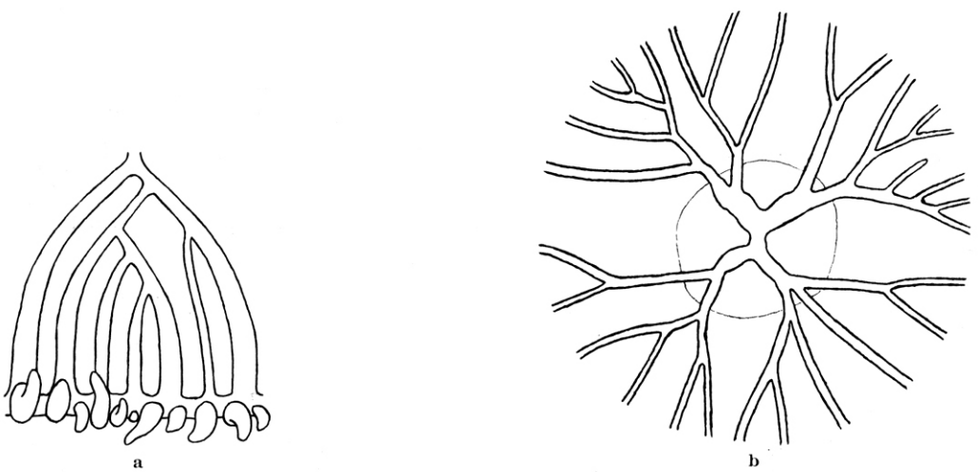


Fig. 6. *Dichotoma cannoides*. Branching of radial canals. *a*, one quadranth, with bell margin ("Dana" St. 1294); *b*, aboral view of central part of umbrella with four groups of radial canals, outline of stomach faintly indicated ("Dana" St. 850).

branches immediately outside the base of the stomach, but the further branching takes place by emission of lateral branches of first, second and third order, all the branches being collected inside the space between the two original diverging canals; in this specimen altogether 29 canals open into the ring canal. In the specimen from St. 850 the branching is somewhat more irregular (fig. 6*b*). In all the specimens which are so well preserved that it has been possible to follow the course of the canals, the terminal ends of the canals join

the ring canal at almost equal distances. Most of the canals are fairly broad, but some are quite narrow; their attachment to the subumbrella is as described and figured by BROOKS. The ring canal is also fairly broad. The manubrium is broad and about half as long as the height of the umbrella cavity.

Where it has been possible to count the tentacles, their number is usually 50—60, in the largest specimen, 8 mm. wide, as many as 70; most of them are broken at a short distance from their base. The basal bulbs are elongated pear-shaped and of very different sizes, but large and small are not regularly alternating, and their position is not always in correspondence with the canals. The tentacles are so densely crowded that they are more or less displaced up- and downwards on the umbrella margin, without regularity. According to the original description there are two kinds of tentacles in this species, 16—32 long hollow tentacles alternating with as many short, stiff, solid tentacles which are directed upwards. In the present specimens large and small tentacles differ from each other only in size; their basal bulbs are hollow, the young tentacles, some of which are fully retained, are not "solid" in the sense that their endoderm consists of a single core of cylindrical cells, but there are several rows of endoderm cells, so that even if no central cavity is present, the structure is essentially the same as in the fully developed tentacles. It is true that the small tentacles are kept in an upright position, but so are the basal bulbs of many of the large tentacles.

The numbers of terminal branches of the radial canals in proportion to the approximate numbers of tentacles in eight specimens are as follows: 25/50, 28/50, 29/50, 30/60, 30/65, 32/50, 32/55, 32/70.

Distribution: West Indies and the waters north of these islands up to about 39° N.

Fam. **Laodiceidae.**

Laodicea undulata (FORBES & GOODSIR).

Thaumantias undulata FORBES & GOODSIR 1853 p. 313, Pl. 10 fig. 7.
Laodicea cruciata MAYER 1910 p. 201.
Laodicea undulata KRAMP 1919 p. 16, Pl. 2 fig. 1—8.
Laodicea undulata RUSSELL 1953 p. 230, Pl. 14 fig. 1—3, text-fig. 123—131.

Material:

St. 850 4.VI.20
20°39′ N. 61°48′ W.
P 150 50 m. w. **1**

St. 1294 18.IV.22
17°43′ N. 64°56′ W.
S 200 100 m. w. **11**
S 200 600 m. w. **1**

St. 4003 9.III.30
8°26′ N. 15°11′ W.
S 150 3000 m. w. **1**

St. 4005 12.III.30
13°31′ N. 18°03′ W.
S 200 100 m. w. **6**
S 150 1000 m. w. **1**
S 150 2000 m. w. **1**
S 150 2500 m. w. **1**

St. 4007 15.III.30
18°22′ N. 18°14′ W.
S 200 50 m. w. **1**
S 200 100 m. w. **1**
S 150 2000 m. w. **1**

St. 4050 2—3.V.30
38°48′ N. 12°06′ E.
S 200 100 m. w. **2**
S 200 150 m. w. **1**
S 200 200 m. w. **1**
S 200 250 m. w. **2**
S 200 300 m. w. **1**

All specimens taken in deep hauls were probably captured in the upper strata during the hauling in or setting out of the nets.

The West-Indian specimens (St. 1294) are small, 3—4 mm. in diameter; the specimens from West Africa (St. 4003, 4005 and 4007) are 4—11 mm. wide; the specimens from the Mediterranean, near the west point of Sicily (St. 4050), are somewhat larger, 7—13 mm. in diameter. Most of the specimens are badly preserved; only in the specimens from the West Indies have I been able to state that there is an ocellus on about every third tentacle bulb.

Distribution: Common in the Mediterranean and the north-eastern Atlantic as far north as Iceland and Lofoten in Norway; also recorded from a number of localities along the west coast of Africa southwards to the Cape of Good Hope. In the western Atlantic it ranges from the Gulf of Maine to the West Indies, and it has also been found near the coast of Brazil, about 10° S., and on the Patagonian Bank.

Orchistoma pileus (LESSON).

Mesonema pileus LESSON 1843 p. 317. Pl. 6 fig. 1.
Orchistoma pileus MAYER 1910 p. 211. Pl. 25 fig. 1—4.

Material:

St. 1294. 18.IV.22. 17°43′ N. 64°56′ W. S 200, 300 m. w. 9 specimens.

The specimens are badly preserved, but I have no doubt of the correctness of the determination.

Distribution: ? West Africa (LESSON); Florida, Bahamas, and south of Cuba. Now found near the Virgin Islands.

"Orchistoma" tentaculata MAYER.

Orchistoma tentaculata MAYER 1900 *a* p. 8, Pl. 5 fig. 19.
Orchistoma tentaculata MAYER 1910 p. 212, Pl. 24 fig. 1.

Material:

"Agent Petersen" St. 301. 16.VI.11. 38°50′ N. 50°50′ W. S 100, 19 m. w., 1 specimen.

The locality is north-east of the Bermuda Islands. The specimen is somewhat mutilated, 5.5 mm. wide and about 4 mm. high, with dome-shaped apical jelly. The stomach is torn but has been broad. There are 22 unbranched radial canals issuing from the periphery of the stomach, all extending to the ring canal; the radial canals are ribbon-like, the ring canal narrow. Altogether 59 tentacles, 8 of which are distinctly larger than all the others. The large tentacles have a broadly conical or somewhat pear-shaped basal bulb, flattened on the abaxial side, without ocelli and without an adaxial papilla; these tentacles have apparently been long, one of them is spirally coiled at the tip. The small tentacles are densely crowded; they have no basal swellings, and most of them are directed outwards from the umbrella margin. Cordyli have not been observed in this species, but in the present specimen a few minute appendages may possibly be mutilated cordyli. The velum is lost.

I have no doubt but that this specimen belongs to the same species which was described by MAYER from a single specimen taken at Newport, Rhode Island. Since, however, the presence of cordyli has not been stated with certainty, its systematic position remains doubtful.

Distribution: Off the Atlantic coast of North America.

Toxorchis polynema n. sp.

Pl. I fig. 13, Pl. II fig. 4.

Material:

St. 3988. 23.II.30. 15°52′ S. 6°02′ W. S 200, 50 m. w. 1 specimen, which is the **type specimen.**

Description: Umbrella flat and thin, 17 mm. in diameter. Manubrium broad and flat, mouth with broad crenulated lips; the aboral surface of the stomach is attached to the subumbrella along the margins of a perradial cross consisting of two pairs of diverging branches united by a short bridge. Near the margin of the stomach each of the cross-arms is divided into two diverging furrows, each of which gives rise to two radial canals running to the umbrella margin. The result of this branching process is the formation of four groups of radial canals, each consisting of four canals arranged in two pairs. The branching is thus typically dichotomous, but it takes place inside the cruciform base of the stomach. The terminal ends of the radial canals, where they join the ring canal, are not equidistant, but the number of tentacles between two successive canals varies from 5 to about 40. There are 16 elongated gonads (female) along the proximal 3/5 or 2/3 of the radial canals, so that also the gonads are arranged in four groups with two pairs of gonads in

each group. The proximal ends of the gonads in each pair are very close together, but they are not confluent. The gonads are somewhat sinuous, broader in their proximal than in their distal ends; they are divided by a median line along their ventral edge. The distal portions of the radial canals free of gonads are very narrow, and the ring canal is also narrow.

The marginal tentacles (Pl. I fig. 13) are very numerous and all alike; parts of the umbrella margin are somewhat mutilated, but the greater part is retained, and the number of tentacles may be estimated at about 320. The basal bulbs of the tentacles are broadly pear-shaped, most of the tentacles are broken near their base, but some of them have retained their filiform part, which is either densely spirally coiled or extended to a length of $3^1/_2$—4 mm. and very thin. The cordyli are slightly club-shaped, somewhat shorter than the broad parts of the tentacle bulbs, each mounted on a minute marginal protuberance, and they have no nematocysts. Most of the cordyli are lost, but apparently there has been one between every successive pair of tentacles. Velum very narrow.

MAYER (1910 p. 228) gives the following diagnosis of the genus *Toxorchis*: "Thaumantiadae with 4, 6, or more main radial canals which branch regularly and dichotomously one or more times. The gonads are upon the outermost branches of the radial canals, near the ring-canal. Numerous tentacles, cirri, and marginal clubs". (The term "near the ring canal" must, however, be excluded from the diagnosis, since in all the species the radial canals have a considerable distal part free of gonads). The type species is *Toxorchis arcuatus* HAECKEL from the Canary Islands, which has six radial canals bifurcated once, and 24 tentacles; cordyli and spiral cirri are present. *T. kellneri* MAYER (1910), which occurs off the American coast from Cape Cod to Florida, has 8 radial canals bifurtated once, about 32 tentacles and about 50 cordyli. *Dipleurosoma brooksi* MAYER (1910) may probably also be referred to *Toxorchis*; it was found at the Bahamas, and it has 8 principal radial canals, four of which have two lateral branches opposite each other, whereas the four other radial canals are unbranched, and 16 tentacles (+ two small ones); cordyli are not mentioned in the description, which is based on a drawing made by the late W. K. BROOKS, but the figure distinctly shows a club-shaped marginal body between each successive pair of tentacles. The new species described above agrees with the diagnosis of the genus, except that no cirri are observed, but it cannot be confounded with any of the three species mentioned above.

MAYER (1910 p. 228) also refers *Berenix thalassina* PÉRON & LESUEUR (1809) to *Toxorchis*; it was found in northern Australia, and it was 50 mm. in diameter with about 70—100 tentacles; it had six primary radial canals, dichotomously branched several times, each with about 16 terminal branches. Cordyli were not seen by PÉRON, but MAYER may be right that *Cladocanna polyclada* HAECKEL, from New Guinea, belongs to the same species; it has a similar number of canals and tentacles, and it has marginal clubs and cirri; unfortunately it was not figured. According to the pretty figure given by PÉRON & LESUEUR the mode of branching of the radial canals in *T. thalassina* is very similar to that in the new species *T. polynema*, but it has six principal radial canals, and they are much more branched.

Toxorchis polynema n. sp. is well characterized by having four principal radial canals twice dichotomously branched, and very numerous tentacles.

Fam. **Mitrocomidae.**

Tiaropsis multicirrata (M. SARS).

Thaumantias multicirrata M. SARS 1835 p. 26. Pl. 5 fig. 12 *a—c*.
Tiaropsis diademata L. AGASSIZ 1849 p. 289. Pl. 6 fig. 1—18, Pl. 8 fig. 11.
Thaumantias eschscholtzii HAECKEL 1879, p. 129. Pl. 8 fig. 4.
Tiaropsis multicirrata KRAMP 1932 p. 364. Fig. 14, 15, 20, 35, 48 (full synonymy).
Tiaropsis multicirrata RUSSELL 1953 p. 278. Pl. 17 fig. 1, text-fig. 167—171.

Material:

St. 4019. 30.III.30. 33°08′ N. 10°22′ W. S 200, 50 m. w. 1 specimen.

The specimen is 5 mm. in diameter, somewhat mutilated, but there is no doubt of the identification. The locality, which is in the mouth of the Bay of Cadiz, is considerably farther south than the previously known area of distribution of this species.

Distribution: Common in the coastal waters of the northern Atlantic and adjacent waters; it occurs from Woods Hole on the American coast northwards to about 70° N. on the coasts of Baffin Land and Greenland; its occurrence in north-western Europe ranges from the English Channel to the north coast of Iceland and along the Norwegian coast to the Barents Sea. Also recorded from the Tschukotski Sea north of Siberia and from the Bering Sea.

Fam. **Phialuciidae.**

Octophialucium funerarium (QUOY & GAIMARD).

Dianaea funeraria QUOY & GAIMARD 1827 p. 184. Pl. 6 fig. 10—15.
Octocanna funeraria MAAS 1911 p. 3.
Octocanna funeraria KRAMP & DAMAS 1925 p. 306, fig. 27—33.
Octophialucium funerarium KRAMP 1955 p. 260.

Material:

St. 4025. 9.IV.30. 35°57′ N. 5°30′ W. S 200, 50 m. w. 7 specimens. S 200, 100 m. w. 8 specimens. S 200, 300 m. w. 8 specimens. S 200, 600 m. w. 12 specimens.
St. 4158. 17.VI.30. 46°28′ N. 8°01′ W. S 200, 950 m. w. 1 specimen.

In a recent paper (KRAMP 1955) I have given reasons for the view that the generic name *Octocanna* HAECKEL (1879) must be cancelled, because the two species, for which HAECKEL erected this genus, are unrecognizable. For the other species, which later on had been referred to *Octocanna*, I introduced the new name *Octophialucium*. I also demonstrated the near relation between these species and the species of the genus *Phialucium* MAAS and united the two genera into the new family Phialuciidae.

The specimen from St. 4158 in the Bay of Biscay is much damaged; it has probably been about 30 mm. in diameter. The other specimens, which were taken in the Straits of Gibraltar, the classical locality of the species, are likewise rather badly preserved, the tentacles cannot be counted in any of them, but most of them could be measured. They vary in size between 7 and 19 mm. in diameter, without relation to the depth in which they were captured; among 31 specimens 21 are between 10 and 13 mm. wide, 4 are less than 10 mm., 6 are more than 13 mm. Three specimens have only 7 radial canals, all the others have the normal number of eight.

Distribution: Fairly common in the Mediterranean and in some of the deep Norwegian fjords, once recorded from west of Scotland; St. 4158 in the Bay of Biscay connects these two areas of distribution. It is a medusa belonging to the deep and intermediate strata, and it is very interesting that at St. 4025 in the Straits of Gibraltar it was collected in the upper water layers.

Octophialucium sp.

Material:

St. 1294. 18.IV.22. 17°43′ N. 64°56′ W. S 200, 100 m. w. 2 specimens.

The specimens are about 18 mm. in diameter, one with eight, the other probably with nine radial canals; both specimens are very badly preserved, and their tentacles cannot be counted. It is deplorable that the species cannot be identified, since this is the first time that an *Octophialucium* has been found in the western Atlantic.

Fam. **Eirenidae.**

Philopsis diegensis TORREY.

Phialopsis diegensis TORREY 1909 p. 23. Fig. 9.
Eirene diegensis RANSON 1934 *a* p. 275.
Phialopsis diegensis RUSSELL 1953 p. 333. Pl. 20 fig. 5; text-fig. 213, 214.
Phialopsis diegensis KRAMP 1957 p. 35.

Material:

St. 3996 25.II.30
15°41′ S. 5°50′ W.
S 150 1000 m. w. **2**

St. 3998 1.III.30
7°34′ S. 8°48′ W.
S 150 2000 m. w. **2**
S 150 3000 m. w. **1**

St. 4000 4.III.30
0°31′ S. 11°02′ W.
S 200 600 m. w. **1**

St. 4003 9.III.30
8°26′ N. 15°11′ W.
S 200 100 m. w. **2**
S 200 300 m. w. **10**
S 150 1000 m. w. **1**
S 150 2000 m. w. **1**
S 150 3000 m. w. **2**
S 150 5000 m. w. **1**

St. 4005 12.III.30
13°31′ N. 18°03′ W.
S 200 50 m. w. **11**
S 200 100 m. w. **5**
S 200 300 m. w. **2**
S 200 600 m. w. **1**
S 150 1000 m. w. **3**
S 150 2500 m. w. **1**

St. 4007 15.III.30
18°22′ N. 18°14′ W.
S 200 300 m. w. **1**
S 150 2000 m. w. **2**

St. 4009 18.III.30
24°36.5′ N. 17°27′ W.
S 200 300 m. w. **1**
S 150 3500 m. w. **1**

St. 4017 27.III.30
29°11′ N. 14°14′ W.
S 200 50 m. w. **1**
S 200 100 m. w. **1**
S 150 1500 m. w. **1**

St. 4019 30.III.30
33°08′ N. 10°22′ W.
S 200 300 m. w. **2**

All the specimens are in a very bad condition, but by comparison with other specimens from neighbouring localities they could be identified.

Distribution: Though this is a Leptomedusa, it has a predominantly oceanic distribution. All the stations mentioned above are off the west coast of Africa, where the species has previously been found in several localities. It is also recorded from off the coast of Uruguay in South America, from South Africa and from Somaliland on the east coast of Africa. In the northern Atlantic it has been found south-west of Ireland, east of Newfoundland, and in the Irminger Sea. In the eastern Pacific it is recorded from a locality south-west of the Galapagos Islands and from San Diego in California, whence it was first described by TORREY.

Fam. **Aequoreidae.**

Aequorea aequorea (FORSKÅL).

Medusa aequorea FORSKÅL 1775 p. 110, 1776 Pl. 32.
Aequorea forskalea PÉRON & LESUEUR 1809 p. 336.
Aequorea forskalea RUSSELL 1953 p. 342. Pl. 21 fig. 3, Pl. 32 fig. 1—2, text-fig. 220—221.

Material:

St. 299. 13.VI.11. 37°05′ N. 54°34′ W. S 100, 34 m. w., 1 specimen.
St. 4195. 22.VI.31. 41°55′ N. 32°22′ W. S 200, 50 m. w., 1 specimen.

The specimen from St. 299 is 58 mm. in diameter, that from St. 4195 is young specimen, 18 mm. wide, with about 72 radial canals; number of tentacles estimated at about 20.

Distribution: European coasts from Portugal to about 66° N. off the west coast of Norway; Mediterranean Sea; Atlantic coast of North America from Florida to Cape Cod; recorded from scattered localities on the west coast of Africa between Cape Verde and the Cape of Good Hope; Patagonian coast of South America. The locality mentioned above is near the Azores. Records from the Pacific coast of North America are doubtful.

Aequorea macrodactyla (Brandt).

Mesonema macrodactylum Brandt 1838 p. 359. Pl. 5.
Aequorea maldivensis Browne 1905 p. 732. Pl. 56 fig. 4—12.
Aequorea macrodactylum Bigelow 1909 *a* p. 174. Pl. 36 fig. 5—10.
Aequorea macrodactyla Mayer 1910 p. 333.
Aequorea macrodactyla Kramp 1953 p. 294.
Aequorea pensilis Russell 1953 p. 355. Pl. 33 fig. 1—5; text-fig. 220 C, D, 225.

Material:

St. 1192 15.XII.21
17°43.4′ N. 64°43.3′ W.
S 200 100 m. w. **1**

St. 1208 16.I.22
6°48′ N. 80°33′ W.
E 300 1000 m. w. **7**

St. 1225 2.II.22
23°58′ N. 83°22′ W.
E 300 1000 m. w. **1**

St. 3975 31.I.30
35°42′ S. 18°37′ E.
S 150 1500 m. w. **4**
S 150 2000 m. w. **3**
S 150 2500 m. w. **3**

St. 3980 17.II.30
23°26′ S. 3°56′ E.
S 150 2000 m. w. **1**

St. 3988 23.II.30
15°52′ S. 6°02′ W.
S 200 50 m. w. **4**

St. 3996 25.II.30
15°41′ S. 5°50′ W.
S 200 50 m. w. **10**
S 200 100 m. w. **6**
S 200 300 m. w. **9**
E 300 1000 m. w. **8**
S 150 1000 m. w. **3**
S 150 1500 m. w. **6**
S 150 2000 m. w. **19**
S 150 3000 m. w. **47**
E 300 4000 m. w. **3**

St. 3998 1.III.30
7°34′ S. 8°48′ W.
S 200 600 m. w. **1**

As previously stated by me (Kramp 1953) *A. pensilis* (Haeckel) and *A. macrodactyla* (Brandt) are two distinct species, distinguished from each other mainly by the structure of the tentacle bulbs, which in *A. macrodactyla* are provided with an abaxial longitudinal keel and spur and a prominent adaxial excretory papilla, whereas in *A. pensilis* the bulbs have long lateral extensions and no keel, and the excretory pore is not mounted on a papilla. As a rule *A. pensilis* has many more radial canals than *A. macrodactyla* of corresponding size, but in numerical respect both species are very variable and overlap each other. Both are widely distributed in the Pacific and Indian Oceans, but *A. pensilis* does not seem to occur in the Atlantic, whence *A. macrodactyla* is recorded several times.

In most of the specimens collected by the "Dana" counting of radial canals and tentacles was impossible, but I shall give the available data.

The specimen from St. 1192, near the Virgin Islands in the West Indies, is about 25 mm. wide; the specimen from St. 1225, between Cuba and Florida, is 70 mm. wide with 83 radial canals and probably about 17 tentacles. St. 1208 is in the Gulf of Panama; the seven specimens taken here are small and have the following numbers of radial canals:

Diameter, mm	5	8	9—10	12
Radial canals	26	?	29—31	27—34

All the other stations are off the west coast of Africa, and their dimensions may be treated collectively.

Diameter mm.	Radial canals	Tentacles	Diameter mm.	Radial canals	Tentacles
5	26	6	12	34	?
6	36	4	13	32	?
8	34	7	14	28	?
8	39	?	14	32	7
9	31	?	15	32	7
12	33	6	15	35	11
12	33	?	17	28	7
12	34	5			

The variation in number of radial canals and tentacles is thus not very great in this collection.

It is rather peculiar that *A. macrodactyla*, which usually occurs in the upper strata, was taken by the "Dana" in hauls with very different lengths of wire out. It seems to me most probable that all of them were actually captured in the surface water, where this, as well as other species of *Aequorea*, may sometimes be

seen in dense shoals. This impression is confirmed by the following measurements of the specimens taken in hauls with different lengths of wire; if the specimens had really been captured at so many different levels down to about 2000 metres below the surface, one should expect to find a certain characteristic vertical dispersion of the various size-groups. The figures show, however, that the specimens vary within very nearly the same limits at all "depths":

Length of wire m.	Number of specimens	Diameter mm.	Length of wire m.	Number of specimens	Diameter mm.
50	13	8—17	1500	10	5—14
100	6	13—16	2000	23	5—12
300	9	5—13	2500	3	6—12
600	1	9	3000	47	5—17
1000	11	5—13	4000	3	8—10

No adult specimens were taken in the series of stations off the African coast. This may possibly be due to the season (February).

Distribution: Widely distributed in the warm parts of the Indian and Pacific Oceans from Africa to America. Also recorded from Great Fishbay (THIEL 1938 p. 332) and several other localities off the southern part of the west coast of Africa and from the Patagonian coast of South America (KRAMP 1957). According to RUSSELL (1953) it may occur in the English Channel. Now also found in the West Indies, whence it has not previously been recorded.

Aequorea sp.

Material:

St. 1192. 15.XII.21. 17°43.4′ N. 64°54.3′ W. S 200, 300 m. w., 1 specimen.
St. 1294. 18.IV.22. 17°43′ N. 64°56′ W. S 200, 100 m. w., 1 specimen.
St. 1314. 22.IV.22. 17°43′ N. 64°56′ W. E 300, 1000 m. w., 1 specimen.

Fragmentary specimens which may possibly belong to *A. macrodactyla*. The localities are near the Virgin Islands in the West Indies.

Zygocanna vagans BIGELOW.

Zygocanna vagans BIGELOW 1912 p. 255.
Zygocanna vagans BIGELOW 1919 p. 315. Pl. 42 fig. 5—7, Pl. 43 fig. 6.
Zygocanna vagans BIGELOW 1940 p. 299. Fig. 14.
Zygocanna vagans KRAMP 1957 p. 40.

Material:

St. 4195. 22.VI.31. 41°55′ N. 32°22′ W. S 200, 300 m. w., 1 specimen.

The specimen is in a fairly good condition, 50 mm. in diameter, flat and rigid. It agrees perfectly with BIGELOW's descriptions. The variability and irregularities of the branching of the radial canals are pointed out by BIGELOW; the way of branching in the present specimen is illustrated in text-fig. 7. The thoroughly dichotomous branching takes place entirely inside the periphery of the stomach, which is about 17 mm. in diameter measured between its outermost lobes. As a matter of fact, therefore, it is not the canals themselves which are branched, but "rather the lines on the roof of the manubrium, which represent their location at early stages" (BIGELOW). The branching originates from three diverging central trunks, each of which soon bifurcates, and the repeated bifurcation results in 41 canals leaving the periphery of the stomach; one, and only one, of the canals, is further bifurcated twice before reaching the umbrella margin. The "canals" inside the periphery of the stomach may approximately be divided into six groups consisting of 8, 7, 5, 6, 6 and 9 terminal branches. The numbers of marginal tentacles corresponding to the six groups of canals are respectively: 6, 5, 5, 6, 6 and 6; the total number of tentacles thus is 34. Between successive tentacles

there are sometimes two, but usually 3—4 rudimentary marginal knobs. There is a radiating row of prominent gelatinous papillae on the subumbrella between each successive pair of radial canals, exactly as in the specimens described by BIGELOW.

BIGELOW is inclined to think that the two medusae from the Malayan Archipelago, described by MAAS (1905 p. 44), belong to *Zygocanna vagans*. They are young specimens, 20—22 mm. wide, and the branching of the radial canals mainly takes place outside the periphery of the stomach. There is the possibility that by further development the stomach may grow outwards beyond the basal parts of the canals with the result that their branching portions will be situated inside the periphery of the stomach as in *Z. vagans*. According to the figure of the marginal organs (MAAS Pl. 8 fig. 53) the basal bulbs of the tentacles in his specimens are

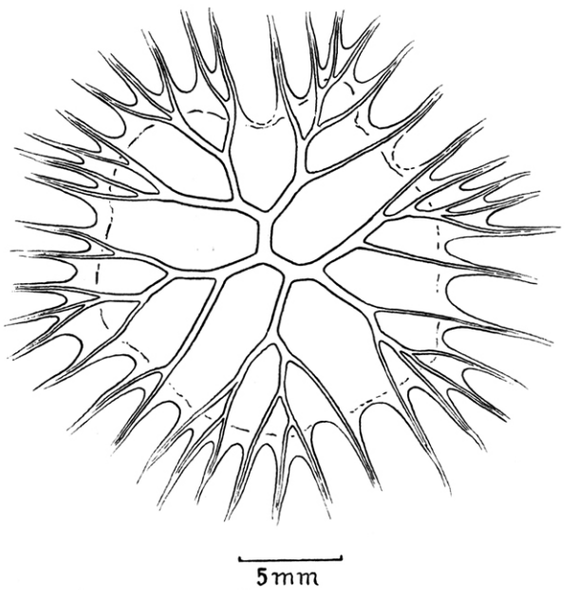


Fig. 7. *Zygocanna vagans*. aboral view of stomach, showing branching of radial canals (P. WINTHER del.).

considerably broader and shorter than in *Z. vagans*, and excretory papillae seem to be absent, whereas in *Z. vagans* the tentacle bulbs as well as the rudimentary marginal knobs are provided with particularly long and prominent excretory papillae. BIGELOW may be right in his assumption, but some doubt of the identity seems to me to remain.

Distribution: The specimens described by BIGELOW were collected in two widely separated parts of the Pacific, the Philippines and the Gulf of Panama. A specimen was taken by the "Discovery" near the Cape of Good Hope in South Africa (KRAMP 1957) and the locality where it was found by the "Dana" is near the Azores. It is very interesting that, apart from minor individual variations in numerical respects, the specimens found in these four widely separated areas agree so perfectly in all structural details; in this species no indication of geographical variation may be pointed out.

Trachymedusae.

Fam. **Halicreidae.**

Halicreas minimum Fewkes.

Halicreas minimum Fewkes 1882 p. 306.
Halicreas papillosum Vanhöffen 1902 p. 68. Pl. 9 fig. 7, 8, Pl. 11 fig. 30.
Halicreas papillosum Bigelow 1909 *a* p. 138. Pl. 3 fig. 3, Pl. 33 fig. 8, 9, Pl. 34 fig. 1—3, 5, 8, 10, 11.
Halicreas minimum Bigelow 1938 p. 122.
Halicreas minimum Kramp 1947 p. 7. Pl. 6 fig. 3.
Halicreas minimum Kramp 1957 p. 47.

Material:

St. 1156 25.X.21
25°11′ N. 20°57′ W.
6000 m. w. **1**

St. 1185 27.XI.21
17°41′ N. 60°50′ W.
E 300 6000 m. w. **2**

St. 1203 11.I.22
7°30′ N. 79°19′ W.
E 300 2500 m. w. **1**
E 300 3500 m. w. **6**

St. 1206 14.I.22
6°40′ N. 80°47′ W.
E 300 4500 m. w. **30**

St. 1208 16.I.22
6°48′ N. 80°33′ W.
E 300 3500 m. w. **30**
E 300 3600 m. w. **30**

St. 1209 17.I.22
7°15′ N. 78°54′ W.
E 300 3500 m. w. **15**

St. 1217 29.I.22
18°50′ N. 79°07′ W.
E 300 4000 m. w. **1**

St. 1228 3.II.22
23°35′ N. 81°54′ W.
E 300 1000 m. w. **1**

St. 1239 12.II.22
25°50′ N. 76°55′ W.
S 150 3000 m. w. **1**
S 150 4000 m. w. **5**
E 300 4500 m. w. **4**

St. 1242 14.II.22
24°05′ N. 74°36′ W.
E 300 4000 m. w. **2**

St. 1247 20.II.22
17°57′ N. 72°51′ W.
E 300 1000 m. w. **1**

St. 1261 9.III.22
19°04′ N. 65°43′ W.
S 150 4000 m. w. **3**

St. 1267 14.III.22
17°56′ N. 64°50′ W.
E 300 4500 m. w. **2**

St. 1269 15.III.22
17°13′ N. 64°58′ W.
E 300 4500 m. w. **2**

St. 1288 10.IV.22
16°04′ N. 61°52′ W.
E 300 1500 m. w. **1**

St. 1342 15.V.22
34°00′ N. 70°01′ W.
E 300 4500 m. w. **2**

St. 1387 25.VI.22
46°28′ N. 8°01′ W.
E 300 5000 m. w. **6**

St. 3975 31.I.30
35°42′ S. 18°37′ E.
E 300 1000 m. w. **13**
S 150 1000 m. w. **12**
S 150 2500 m. w. **2**
E 300 3000 m. w. **30**

St. 3978 13.II.30
30°15′ S. 13°15′ E.
S 150 2000 m. w. **7**
S 150 3000 m. w. **27**
S 150 4000 m. w. **15**
E 300 5000 m. w. **9**

St. 3980 17.II.30
23°26′ S. 3°56′ E.
S 150 2000 m. w. **3**
S 150 3000 m. w. **11**
S 150 4000 m. w. **2**
S 150 5000 m. w. **2**
E 300 6000 m. w. **1**

St. 3996 25.II.30
15°41′ S. 5°50′ W.
S 150 2000 m. w. **10**
S 150 3000 m. w. **11**
E 300 4000 m. w. **8**

St. 3998 1.III.30
7°34′ S. 8°48′ W.
S 150 2000 m. w. **17**
S 150 3000 m. w. **5**
S 150 4000 m. w. **5**
S 150 5000 m. w. **3**
E 300 6000 m. w. **11**

St. 4000 4.III.30
0°31′ S. 11°02′ W.
E 300 1000 m. w. **14**
S 150 2000 m. w. **1**
S 150 3000 m. w. **12**
S 150 4000 m. w. **12**
S 150 5000 m. w. **12**
E 300 6000 m. w. **25**

St. 4003 9.III.30
8°26′ N. 15°11′ W.
E 300 1000 m. w. **3**
S 150 2000 m. w. **11**
S 150 3000 m. w. **2**
S 150 4000 m. w. **3**
S 150 5000 m. w. **3**
E 300 6000 m. w. **12**

St. 4005 12.III.30
13°31′ N. 18°03′ W.
S 200 600 m. w. **2**
E 300 1000 m. w. **80**
S 150 1000 m. w. **10**
S 150 2500 m. w. **8**
S 150 3500 m. w. **14**
E 300 4000 m. w. **14**

St. 4007 15.III.30
18°22′ N. 18°14′ W.
E 300 1000 m. w. **72**
S 150 1000 m. w. **16**
S 150 2000 m. w. **13**
S 150 2500 m. w. **29**
S 150 3000 m. w. **19**
S 150 3500 m. w. **27**
E 300 4000 m. w. **115**

St. 4009 18.III.30
24°36.5′ N. 17°27′ W.
S 150 2500 m. w. **12**
S 150 3000 m. w. **18**
S 150 3500 m. w. **8**
E 300 4000 m. w. **17**

St. 4017 27.III.30
29°11′ N. 14°14′ W.
S 150 3000 m. w. **2**
S 150 4000 m. w. **2**
E 300 5000 m. w. **2**

St. 4019 30.III.30
33°08′ N. 10°22′ W.
S 150 3000 m. w. **1**
E 300 4000 m. w. **1**

St. 4158 17.VI.30
46°28′ N. 8°01′ W.
S 150 4000 m. w. **1**
S 150 4500 m. w. **1**
E 300 5000 m. w. **7**
S 150 5500 m. w. **1**

Almost all the specimens are badly preserved, as a rule only the gelatinous disk is left, but even so the species may be determined with security by means of the gelatinous marginal warts. The diameter has been measured, when it was possible, in order to see, whether any correlation between the size of the specimens and their bathymetrical occurrence might be pointed out. The number of specimens found in different parts of the areas investigated presents some points of interest.

Very few specimens were taken at St. 1156 south-west of the Canary Islands, St. 1342 north-west of the Bermudas, and St. 1387 and 4158 in the Bay of Biscay. The species likewise seems to be scarce in West-Indian waters, St. 1185 and 1217—1288; it has not previously been recorded from this area. At St. 1203—1209 in the Gulf of Panama it was rather abundant.

St. 3975—4019 is an interesting series off the west coast of Africa from near the Cape of Good Hope to Morocco. The number of specimens taken at each of the eleven stations of this series is very variable and may roughly be illustrated by the following figures:

Station number	Average number of specimens per one haul	Maximal number of specimens in one haul
3975	19	30
3978	14.5	27
3980	4	3
3996	10	11
3998	8	17
4000	13	25
4003	11	12
4005	21	80
4007	42	115
4009	14	18
4017	2	2
4019	1	1

Though these figures do not give an exact impression of the quantity of the medusa in the various parts of this tract, they clearly show that it was particularly abundant at St. 3975 and 3978 near the southernmost part of the African coast, and at St. 4005 and 4007, which are near the coast between Cape Verde and Cape Blanco, whereas it was less common in the off-shore area between the Cape of Good Hope and Cape Verde and again decreasing remarkably in number in the coastal waters off Rio de Oro and Morocco. Considering that this species is a distinctly oceanic, bathypelagic medusa, it seems peculiar that it was less abundant in the off-shore areas than in the neighbourhood of the coasts. It should be remembered, however, that upwelling of cold deep water towards the coast is particularly pronounced just off the two parts of the African coast, where *Halicreas* was so very abundant. The upwelling does not directly concern the deep strata inhabited by this medusa, but the upwelling brings about an increased production of nutritive matters in the upper strata, resulting in the development of a dense population of pelagic animals, and this effect is transmitted downwards to the inhabitants of the psychrosphere and improve their conditions of life. The abundance of *Halicreas* near the coasts of South-West Africa and the Cape Verde region is most probably due to particularly favourable food conditions in these tracts. Upwelling also takes place further north off the Mauretanian coast; nevertheless *Halicreas* was scarce in this tract, decreasing remarkably in number from St. 4009 to 4017 and 4019. This is most probably due to the outflow of water from the Mediterranean causing a comparatively high temperature of the lower strata, as seen from the following examples of the hydrographical observations:

Station number	Temperatures[1]) at: 600 m.	1000 m.	2000 m.
4005	8.0°	5.6°	3.4°
4007	8.7°	6.3°	3.5°
4009	9.75°	7.15°	3.7°
4017	11.1°	8.3°	4.4°
4019	10.6°	9.8°	4.3°

The medusa was still moderately common at St. 4009 in hauls with 2500 to 4000 m. wire, but very rare at the two northernmost stations, where it was entirely lacking in hauls with less than 3000 m. wire, a few

[1]) All temperatures in the present paper are given in centigrades.

specimens being found in the deepest strata, where the increase in temperature was not so remarkable. This is in good accordance with the general occurrence of this bathypelagic medusa.

Owing to the use of open nets, the depths in which the specimens have actually been captured cannot be stated with certainty. The maximal depth may, however, be determined, and measurements of the specimens give some idea of the bathymetrical distribution of the different stages of development, as seen from the following measurements of specimens found off the west coast of Africa:

Length of wire m.	Size-limits of the specimens mm.
600	8—14
1000	8—18 (27)
2000	8—34
3000	6—37
4000	10—38
5000	10—38
6000	8—35

During the investigations by the "Dana" *Halicreas* was taken with 600 m. wire out on only one occasion, at St. 4005, near Cape Verde, when two specimens were found at this comparatively high level, both of them small. With the exception of one specimen, 27 mm. wide, which was found at St. 3975 near the Cape of Good Hope, all the specimens taken in hauls with 1000 m. wire were less than 18 mm. in diameter. At greater depths all sizes were represented, varying from 6 to 38 mm. in diameter. Some of the specimens taken in the deep hauls may have been captured at higher levels, but the figures clearly show that adult specimens were found only in hauls with 2000 m. wire or more, whereas young individuals may ascend into somewhat higher levels. Measurements of the specimens from the Gulf of Panama give similar results; in the hauls with 3500 and 4500 m. wire the umbrella of the medusae varied in size between 14 and 41 mm.; the only specimen taken with 2500 m. wire was only 23 mm. wide. The few specimens from the West Indies were all fairly small, 18—26 mm. wide.

Distribution: *Halicreas minimum* is a bathypelagic medusa, probably generally distributed in the deep parts of all the oceans except the Mediterranean and the arctic basins. In the Atlantic it occurs as far north as off the south coast of Iceland and into the southern part of Davis Strait. It was not previously known from the West-Indian waters, where the "Dana" found it in several localities. Its southward distribution extends almost to the slope of the Antarctic Continent, in the Atlantic as well as in the Indian sector. It is abundant in the eastern tropical Pacific and also recorded from the Bering Sea, the Sea of Ochotsk, Japan, the Philippines, the Malayan Archipelago and off North-East and South-East Australia, whereas it has not yet been recorded from the central and southern parts of the Pacific.

Haliscera bigelowi KRAMP.

Homoeonema alba BIGELOW 1909 *a* p. 142. Pl. 3 fig. 1, 2, Pl. 33 fig. 6, 11, Pl. 34 fig. 9.
Haliscera bigelowi KRAMP 1947 p. 8. Pl. 1 fig. 5—8, Pl. 2 fig. 1, 2.
Haliscera bigelowi KRAMP 1948 *b* p. 6.
Haliscera bigelowi RUSSELL 1953 p. 456. Pl. 27 fig. 2; text-fig. 301, 302.

Material:

St. 4003 9.III.30 8°26′ N. 15°11′ W. S 150, 3000 m. w. 15 specimens.
St. 4017 27.III.30 29°11′ N. 14°14′ W. S 150, 4000 m. w. 1 specimen.
St. 4158 18.VI.30 46°28′ N. 8°01′ W. S 150, 1500 m. w., 50 specimens, S 150, 2000 m. w., 5 specimens, S 150, 3000 m. w., 6 specimens, S 150, 4000 m. w., 1 specimen, E 300, 5000 m. w., 6 specimens, S 150, 5500 m. w., 3 specimens.

This species is quite different from *Haliscera alba* which has never been found again since it was insufficiently described by VANHÖFFEN (1902) from a locality south-west of Africa.

Distribution: The previous records of *Haliscera bigelowi* are partly from the eastern tropical Pacific (BIGELOW), partly from the northern Atlantic ranging from about 45° N. towards the south coast of Iceland. It is interesting that it has now been found off the northern part of the west coast of Africa. It is a predominantly bathypelagic species.

Botrynema brucei BROWNE.

Halicreas glabrum VANHÖFFEN 1902 p. 70. Pl. 9 fig. 3.
Botrynema brucei BROWNE 1908 p. 239. Pl. 1 fig. 8, 9, Pl. 2 fig. 1.
Botrynema brucei VANHÖFFEN 1912 *a* p. 382. Pl. 25 fig. 5; text-fig. 18, 19.
Botrynema brucei KRAMP 1942 p. 77.
Botrynema brucei KRAMP 1947 p. 11. Pl. 1 fig. 9, Pl. 2 fig. 3, Pl. 6 fig. 4.
Botrynema brucei KRAMP 1948 *b* p. 6.
Botrynema brucei RUSSELL 1953 p. 459. Pl. 27 fig. 1; text-fig. 303, 304.

Material:

St. 1239 12.II.22
25°50′ N. 76°55′ W.
S 150 4000 m. w. **1**
E 300 4500 m. w. **3**

St. 1342 15.V.22
34°00′ N. 70°01′ W.
E 300 4500 m. w. **2**

St. 3978 13.II.30
30°15′ S. 13°15′ E.
S 150 4000 m. w. **2**

St. 3980 17.II.22
23°26′ S. 3°56′ E.
S 150 5000 m. w. **1**
E 300 6000 m. w. **1**

St. 3996 25.II.22
15°41′ S. 5°50′ W.
E 300 4000 m. w. **2**

St. 3998 1.III.30
7°34′ S. 8°48′ W.
S 150 2000 m. w. **1**
S 150 3000 m. w. **1**
S 150 4000 m. w. **1**

St. 4000 4.III.30
0°31′ S. 11°02′ W.
S 150 4000 m. w. **2**
S 150 5000 m. w. **2**
E 300 6000 m. w. **2**

St. 4158 18.VI.30
46°28′ N. 8°01′ W.
S 150 5500 m. w. **1**

As previously stated by me "*Halicreas glabrum*" VANHÖFFEN was not described in a recognizable way, and the accompanying figure was misleading. I therefore preferred to use the name *Botrynema brucei* BROWNE for this medusa. As a rule even badly preserved specimens may be identified with certainty by means of the characteristic shape of the umbrella and the peculiar arrangement of the traces of tentacles which are usually left on the umbrella margin.

St. 4158 is in the Bay of Biscay. St. 1239 is near the Bahamas, St. 1342 north-west of Bermuda; this is the first time the species has been found in the western part of the tropical Atlantic. The other stations are off the west coast of Africa, where the species has previously been found in several localities.

Distribution: Widely distributed in the Atlantic Ocean, where it has its northern limit of distribution south of the submarine ridge between Scotland, Iceland, Greenland and Baffin Land. Towards the south it penetrates far into the antarctic region into the Weddell Sea. It also occurs near the Indian sector of the Antarctic Continent as well as in warmer parts of the Indian Ocean. The only records from the Pacific are in two widely separated areas, the Bering Sea (BIGELOW 1913) and South-East Australia (BLACKBURN 1955). It is a decidedly bathypelagic species.

Halitrephes maasi BIGELOW.

Halitrephes maasi BIGELOW 1909 *a* p. 146. Pl. 33 fig. 1—5, 7, 10; Pl. 45 fig. 13.
Halitrephes valdiviae VANHÖFFEN 1912 *a* p. 384.
Halitrephes valdiviae BIGELOW 1938 p. 125.
Halitrephes valdiviae KRAMP 1948 *a* p. 7.
Halitrephes medius KRAMP 1948 *a* p. 7; fig. 1.
Halitrephes maasi KRAMP 1957 p. 51.

Material:

St. 1203 11.I.22
7°30′ N. 79°19′ W.
E 300 3500 m. w. **9**

St. 1206 14—15.I.22
6°40′ N. 80°47′ W.
E 300 1200 m. w. **1**
E 300 4500 m. w. **39**

St. 1208 16.I.22
6°48′ N. 80°33′ W.
E 300 3500 m. w. **2**
E 300 3600 m. w. **1**

St. 1217 29.I.22
18°50′ N. 79°07′ W.
E 300 4000 m. w. **2**

St. 1245 17.II.22
19°35′ N. 73°08′ W.
E 300 1000 m. w. **1**

St. 1261 9.III.22
19°04′ N. 65°43′ W.
S 150 3500 m. w. **1**

St. 1283 5.IV.22
14°38′ N. 61°16′ W.
E 300 4000 m. w. **2**

St. 1287 8.IV.22
16°04′ N. 61°52′ W.
E 300 1000 m. w. **1**

St. 1322 30.IV.22
27°02′ N. 53°39′ W.
E 300 2500 m. w. **1**

St. 3978 13.II.30
30°15′ S. 13°15′ E.
S 150 1000 m. w. **2**
S 150 3000 m. w. **1**

St. 3998 1.III.30
7°34′ S. 8°48′ W.
E 300 6000 m. w. **1**

St. 4005 12.III.30
13°31′ N. 18°05′ W.
E 300 4000 m. w. **2**

The relation between the three species of *Halitrephes* was recently discussed by me (KRAMP 1957). I then came to the conclusion that most of VANHÖFFEN's specimens of *H. valdiviae* belong to *H. maasi* BIGELOW, whereas the largest specimen of *H. valdiviae* might provisionally be regarded as a distinct species. Until further evidence to the contrary I also retained *H. medius* as a separate species. The "Dana" collection, however, has convinced me that all of them must be united into one species, *H. maasi*.

Unfortunately this bathypelagic medusa is very brittle and delicate; very often the gastrovascular system has entirely disappeared, so that the radial canals cannot be counted; but the basal stumps of the tentacles are usually retained and likewise some of the sensory clubs. As a rule, therefore, it is possible to determine the genus and count the tentacles. The specimens collected by the "Dana" are no exceptions from the rule, all of them are badly preserved, and in the above enumeration I have omitted several specimens of Halicreids which may have belonged to *Halitrephes* but could not be identified with certainty. In only one of the numerous specimens was it possible to count the radial canals; it is a young specimen from St. 3978, 10 mm. in diameter with 16 radial canals and about 30 tentacles.

In my recent paper in the Discovery Reports I have given a detailed account of the number of tentacles in proportion to the diameter of the umbrella in all specimens observed up to then by BIGELOW, VANHÖFFEN and myself. In the present collection I have been able to count, or at least to estimate, the number of tentacles in 41 specimens as follows:

Diam. of umbrella mm.	Approximate number of tentacles	Number of specimens
9—10	30	2
25—30	45—50	2
30—35	60—70	2
35—40	55—70	5
40—45	50—80	8
45—50	45—80	10
50—55	70—145	2
55—60	50—90	4
60—65	145	1
65—70	170—190	1
70—75	165—180	2
75—80	190	1
80—85	205	1
130	300	1

The accompanying diagram (fig. 8) shows the number of tentacles in all specimens observed up to now in which counting was possible. The variations may be due partly to the inaccuracy of the countings, partly to the softness of the umbrella which renders an exact measurement of the diameter difficult.

It will be seen that the specimens of the various collections vary within about the same limits, and the numerous specimens from the "Discovery" and the "Dana" establish a connection of BIGELOW's original specimen of *H. maasi* (55 mm. wide with about 70 tentacles) with VANHÖFFEN's specimens of *H. valdiviae*

less than 45 mm. in diameter. The large specimen of *H. valdiviae* (70 mm. wide with 204 tentacles) occupied an isolated position; the gap between this specimen and *H. maasi* was partly bridged by some specimens from the Bermudas (BIGELOW 1938, 45 mm. with at least 105 tentacles, 55 mm. with 102, and 60—80 mm. with at least 145—170 tentacles), and the connection is completed through a number of specimens from the "Dana", 52—83 mm. wide with 145—205 tentacles. *H. medius* KRAMP was distinguished by its large size (100 mm.) and very numerous tentacles (about 280); in both respects it is surpassed by one of the "Dana" specimens, being 130 mm. wide with about 300 tentacles.

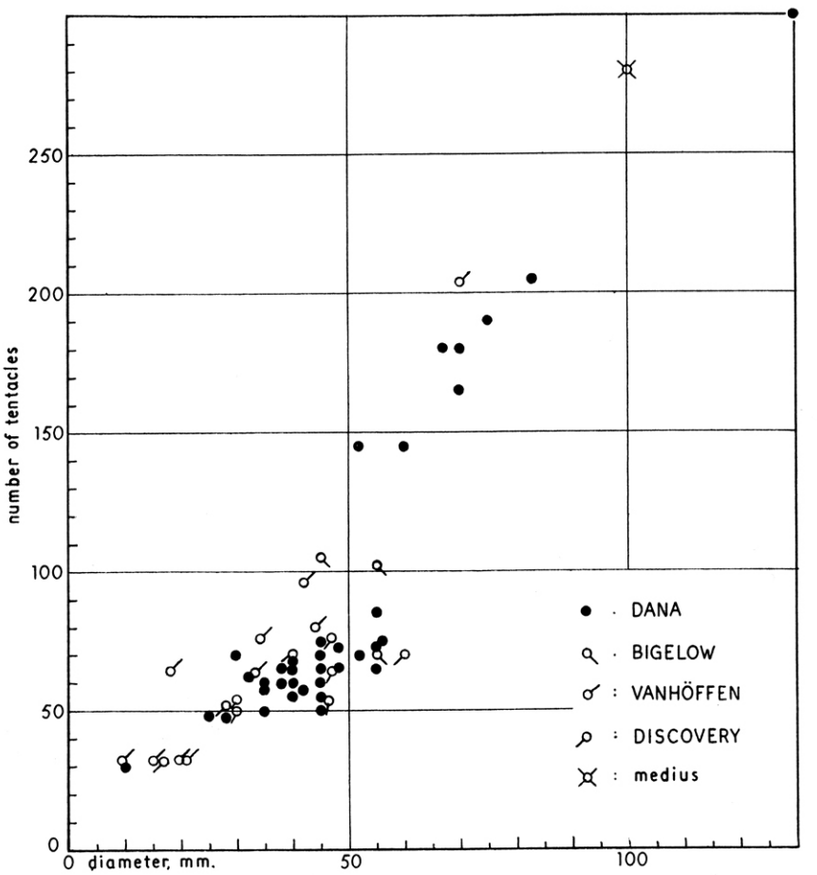


Fig. 8. *Halitrephes maasi*. Number of tentacles in proportion to diameter of umbrella.

As far as the number of tentacles in relation to size of the umbrella is concerned, there is accordingly an even transition between the three "species" of *Halitrephes*. The number of radial canals has been stated in only very few specimens. In VANHÖFFEN's specimens there were 16 canals, in so far as it was possible to count them; presumably they were not counted in the large specimen with 204 tentacles. Five specimens of the "Discovery" collection, 10—40 mm. wide, had 16—20 canals. A young specimen from South-East Australia, 18 mm. wide, recently described by BLACKBURN (1955) had 16 canals. In BIGELOW's original specimen of *H. maasi*, 55 mm. wide, 28 canals issued from the periphery of the stomach, but some of them were bifurcated, so that 33 canals reached the umbrella margin. The only specimen of *H. medius* KRAMP, 100 mm. wide, had 30 radial canals. If we presume that the radial canals were not counted in VANHÖFFEN's largest specimen, the numbers of canals do not afford any objection to the supposition that all specimens of *Halitrephes* observed up to now belong to one species, *H. maasi* BIGELOW.

Distribution: *Halitrephes maasi* is a bathypelagic medusa with a circumglobal distribution in the tropical and subtropical parts of the great oceans. It is recorded from the eastern tropical Pacific, the waters between New Zealand and southern Australia, some scattered localities in the Indian Ocean, and from several localities

in the Atlantic between about 50° S. and 32° N. (Bermudas). In the eastern Atlantic it occurs from the Cape of Good Hope to Cape Verde. It was not previously found in the West-Indian waters, where it was taken at several stations by the "Dana".

Halicreidae indeterminatae.

Undeterminable specimens of Halicreidae were collected at the following stations:

St. 1267 14.III.22
17°56′ N. 64°50′ W.
E 300 4500 m. w. **2**

St. 3975 31.I.30
35°42′ S. 18°37′ E.
S 150 1000 m. w. **3**
S 150 2000 m. w. **26**
S 150 2500 m. w. **22**

St. 3978 13.II.30
30°15′ S. 13°15′ E.
S 150 1500 m. w. **3**
S 150 2000 m. w. **7**
S 150 3000 m. w. **2**

St. 3980 17.II.30
23°26′ S. 3°56′ E.
S 200 600 m. w. **1**
S 150 2000 m. w. **10**
S 150 3000 m. w. **4**
S 150 4000 m. w. **5**
S 150 5000 m. w. **2**

St. 3996 25.II.30
15°41′ S. 5°50′ W.
S 200 600 m. w. **22**
S 150 1000 m. w. **9**
S 150 1500 m. w. **3**
S 150 2000 m. w. **14**
S 150 3000 m. w. **15**
S 150 4000 m. w. **3**

St. 3998 1.III.30
7°34′ S. 8°48′ W.
E 300 1000 m. w. **20**
S 150 1000 m. w. **3**
S 150 2000 m. w. **29**
S 150 3000 m. w. **3**
S 150 4000 m. w. **4**
S 150 5000 m. w. **1**
E 300 6000 m. w. **18**

St. 4000 4.III.30
0°31′ S. 11°02′ W.
E 300 1000 m. w. **16**
S 150 1000 m. w. **2**
S 150 2000 m. w. **10**
S 150 3000 m. w. **6**
S 150 4000 m. w. **1**
S 150 5000 m. w. **6**
E 300 6000 m. w. **2**

St. 4003 9.III.30
8°26′ N. 15°11′ W.
S 200 300 m. w. **5**
E 300 1000 m. w. **29**
S 150 1000 m. w. **4**
S 150 4000 m. w. **3**
S 150 5000 m. w. **5**
E 300 6000 m. w. **7**

St. 4005 12.III.30
13°31′ N. 18°03′ W.
S 200 300 m. w. **5**
S 200 600 m. w. **14**
S 150 1000 m. w. **22**
S 150 2000 m. w. **5**
S 150 2500 m. w. **8**
S 150 3500 m. w. **7**
E 300 4000 m. w. **15**

St. 4007 15.III.30
18°22′ N. 18°14′ W.
S 200 300 m. w. **10**
S 200 600 m. w. **25**
E 300 1000 m. w. **198**
S 150 1000 m. w. **67**
S 150 2000 m. w. **17**
S 150 2000 m. w. **17**
S 150 2500 m. w. **5**
S 150 3000 m. w. **8**
S 150 3500 m. w. **13**
E 300 4000 m. w. **23**

St. 4009 18.III.30
24°36.5′ N. 17°27′ W.
S 150 2000 m. w. **12**
S 150 2500 m. w. **3**
E 300 4000 m. w. **3**

St. 4017 27.III.30
29°11′ N. 14°14′ W.
S 150 2000 m. w. **3**
S 150 3000 m. w. **3**

St. 4019 30.III.30
33°08′ N. 10°22′ W.
S 150 1000 m. w. **3**
S 150 2000 m. w. **4**
S 150 3000 m. w. **2**
S 150 3500 m. w. **2**

St. 4158 17.VI.30
46°28′ N. 8°01′ W.
E 300 1000 m. w. **13**

Fam. **Rhopalonematidae.**

Rhopalonema velatum Gegenbaur.

Rhopalonema velatum Gegenbaur 1856 p. 251. Pl. 9 fig. 1—5.
Rhopalonema velatum Mayer 1910 p. 378. Fig. 218.
Syn.: *R. clavigerum, clavigerum* and *coeruleum* Haeckel 1879, *R. striatum* Maas 1893.

Material:

"Thor"
St. 178 2.IX.06
48°04′ N. 12°40′ W.
1000 m. w. **1**

"Ingolf"
St. 251 3.III.11
22°16′ N. 63°16′ W.
S 150 19 m. w. **1**

St. 252 4.III.11
23°53′ N. 61°36′ W.
S 150 25 m. w. **28**
S 100 47 m. w. **1**

St. 256 8.III.11
28°55′ N. 55°25′ W.
S 150 25 m. w. **12**
S 100 47 m. w. **5**

St. 259 12.III.30
33°55′ N. 43°40′ W.
S 150 25 m. w. **21**

St. 260 13.III.11
34°39′ N. 40°54′ W.
S 150 25 m. w. **5**

St. 261 14.III.11
35°27′ N. 37°18′ W.
S 100 47 m. w. **9**

St. 262 15.III.11
36°13′ N. 33°50′ W.
S 150 25 m. w. **79**
S 100 47 m. w. **60**

St. 269 4.III.11
46°44′ N. 11°20′ W.
S 100 47 m. w. **1**

"St. Croix"
St. 290 12.V.11
37°31′ N. 35°24′ W.
S 200 28 m. w. **1**

"Caroline Kock"
St. 309 6.II.11
38°06′ N. 18°24′ W.
S 100 38 m. w. **1**

"Caroline Kock"
St. 315 28.V.11
39°50′ N. 49°30′ W.
S 100 38 m. w. **21**

"Anne"
St. 374 7.X.11
42°30′ N. 32°45′ W.
S 100 48 m. w. **11**

"Ingolf"
St. 403 3.XI.11
27°10′ N. 21°53′ W.
S 200 surface **210**
S 150 56 m. w. **23**

St. 404 3.XI.11
26°12′ N. 23°02′ W.
S 200 surface **3**

St. 405 5.XI.11
24°42′ N. 24°50′ W.
S 200 surface **55**

St. 406 5.XI.11
23°49′ N. 26°25′ W.
Surface **6**
56 m. w. **20**

"Dana"
St. 842 28.IV.20
25°48′ N. 49°22′ W.
P 150 300 m. w. **4**

St. 844 29.IV.20
25°54′ N. 51°47′ W.
P 100 surface **3**

St. 845 30.IV.20
24°46′ N. 54°08′ W.
P 150 300 m. w. **1**

St. 848 2.VI.20
18°00′ N. 64°41′ W.
S 200 300 m. w. **1**

St. 849 3.VI.20
19°00′ N. 63°53′ W.
P 150 surface **1**
P 150 100 m. w. **2**
P 150 200 m. w. **3**
S 200 300 m. w. **8**

St. 850 4.VI.20
20°39′ N. 61°48′ W.
P 150 50 m. w. **8**
P 150 100 m. w. **5**
S 200 150 m. w. **14**
S 200 300 m. w. **3**

St. 851 5.VI.20
22°23′ N. 60°46′ W.
P 150 50 m. w. **36**

St. 856 11.VI.20
30°27′ N. 60°53′ W.
P 150 800 m. w. **1**

St. 868 24.VI.20
27°10′ N. 55°52′ W.
S 150 125 m. w. **1**

St. 870 26.VI.20
27°29′ N. 59°20′ W.
S 150 100 m. w. **3**
S 150 200 m. w. **5**

St. 884 15.VII.20
28°49′ N. 54°10′ W.
S 200 100 m. w. **11**

"Dana" II
St. 1107 13.IX.21
36°28′ N. 8°38′ W.
S 200 200 m. w. **2**

St. 1141 15.X.21
34°15′ N. 16°53′ W.
S 200 500 m. w. **3**

St. 1192 15.XII.21
17°43.4′ N. 64°54.3′ W.
S 200 50 m. w. **10**
S 200 100 m. w. **5**

St. 1331 5.V.22
26°37′ N. 55°50′ W.
P 150 400 m. w. **1**

St. 1353 23.V.22
33°57′ N. 66°43′ W.
E 300 1000 m. w. **1**

St. 3978 13.II.30
30°15′ S. 13°15′ E.
S 200 50 m. w. **11**
S 200 100 m. w. **1**
S 200 600 m. w. **1**
S 150 1000 m. w. **1**
S 150 1500 m. w. **1**
S 150 2000 m. w. **1**

St. 3980 17.II.30
23°26′ S. 3°56′ E.
S 200 50 m. w. **2**
S 200 100 m. w. **2**
S 200 300 m. w. **2**
S 200 600 m. w. **1**

St. 3996 25.II.30
15°41′ S. 5°50′ W.
S 200 50 m. w. **5**
S 200 300 m. w. **1**
S 150 1000 m. w. **1**
E 300 4000 m. w. **1**

St. 3998 1.III.30
7°34′ S. 8°48′ W.
S 50 surface **2**
S 200 50 m. w. **600**
S 200 100 m. w. **500**
S 200 300 m. w. **9**
S 200 600 m. w. **2**
E 300 1000 m. w. **1**
S 150 1000 m. w. **3**
S 150 2000 m. w. **2**
S 150 3000 m. w. **1**
S 150 4000 m. w. **7**
S 150 5000 m. w. **5**

St. 4000 4.III.30
0°31′ S. 11°02′ W.
S 200 50 m. w. **12**
S 200 100 m. w. **2**
S 200 300 m. w. **25**
S 200 600 m. w. **4**
E 300 1000 m. w. **1**
S 150 1000 m. w. **6**
S 150 2000 m. w. **1**
S 150 3000 m. w. **8**
S 150 4000 m. w. **9**
S 150 5000 m. w. **10**

St. 4003 9.III.30
8°26′ N. 15°11′ W.
S 200 50 m. w. **88**
S 200 100 m. w. **1**
S 200 300 m. w. **1**
S 150 3000 m. w. **1**
S 150 4000 m. w. **1**
E 300 6000 m. w. **1**

St. 4005 12.III.30
13°31′ N. 18°03′ W.
S 200 50 m. w. **24**
S 200 100 m. w. **7**
S 200 300 m. w. **4**
S 200 600 m. w. **2**
S 150 2000 m. w. **9**
S 150 2500 m. w. **2**
S 150 3500 m. w. **1**

St. 4007 15.III.30
18°22′ N. 18°14′ W.
S 200 300 m. w. **1**

St. 4009 18.III.30
24°36.5′ N. 17°27′ W.
S 200 100 m. w. **19**
S 200 300 m. w. **10**
S 200 600 m. w. **45**
S 150 1000 m. w. **150**
S 150 2000 m. w. **9**
S 150 2500 m. w. **5**
S 150 3000 m. w. **2**
S 150 3500 m. w. **1**

St. 4014 25.III.30
28°09′ N. 15°19′ W.
S 50 surface **1**
S 200 300 m. w. **12**
S 200 600 m. w. **65**
S 200 900 m. w. **62**
S 200 1200 m. w. **28**

St. 4017 27.III.30
29°11′ N. 14°14′ W.
S 200 50 m. w. **6**
S 200 100 m. w. **140**
S 200 300 m. w. **90**
S 200 600 m. w. **24**
S 150 1000 m. w. **92**
S 150 2000 m. w. **38**
S 150 3000 m. w. **9**
S 150 4000 m. w. **12**
E 300 5000 m. w. **2**

St. 4019 30.III.30
33°08′ N. 10°22′ W.
S 200 50 m. w. **13**
S 200 100 m. w. **265**
S 200 300 m. w. **38**
S 200 600 m. w. **41**
S 150 1000 m. w. **120**
S 150 2000 m. w. **5**
S 150 3000 m. w. **10**
S 150 3500 m. w. **4**

St. 4025 9.IV.30
35°57′ N. 5°30′ W.
S 200 50 m. w. **1**
S 200 100 m. w. **1**
S 200 300 m. w. **1**

St. 4050 2—3.V.30
38°48′ N. 12°06′ E.
S 150 1000 m. w. **95**
S 150 1500 m. w. **1**
S 150 2000 m. w. **12**
S 150 2500 m. w. **10**
S 200 3000 m. w. **3**

St. 4158 17.VI.30
46°28′ N. 8°01′ W.
S 150 50 m. w. **20**
S 200 100 m. w. **c. 500**
S 200 150 m. w. **34**
S 200 200 m. w. **165**
S 200 250 m. w. **76**
S 200 300 m. w. **23**
S 200 600 m. w. **c. 400**
S 200 950 m. w. **80**
S 150 1500 m. w. **6**
S 150 2000 m. w. **10**
S 150 3000 m. w. **12**
S 150 4000 m. w. **15**
S 150 4500 m. w. **3**
S 150 5500 m. w. **2**

St. 4185 11.VI.31
37°04′ N. 23°07′ W.
S 200 800 m. w. **3**

St. 4192 19.VI.31
39°57′ N. 24°59′ W.
S 200 300 m. w. **3**
S 200 500 m. w. **5**
S 200 600 m. w. **24**

St. 4195 22.VI.31
41°55′ N. 32°22′ W.
S 200 100 m. w. **7**
S 200 300 m. w. **5**

St. 4197 25.VI.31
43°39′ N. 24°04′ W.
S 200 100 m. w. **2**
E 300 600 m. w. **1**

In the series of stations taken in March 1911 by the naval schooner "Ingolf" (St. 251—262) from the West Indies to the Azores *Rhopalonema velatum* was particularly common at the station nearest the Azores. In September of the same year (St. 403—406) it was abundant at the first station near the Canary Islands, less common further towards the S.W. During the investigations in the waters north and north-east of the West Indies by the M.S. "Dana" (1920, St. 842—884) and the S.S. "Dana" (1921—22, St. 1192—1353) the species was altogether rather scarce. The other stations listed above, until St. 1353 in 1922, are scattered over the northern Atlantic north of about 33° N. The areas, in which this species was collected, are entirely inside regions from where it was known before.

It is interesting to note the great variations in number of specimens taken in different parts of the eastern Atlantic during the voyage of the "Dana" from South Africa (St. 3978) to Morocco (St. 4019) in February and March 1930. This is best illustrated by the maximal number taken in one haul at each station, as follows:

Station number	Maximal number of specimens in one haul
3978	11
3980	2
3996	5
3998	600
4000	25
4003	88
4005	24
4007	1
4009	150
4014	65
4017	140
4019	265

It was rather scarce off the southern part of the west coast of Africa, but at St. 3998, outside the Gulf of Guinea, it suddenly appeared in enormous quantities, decreasing again northwards towards the Canary Islands, but once more taken in great abundance off the north-west coast of Africa (St. 4009—4019). The vast majority of the specimens were undoubtedly taken in the upper layers of the water. The remarkable variation in the number of the medusae cannot be explained by the temperatures observed in these strata. Neither is there any obvious connection between the amount of the catches and the hours when they were made, as will be seen from the table below. The remarkable accumulations off the Mauretanian coast and in one single locality off the Gulf of Guinea may perhaps be explained by the currents prevailing in these areas.

A few specimens were taken in the Straits of Gibraltar (St. 4025), and the species must have been very abundant at St. 4158 in the Mediterranean, near Sicily, since a considerable number of specimens were captured in the deep-sea hauls, with 1000—3000 m. wire out; they were probably taken during the hauling in of the nets through the upper strata from which, however, no material is at hand.

Once more during the expedition of the "Dana" in 1930 *Rhopalonema velatum* was found in great abun-

Occurrence of *Rhopalonema velatum* off the west coast of Africa in February—March 1930.

Station	3978	3980	3998	4000	4003	4005	4007	4009	4017	4019
Hour	2^{30}	3^{15}	1^{10}	2^{30}	18^{45}	18^{30}	3^{15}	3^{15}	18^{30}	18^{30}
Temperature °C										
0 m.	19.5	21.2	25.5	26.8	22.6	18.7	18.5	19.5	17.7	16.5
50 -	19.3	20.5	24.3	24.1	16.1	15.5	16.1	19.4	17.5	16.4
100 -	13.7	16.4	14.9	14.1	14.6	13.6	14.2	18.9	17.1	15.9
150 -	13.1	14.3	12.3	13.5	13.8	13.0	13.5	17.7	17.0	14.9
200 -	12.5	12.7	10.6	13.0	12.9	12.2	13.0	16.1	16.3	13.9
Maximal number of specimens in one haul	11	2	600	25	88	24	1	150	140	265

dance, viz. in the Bay of Biscay, 17th April (St. 4158). Specimens were taken in all the nets used at this station, with 50—5500 m. wire out, but the great shoal was undoubtedly accumulated about 50 m. below the surface, where about 500 specimens were taken; the net towed with 600 m. wire contained a similar number (about 400), so apparently this net must have been kept hauling through the surface layers for a rather considerable time, either while being set out or hauled in. The hauls with less than 950 m. wire at this station were taken at 1^{45} at night.

The catches of *Rhopalonema velatum* confirm the previous statement that the depths in which the medusae actually occur cannot be determined with certainty, when several open nets are towed simultaneously at various depths. In the present case we can state that the species mainly occurs in the upper strata. At St. 3998 there was evidently a dense accumulation about 25—50 m. below the surface, but each of the nets with greater length of wire caught some few specimens while hauled through the shoal of medusae in the surface water, and there is no reason to believe that any of these few specimens were captured at deeper levels. The vertical distribution is equally clear at St. 4003 and 4005, where many more specimens were taken with 50 m. wire than in the deeper hauls. At St. 4009, on the other hand, the maximal number was taken in the net with 1000 m. wire out; there can hardly be any doubt but that this net was accidentally allowed to drift through the upper strata for a considerable while either before or after it was towed at the predetermined depth, and similar accidents have evidently occurred at other stations.

Distribution: *Rhopalonema velatum* is a predominantly epipelagic medusa, very common in the warm parts of all the oceans. In the Pacific it occurs between about 30° S. and 35° N., in the eastern as well as in the western parts of the ocean, and it has recently been recorded from the south-eastern coast of Australia and Tasmania. In the Indian and Atlantic Oceans its southern limit of distribution is at about 45—50° S. In the western Atlantic it penetrates as far north as to the Gulf of Maine; in the eastern Atlantic it follows the Gulf Stream to the waters west of Scotland. It is also very abundant in the Mediterranean.

Rhopalonema funerarium Vanhöffen.

Rhopalonema funerarium Vanhöffen 1902 p. 61. Pl. 9 fig. 2, Pl. 10 fig. 17, Pl. 11 fig. 31.
Rhopalonema coeruleum Mayer 1910 p. 380, in part.
Rhopalonema velatum Thiel 1936 p. 10, in part.
Rhopalonema funerarium Kramp 1947 p. 14. Pl. 2 fig. 4, 5.
Rhopalonema funerarium Kramp 1957 p. 53.

Material:

St. 3975 31.I.30
35°42′ S. 18°37′ E.
S 150 2000 m. w. **1**

St. 3978 13.II.30
30°15′ S. 13°15′ E.
S 150 1500 m. w. **1**

St. 3996 25.II.30
15°41′ S. 5°50′ W.
S 200 600 m. w. **13**
E 300 1000 m. w. **3**
S 150 1000 m. w. **50**
S 150 1500 m. w. **7**
S 150 3000 m. w. **1**

St. 3998 1.III.30
7°34′ S. 8°48′ W.
S 150 1000 m. w. **6**

St. 4000 4.III.30
0°31′ S. 11°02′ W.
S 200 300 m. w. **5**
S 200 600 m. w. **30**
E 300 1000 m. w. **4**
S 150 1000 m. w. **5**
S 150 2000 m. w. **5**
S 150 3000 m. w. **2**

St. 4003 9.III.30
8°26′ N. 15°11′ W.
S 200 100 m. w. **1**
S 200 300 m. w. **2**

St. 4005 12.III.30
13°31′ N. 18°03′ W.
S 200 600 m. w. **23**
S 150 1000 m. w. **2**
S 150 2500 m. w. **1**
E 300 4000 m. w. **1**

St. 4007 15.III.30
18°22′ N. 18°14′ W.
S 200 100 m. w. **1**
S 200 300 m. w. **1**
S 200 600 m. w. **19**
S 150 1000 m. w. **10**
S 150 2000 m. w. **2**
S 150 3000 m. w. **1**

St. 4009 18.III.30
24°36.5′ N. 17°27′ W.
S 150 2500 m. w. **4**

St. 4014 25.III.30
28°09′ N. 15°19′ W.
S 200 900 m. w. **2**

St. 4017 27.III.30
29°11′ N. 14°14′ W.
S 150 3000 m. w. **1**

St. 4158 17.VI.30
46°28′ N. 8°01′ W.
E 300 1000 m. w. **1**

All these localities are from the "Dana" Expedition in 1930 off the west coast of Africa from near the Cape of Good Hope to Morocco (St. 3975—4017) and the Bay of Biscay (St. 4158). The species was previously recorded from the same tracts, e. g. in the Discovery Reports (Kramp 1957).

As repeatedly stated by me, in contradistinction to THIEL, *R. funerarium* is quite distinct from *R. velatum*; I have seen both species alive side by side. The present records confirm the previous statements that *R. funerarium* mainly occurs in the intermediate and deep strata, though it may occasionally ascend towards higher levels. During the cruise of the "Dana" the majority of the specimens were taken in hauls with 600 m. wire out (at St. 3996 the haul with 1000 m. wire also contained a considerable number of specimens). It thus seems to prefer the strata immediately below the discontinuity layer at temperatures between about $9^1/_2$ and $11^1/_2$° C.

Distribution: Widely distributed in the deep parts of all the oceans. In the Pacific it is known only from the eastern tropical part; in the Indian Ocean it has been taken only by the "Valdivia" Expedition; unfortunately VANHÖFFEN gives no precise data but only a general statement that it was found near St. Paul and in the whole warm area of the Indian Ocean. In the Atlantic it is quite common west of Africa and around the Azores, penetrating northwards to the Gulf of Maine and the waters west of Scotland. An isolated record is that from a locality north of South Georgia, about 50° S. (KRAMP 1957). The only record from the Mediterranean (near Monaco) is given by RANSON (1936 p. 144).

Pantachogon haeckeli MAAS.

Pantachogon haeckeli MAAS 1893 p. 17. Pl. 1 fig. 2.
Pantachogon rubrum VANHÖFFEN 1902 p. 63. Pl. 9 fig. 9, Pl. 10 fig. 19, 20, Pl. 11 fig. 25.
Pantachogon haeckeli KRAMP 1947 p. 19. Pl. 2 fig. 7, 8.
Pantachogon haeckeli RUSSELL 1953 p. 440. Pl. 25 fig. 2; text-fig. 290—292.
Pantachogon haeckeli KRAMP 1957 p. 53.

Material:

St. 1283 5.IV.22
14°38′ N. 61°16′ W.
E 300 4000 m. w. **1**

St. 3975 31.I.30
35°42′ S. 18°37′ E.
S 150 1000 m. w. **2**
S 150 2000 m. w. **2**
S 150 2500 m. w. **12**
E 300 3000 m. w. **1**

St. 3978 13.II.30
30°15′ S. 13°15′ E.
S 150 3000 m. w. **2**
S 150 4000 m. w. **6**

St. 3980 17.II.30
23°26′ S. 3°56′ E.
S 150 2000 m. w. **1**
S 150 3000 m. w. **3**
S 150 4000 m. w. **6**
S 150 5000 m. w. **1**

St. 3996 25.II.30
15°41′ S. 5°50′ W.
S 150 3000 m. w. **7**
E 300 4000 m. w. **2**

St. 3998 1.III.30
7°34′ S. 8°48′ W.
S 150 2000 m. w. **6**
S 150 3000 m. w. **1**

St. 4000 4.III.30
0°31′ S. 11°02′ W.
S 150 2000 m. w. **1**
S 150 3000 m. w. **16**
S 150 4000 m. w. **2**
S 150 5000 m. w. **8**

St. 4003 9.III.30
8°26′ N. 15°11′ W.
S 150 2000 m. w. **162**
S 150 3000 m. w. **72**
S 150 4000 m. w. **15**
S 150 5000 m. w. **8**
E 300 6000 m. w. **2**

St. 4005 12.III.30
13°31′ N. 18°03′ W.
S 150 2500 m. w. **34**
S 150 3500 m. w. **139**
E 300 4000 m. w. **40**

St. 4007 15.III.30
18°22′ N. 18°14′ W.
S 150 2000 m. w. **107**
S 150 3000 m. w. **8**
S 150 3500 m. w. **1**

St. 4009 18.III.30
24°36.5′ N. 17°27′ W.
S 150 2000 m. w. **11**
S 150 2500 m. w. **175**
S 150 3000 m. w. **140**
S 150 3500 m. w. **67**
E 300 4000 m. w. **30**

St. 4017 27.III.30
29°11′ N. 14°14′ W.
S 150 2000 m. w. **9**
S 150 3000 m. w. **32**
S 150 4000 m. w. **34**

St. 4019 30.III.30
33°08′ N. 10°22′ W.
S 150 3000 m. w. **19**
S 150 3500 m. w. **3**

St. 4158 17.VI.30
47°28′ N. 8°01′ W.
S 150 1500 m. w. **1**
S 150 2000 m. w. **23**
S 150 3000 m. w. **46**
S 150 4000 m. w. **35**
S 150 4500 m. w. **11**
E 300 5000 m. w. **9**

With the exception of St. 1283 in the West Indies and St. 4158 in the Bay of Biscay all these localities are off the west coast of Africa between the Cape of Good Hope and Morocco. The species was nowhere taken in hauls with less than 1000 m. wire out and on only two occasions with less than 2000 m. wire, viz. at St. 3975 near the Cape of Good Hope (1000 m. wire) and St. 4158 in the Bay of Biscay (1500 m. wire). It was fairly scarce off the southern parts of Africa, but very abundant in the coastal areas between Sierra Leone and Rio

de Oro, St. 4003—4009, in the same tract where *Halicreas minimum* was particularly common, probably owing to favourable food conditions.

Distribution: Common in the deep and intermediate strata of the oceans except in the Mediterranean and the arctic seas. It has not yet been recorded from the central parts of the Pacific, but it is found in several localities in northern waters, south of Alaska, in the Bering Sea and Sea of Okhotsk, and at Japan. It also occurs in the Malayan Archipelago, in the tropical Indian Ocean and in the Red Sea. In the Atlantic it is generally distributed as far north as the submarine ridges between Scotland, Iceland, Greenland and Baffin Land. In these northern waters it may ascend towards the upper strata and may occasionally traverse the ridges and be found in Baffin Bay. It also penetrates far to the south, occurring in the "warm deep water" near the slope of the Antarctic Continent in the Atlantic as well as in the Indian and Pacific sections. Some of the antarctic localities given by THIEL (1936) may, however, be erroneous, because this author refers the antarctic species *P. scotti* BROWNE to *P. haeckeli* (under the name *P. rubrum*); I have seen the type specimen of *P. scotti* in the British Museum and I can state that it is a distinct species.

Pantachogon militare (MAAS).

Homoeonema militare MAAS 1893 p. 16. Pl. 1 fig. 1.
Homoeonema militare MAYER 1910 p. 387. Fig. 235.
Pantachogon militare BIGELOW 1913 p. 44.
Pantachogon militare KRAMP 1947 pp. 15, 19.

Material:

St. 3996 25.II.30
15°41′ S. 5°50′ W.
S 150 3000 m. w. **3**

St. 3998 1.III.30
7°34′ S. 8°48′ W.
S 150 4000 m. w. **9**

St. 4003 9.III.30
8°26′ N. 15°11′ W.
S 150 2000 m. w. **2**
S 150 4000 m. w. **4**
S 150 5000 m. w. **10**

St. 4005 12.III.30
13°31′ N. 18°03′ W.
S 150 3500 m. w. **1**

St. 4007 15.III.30
18°22′ N. 18°14′ W.
S 150 2000 m. w. **1**

St. 4017 27.III.30
29°11′ N. 14°14′ W.
S 150 3000 m. w. **10**
S 150 4000 m. w. **20**

St. 4019 30.III.30
33°08′ N. 10°22′ W.
S 150 3500 m. w. **3**

In spite of the poor state of preservation I refer these specimens without any doubt to *P. militare.* They agree perfectly with the description and figure by MAAS in the shape of the umbrella and the position of the gonads, and they are easily recognizable from the specimens of *P. haeckeli* found in the same samples. It was very interesting to find *P. militare* again. The original description was based on a single specimen taken north of Bermuda (MAAS 1893), and according to MAYER (1910) another specimen was found in the Mediterranean by LO BIANCO. Later on a specimen from the Weddell Sea was described by THIEL (1931 p. 326); the specimen was, however, very shrunken and distorted, so that the identification remains doubtful.

BIGELOW (1913) referred this species to the genus *Pantachogon.* On a previous occasion (KRAMP 1947) I have discussed its affinity and was inclined to agree with BIGELOW in this respect, and the examination of the present numerous specimens confirms the correctness of this view.

All the records listed above are from deep water off the west coast of Africa.

Distribution: North of the Bermudas; Mediterranean; west of Africa.

Colobonema sericeum VANHÖFFEN.

Colobenema sericeum VANHÖFFEN 1902 p. 57. Pl. 9 fig. 1, Pl. 12 fig. 39—42.
Colobonema typicum MAAS 1905 p. 53. Pl. 10 fig. 62—65.
Homoeonema typicum MAYER 1910 p. 385, in part.
Colobonema sericeum VANHÖFFEN 1912 *a* p. 372.
Colobonema sericeum KRAMP 1947 p. 18.
Colobonema sericeum RUSSELL 1953 p. 436. Pl. 25 fig. 1; text-fig. 287—289.
Colobonema sericeum KRAMP 1957 p. 54.
non *Homoeonema typicum* MAAS 1897 p. 22. Pl. 3 fig. 1—3.

Material:

St. 1166 11.XI.21
10°16′ N. 40°41′ W.
E 300 1000 m. w. **9**

St. 1171 13.XI.21
8°19′ N. 44°35′ W.
E 300 1000 m. w. **1**

St. 1183 24.XI.21
13°46′ N. 61°26′ W.
E 300 4500 m. w. **1**

St. 1203 11.I.22
7°30′ N. 79°19′ W.
E 300 2500 m. w. **1**

St. 1206 14.I.22
6°40′ N. 80°47′ W.
E 300 4500 m. w. **2**

St. 1239 12.II.22
25°50′ N. 76°55′ W.
E 300 4500 m. w. **2**

St. 1240 13.II.22
25°35′ N. 74°45′ W.
E 300 1000 m. w. **1**

St. 1261 9.III.22
19°04′ N. 65°43′ W.
E 300 4500 m. w. **1**

St. 1322 4.IV.22
27°02′ N. 53°39′ W.
E 300 1100 m. w. **1**
E 300 2500 m. w. **1**

St. 1331 5.V.22
26°37′ N. 55°50′ W.
E 300 1700 m. w. **2**

St. 1342 15.V.22
34°00′ N. 70°01′ W.
E 300 4500 m. w. **2**

St. 1353 23.V.22
33°57′ N. 66°43′ W.
E 300 1000 m. w. **1**

St. 1365 8.VI.22
31°47′ N. 41°41′ W.
E 300 5000 m. w. **1**

St. 1386 24.VI.22
45°15′ N. 8°43′ W.
E 300 1000 m. w. **1**

St. 1387 25.VI.22
46°28′ N. 8°01′ W.
E 300 5000 m. w. **4**

St. 3975 31.I.30
35°42′ S. 18°37′ E.
S 150 1000 m. w. **20**
S 150 2000 m. w. **11**
S 150 2500 m. w. **9**
E 300 3000 m. w. **75**

St. 3978 13.II.30
30°15′ S. 13°15′ E.
S 150 1500 m. w. **8**
S 150 2000 m. w. **1**
S 150 3000 m. w. **6**
S 150 4000 m. w. **1**

St. 3980 17.II.30
23°26′ S. 3°56′ E.
S 150 2000 m. w. **2**

St. 3996 25.II.30
15°41′ S. 5°50′ W.
E 300 1000 m. w. **2**
S 150 1500 m. w. **7**
S 150 2000 m. w. **14**
S 150 3000 m. w. **1**

St. 3998 1.III.30
7°34′ S. 8°48′ W.
S 150 2000 m. w. **2**
S 150 5000 m. w. **1**
E 300 6000 m. w. **4**

St. 4000 4.III.30
0°31′ S. 11°02′ W.
S 150 5000 m. w. **2**

St. 4003 9.III.30
8°26′ N. 15°11′ W.
E 300 1000 m. w. **37**
S 150 1000 m. w. **19**
E 300 6000 m. w. **3**

St. 4005 12.III.30
13°31′ N. 18°03′ W.
S 200 600 m. w. **14**
E 300 1000 m. w. **14**
S 150 1000 m. w. **17**
S 150 2500 m. w. **1**
S 150 3500 m. w. **1**
E 300 4000 m. w. **3**

St. 4007 15.III.30
18°22′ N. 18°14′ W.
E 300 1000 m. w. **3**
S 150 2000 m. w. **7**
S 150 2500 m. w. **2**
S 150 3000 m. w. **1**
E 300 4000 m. w. **8**

St. 4009 18.III.30
24°36.5′ N. 17°27′ W.
S 150 2000 m. w. **3**
S 150 2500 m. w. **7**

St. 4014 25.III.30
28°09′ N. 15°19′ W.
S 200 1200 m. w. **1**
E 300 1500 m. w. **1**

St. 4017 27.III.30
29°11′ N. 14°14′ W.
S 150 2000 m. w. **1**
S 150 3000 m. w. **2**

St. 4019 30.III.30
33°08′ N. 10°22′ W.
S 150 2000 m. w. **1**

St. 4158 17.VI.30
46°28′ N. 8°01′ W.
E 300 1000 m. w. **3**
S 150 1500 m. w. **18**
S 150 2000 m. w. **25**
S 150 3000 m. w. **1**
S 150 4000 m. w. **3**
S 150 4500 m. w. **4**
E 300 5000 m. w. **6**
S 150 5500 m. w. **2**

St. 1203 and 1206 are in the Gulf of Panama, St. 1183 and 1261 in the West Indies, St. 1239 and 1240 near the Bahamas, St. 1342 and 1353 N.W. of Bermuda, St. 1322, 1331, and 1365 between the West Indies and the Azores, St. 1166 and 1171 off the north-east coast of Brazil, St. 1386 and 1387 in the Bay of Biscay. In these scattered localities only some few specimens were collected, all of them in hauls with at least 100 m. wire out.

St. 3975—4019 are off the west coast of Africa from the Cape of Good Hope to Morocco, and in this tract *Colobonema sericeum* shows a similar variation in number of specimens as *Halicreas minimum* and *Pantachogon haeckeli*, in so far as particularly many were found at St. 4003 and 4005 off Sierra Leone and near Cape Verde; at St. 3975 near the Cape of Good Hope as many as 75 specimens were taken in a single haul with 3000 m. wire out. The majority of the specimens found at St. 4003 and 4005 were taken fairly high up in the water, with 600—1000 m. wire.

The species was also fairly abundant at St. 4158 in the Bay of Biscay, where 18 and 25 specimens were taken in the hauls with 1500 and 2000 m. wire respectively.

There is an indication of young specimens usually occurring at higher levels than the adults. Thus all of the fourteen specimens taken with 600 m. wire at St. 4005 are young ones, 5—15 mm. high, and the eight specimens taken with 1500 m. wire at St. 3978 are very young stages, only 5—6 mm. high. The well-known successive development of the tentacles is clearly seen in these specimens. There is no trace of the tentacle which will appear in the middle of each octant, and the two adradial tentacles in each octant are of unequal size, the one to the right of a radial canal being always larger than the other one, so that the tentacles of an octant may be numbered as follows: 1, 2, 4, 3, 1.

Distribution: This large bathypelagic medusa is probably generally distributed in the deep parts of all the oceans, except in the Mediterranean and the arctic and antarctic seas. In the Pacific it is known from the eastern and western parts, but not yet from the central part. It is found in several localities in the tropical Indian Ocean. In the Atlantic it penetrates northwards to the submarine ridges between Scotland and Iceland and Greenland. It has not previously been recorded from West-Indian waters. This is one of the bathypelagic species which does not approach the slope of the Antarctic Continent (see KRAMP 1957 p. 100); the southernmost locality, whence it has been recorded up to now, is at about 42° S., south-west of the Cape of Good Hope (VANHÖFFEN 1902).

Sminthea eurygaster GEGENBAUR.

Sminthea eurygaster GEGENBAUR 1856 p. 245. Pl. 9 fig. 14, 15.
Trachynema eurygaster HAECKEL 1879 p. 260.
Marmanema mammaeforme HAECKEL 1879 p. 262.
Sminthea eurygaster MAYER 1910 p. 383. Fig. 226, 227.
Sminthea eurygaster THIEL 1936 p. 17.
Sminthea eurygaster KRAMP 1957 p. 55.

Material:

St. 3978 13.II.30
30°15′ S. 13°15′ E.
S 200 300 m. w. **1**

St. 3980 17.II.30
23°26′ S. 3°56′ E.
S 200 600 m. w. **3**

St. 3996 25.II.30
15°41′ S. 5°50′ W.
S 200 600 m. w. **1**

St. 4014 25.III.30
28°09′ N. 15°19′ W.
S 200 1200 m. w. **1**

St. 4017 27.III.30
29°11′ N. 14°14′ W.
S 150 1000 m. w. **7**
S 150 2000 m. w. **6**
S 150 3000 m. w. **1**

St. 4019 30.III.30
33°08′ N. 10°22′ W.
S 150 1000 m. w. **12**
S 150 3000 m. w. **1**

St. 4050 2—3.V.30
38°48′ N. 12°06′ E.
S 150 1000 m. w. **1**

St. 4050 is in the Mediterranean near Sicily, the others are off the west coast of Africa.

Distribution: Found in some few localities in the tropical Indian Ocean. Widely distributed in the warm and temperate parts of the Atlantic, penetrating southwards to about 45° S. and northwards into the Bay of Biscay. Mediterranean. It is a mistake when THIEL (1936) unites this species with the arctic medusa *Trachynema arctica* HARTLAUB (1909 p. 466), which is an altogether uncertain species described from a single mutilated specimen. *Sminthea eurygaster* occurs in the deep and intermediate strata.

Amphogona apicata KRAMP.

Amphogona apicata KRAMP 1957 p. 59. Pl. 5 fig. 7.

Material:

St. 3975 31.I.30
35°42′ S. 18°37′ E.
S 150 1500 m. w. **1**
S 150 2000 m. w. **23**
S 150 2500 m. w. **1**

St. 1378 13.II.30
30°15′ S. 13°15′ E.
S 150 2000 m. w. **3**
S 150 3000 m. w. **1**

St. 3980 17.II.30
23°26′ S. 3°56′ E.
E 300 1000 m. w. **2**

St. 4017 27.III.30
29°11′ N. 14°14′ W.
S 150 3000 m. w. **1**

This species, which was recently described by me, is characterized by the high shape of the umbrella, the presence of a distinct apical knob, and by the position of the gonads in the middle parts of the radial canals, in contradistinction to *A. apsteini* in which the gonads are placed very near the ring canal. The large number of tentacles (about 64) separates it from *A. pusilla* HARTLAUB which has only 16 tentacles.

Distribution: St. 4017 is near the Canary Islands, the other stations are off the southern part of the west coast of Africa. Previously recorded from four scattered localities: near the Falkland Islands and South Georgia, near the Cape of Good Hope, and in the Mozambique Channel east of Africa. It is a bathypelagic species.

Tetrorchis erythrogaster BIGELOW.

Tetrorchis erythrogaster BIGELOW 1909 *a* p. 124. Pl. 29 fig. 1—3.
Tetrorchis erythrogaster THIEL 1936 p. 39.
Tetrorchis erythrogaster KRAMP 1957 p. 60.

Material:

St. 3998. 1.III.30. 7°34′ S. 8°48′ W. S 150, 2000 m. w., 7 specimens.
St. 4000. 4.III.30. 0°31′ S. 11°02′ W. S 150, 4000 m. w., 2 specimens.

Distribution: Eastern tropical Pacific (BIGELOW). West coast of Africa: near Cape Verde (THIEL), Gulf of Guinea and near the Cape of Good Hope (KRAMP), now found in two new localities off the Gulf of Guinea.

Ransonia krampi (RANSON).

Aglantha krampi RANSON 1932 p. 1—19. Fig.
Aglantha krampi RANSON 1936 p. 183. Pl. 2 fig. 21.
Ransonia krampi KRAMP 1947 p. 12, note.
Ransonia krampi KRAMP 1948 *b* p. 11.
Ransonia krampi KRAMP 1955 p. 274.

Material:

St. 3978 13.II.30
30°15′ S. 13°15′ E.
S 150 3000 m. w. **1**

St. 4003 9.III.30
8°26′ N. 15°11′ W.
S 200 300 m. w. **6**
S 150 3000 m. w. **1**
S 150 5000 m. w. **1**

St. 4005 12.III.30
13°31′ N. 18°03′ W.
S 200 300 m. w. **1**
S 150 2500 m. w. **3**
S 150 3500 m. w. **1**

St. 4007 15.III.30
18°22′ N. 18°14′ W.
S 150 2000 m. w. **2**
S 150 2500 m. w. **1**

St. 4009 18.III.30
24°36.5′ N. 17°27′ W.
S 150 2000 m. w. **1**
S 150 2500 m. w. **2**
S 150 3000 m. w. **1**

St. 4014 15.III.30
28°09′ N. 15°19′ W.
S 200 600 m. w. **1**

St. 4017 27.III.30
29°11′ N. 14°14′ W.
S 150 1000 m. w. **2**

St. 4025 9.IV.30
35°57′ N. 5°30′ W.
S 200 50 m. w. **6**
S 200 100 m. w. **6**
S 200 300 m. w. **4**
S 200 600 m. w. **5**

St. 1378 is off the southern part of the west coast of Africa, St. 4025 is in the Straits of Gibraltar, the other stations are near the west coast of Africa between Sierra Leone and the Canary Islands.

Distribution: Mediterranean near the Straits of Gibraltar (RANSON 1932 and 1936, KRAMP 1948*b*); Gulf of Guinea (KRAMP 1955); now found in several more localities near the west coast of Africa until as far south as in the neighbourhood of the Cape of Good Hope. It seems to occur mainly in deep and intermediate strata, though in the Straits of Gibraltar it may ascend into the surface layers.

Crossota brunnea VANHÖFFEN.

Crossota brunnea VANHÖFFEN 1902 p. 73. Pl. 9 fig. 11—13, Pl. 12 fig. 34—38 and 43—47.
Crossota brunnea THIEL 1936 p. 20, in part.
Crossota brunnea KRAMP 1957 p. 61.

Material:

St. 4003. 9.III.30. 8°26′ N. 15°11′ W. S 150, 3000 m. w., 1 specimen.

Distribution: Common in deep water in all the oceans south of the equator, penetrating southwards to the slopes of the Antarctic Continent, both in the Pacific, Indian and Atlantic Oceans. The locality mentioned above is the northernmost place in which it has been found in the Atlantic. In the Pacific it is recorded from southern Japan.

Crossota alba Bigelow.

Crossota alba Bigelow 1913 p. 49. Pl. 3 fig. 9—12.
Crossota alba Kramp 1957 p. 61.

Material:

St. 3980 17.II.30	St. 3998 1.III.30	St. 4019 30.III.30
23°26′ S. 3°56′ E.	7°34′ S. 8°48′ W.	33°08′ N. 10°22′ W.
S 150 3000 m. w. **2**	S 150 4000 m. w. **2**	S 150 3000 m. w. **1**
St. 3996 25.II.30	St. 4003 9.III.30	St. 4158 18.VI.30
15°41′ S. 5°50′ W.	8°26′ N. 15°11′ W.	46°28′ N. 8°01′ W.
S 150 1500 m. w. **1**	E 300 1000 m. w. **1**	S 150 3000 m. w. **1**
S 150 3000 m. w. **1**		S 150 4000 m. w. **1**

St. 4158 is in the Bay of Biscay, the other localities are off the west coast of Africa.

This species was originally described from Japan, but I have recently recorded it from two localities off the tropical west coast of Africa and demonstrated that it is a distinct species, quite different from *C. brunnea*, with which Thiel (1936 p. 20) would unite it together with the form which was described from the north-western Pacific by Bigelow (1913 p. 48) as *C. brunnea* var. *norvegica*; the latter, however, is identical with *C. rufobrunnea* (Kramp). Thiel further claims that *C. norvegica* Vanhöffen, *C. pedunculata* Bigelow, and *C. rufobrunnea* (Kramp) do not belong to *Crossota*; he is mistaken in all these aspects. I have previously discussed the relation between the various species of *Crossota* (Kramp 1947 p. 21). It is very satisfying that *C. alba* has now again been found in the Atlantic Ocean, which confirms the correctness of my identification of the specimens collected by the "Discovery".

Distribution: Japan (Bigelow 1913 and Uchida 1947); tropical and subtropical parts of the eastern Atlantic, in deep water.

Aglantha digitale (O. F. Müller).

Medusa digitale O. F. Müller 1776 p. 233.
Aglantha digitalis Haeckel 1879 p. 272. Pl. 16 fig. 5, 6.
Aglanta digitale Kramp 1942 p. 81.

Material:

"Thor"	"Ingolf"	"Ingolf"
St. 69 7.VI.1906	St. 265 20.III.11	St. 269 24.III.11
47°40′ N. 12°41′ W.	39°22′ N. 22°44′ W.	46°44′ N. 11°20′ W.
200 m. w. **109**	S 150 25 m. w. **3**	S 100 47 m. w. **115**
	S 100 47 m. w. **7**	
"Thor"	"Ingolf"	"St. Croix"
St. 72 8.VI.1906	St. 266 21.III.11	St.270 13.II.11
48°41′ N. 11°30′ W.	40°47′ N. 21°10′ W.	47°01′ N. 19°03′ W.
300 m. w. **9**	S 100 47 m. w. **4**	S 150 116 m. w. **10**

"Caroline Kock" St. 318 5.VI.11
48°15′ N. 25°30′ W.
S 100 48 m. w. **1**

"Caroline Kock" St. 319 5.VI.11
48°15′ N. 25°15′ W.
S 100 38 m. w. **158**

"Dana" St. 4158 17.VI.30
46°28′ N. 8°01′ W.
S 150 50 m. w. **2**
S 200 100 m. w. **22**
S 200 150 m. w. **8**
S 200 200 m. w. **30**
S 200 250 m. w. **33**
S 200 300 m. w. **3**
S 200 950 m. w. **11**
S 150 1500 m. w. **5**
S 150 2000 m. w. **10**
S 150 3000 m. w. **13**
S 150 4000 m. w. **13**
S 150 4500 m. w. **29**
S 150 5500 m. w. **280**

During the voyage of the naval schooner "Ingolf" from the West Indies towards the English channel in March 1911 this species was not met with until somewhat east of the Azores (St. 265); a great catch was made outside the Bay of Biscay (St. 269), where 115 specimens were taken in a haul not far below the surface of the water. All the other localities mentioned above are in or west of the Bay of Biscay, and at some of these stations the medusa was taken in great abundance.

The only locality, where it was found by the "Dana" Expedition in 1930, was at St. 4158 in the Bay of Biscay. It was taken in almost all of the hauls made at this station, with from 50 to 5500 m. wire out. This does not mean that the medusa occurred at all these depths; its occurrence was probably restricted to the uppermost 200 metres or so; it is especially very peculiar that the vast majority of specimens were taken in the deepest haul, with 5500 m. wire; this net must have been towed through the upper strata for a rather prolonged time.

Distribution: *Aglantha digitale* is a very common medusa in all arctic and subarctic seas, from where it penetrates more or less into the boreal regions. In the western Atlantic it may occasionally be met with as far south as Chesapeake Bay. In the eastern Atlantic it is recorded from the surroundings of the Azores (Ranson 1936), but not from the European coastal waters south of Cape Finisterre in Spain. The occurrence in the northern Pacific comprises the Sea of Japan, between Japan and Korea, which receives a supply of cold water from the Sea of Okhotsk; a record from Misaki in Sagami Bay, Japan (Uchida 1930 p. 335) seems somewhat doubtful. From the Bering Sea the distribution is extended southwards to Vancouver.

Aglaura hemistoma Péron & Lesueur.

Aglaura hemistoma Péron & Lesueur 1809 p. 351.
Aglaura hemistoma Mayer 1910 p. 398. Pl. 46 fig. 4, 5, Pl. 49 fig. 3—7, Pl. 50 fig. 11.

Material:

St. 850 4.VI.20
20°39′ N. 61°48′ W.
P 150 50 m. w. **1**

St. 851 5.VI.20
22°23′ N. 60°46′ W.
P 150 50 m. w. **6**

St. 3998 8.III.30
7°34′ S. 8°48′ W.
S 150 3000 m. w. **1**

St. 4003 9.III.30
8°26′ N. 15°11′ W.
S 150 2000 m. w. **1**

St. 4005 12.III.30
13°31′ N. 18°03′ W.
S 150 1000 m. w. **1**
S 150 3000 m. w. **7**
S 150 4000 m. w. **1**
S 150 5000 m. w. **3**

St. 4019 30.III.30
33°08′ N. 10°22′ W.
S 200 300 m. w. **7**
S 150 1000 m. w. **35**
S 150 2000 m. w. **3**
S 150 3000 m. w. **7**

St. 850 and 851 are north of the Virgin Islands in the West Indies, the other stations are off the west coast of Africa. All the specimens were undoubtedly captured in the upper strata.

Distribution: This epipelagic medusa in generally distributed in the warm and temperate parts of all the oceans including the Mediterranean. In the Atlantic it occurs as far south as at about 35° S., and towards the north it may occasionally be met with in the Bay of Biscay and off the American coast south of Cape Cod. In the Indian Ocean it occurs north of about 40° S. In the Pacific its range of distribution extends from Tasmania to Japan and from about 30° S. off the South-American coast to California.

Fam. **Geryonidae.**

Liriope tetraphylla (Chamisso & Eysenhardt).

Geryonia tetraphylla Chamisso & Eysenhardt 1821 p. 357. Pl. 27 fig. 2.
Liriope tetraphylla Gegenbaur 1856 p. 257.

Material:

"Ingolf"
St. 252 4.III.11
23°53′ N. 61°36′ W.
S 150 25 m. w. **1**

"Ingolf"
St. 259 12.III.11
33°55′ N. 43°40′ W.
S 100 47 m. w. **1**

"Ingolf"
St. 260 13.III.11
34°39′ N. 40°54′ W.
S 150 25 m. w. **2**

"Ingolf"
St. 261 14.III.11
35°27′ N. 37°18′ W.
S 100 47 m. w. **2**

"Ingolf"
St. 262 15.III.11
36°13′ N. 33°50′ W.
S 150 25 m. w. **4**
S 100 47 m. w. **25**

"Agent Petersen"
St. 303 16.VI.11
39°31′ N. 49°39′ W.
S 100 38 m. w. **2**

"Caroline Kock"
St. 315 28.V.11
39°50′ N. 49°30′ W.
S 100 38 m. w. **1**

"Anne"
St. 359 1.IV.11
30°10′ N. 10°50′ W.
S 100 48 m. w. **4**

"Ingolf"
St. 402 1.XI.11
28°52′ N. 20°36′ W.
S 200 surface **1**

"Ingolf"
St. 403 3.XI.11
27°10′ N. 21°53′ W.
S 200 surface **4**

"Dana"
St. 848 2.VI.20
18°00′ N. 64°41′ W.
S 200 300 m. w. **2**

St. 849 3.VI.20
19°00′ N. 63°53′ W.
P 150 surface **5**
P 150 200 m. w. **1**
S 200 300 m. w. **4**

St. 850 4.VI.20
20°39′ N. 61°48′ W.
P 150 50 m. w. **1**
P 150 100 m. w. **5**
S 200 150 m. w. **3**

St. 851 5.VI.20
22°23′ N. 60°46′ W.
P 150 50 m. w. **1**

St. 866 23.VI.20
28°32′ N. 56°38′ W.
S 200 100 m. w. **1**

St. 870 26.VI.20
27°29′ N. 59°20′ W.
S 150 200 m. w. **1**

St. 875 1.VII.20
28°58′ N. 67°09′ W.
S 150 100 m. w. **1**

St. 882 13.VII.20
33°00′ N. 54°02′ W.
S 200 50 m. w. **70**

St. 1108 14.IX.21
35°11′ N. 8°28′ W.
S 200 50 m. w. **2**
S 200 200 m. w. **1**

St. 1117 21.IX.21
35°59′ N. 5°30′ W.
S 200 200 m. w. **1**

St. 1119 23.IX.21
36°08′ N. 0°30′ W.
S 200 100 m. w. **2**

St. 1157 27.X.21
21°57′ N. 22°58′ W.
E 300 1000 m. w. **1**

St. 1188 7.XII.21
17°43.7′ N. 64°57′ W.
S 200 50 m. w. **2**
S 200 100 m. w. **4**

St. 1191 14.XII.21
17°19′ N. 64°54′ W.
S 200 50 m. w. **2**
S 200 50 m. w. **1**
S 200 100 m. w. **4**

St. 1192 16.XII.21
17°43.4′ N. 64°54.3′ W.
S 200 50 m. w. **98**
S 200 100 m. w. **13**
S 200 100 m. w. **1**

St. 1194 21.XII.21
17°58.5′ N. 64°41′ W.
S 200 50 m. w. **2**
S 100 300 m. w. **1**
S 150 312 m. w. **1**
S 200 320 m. w. **1**

St. 1253 12.III.22
17°43′ N. 64°56′ W.
S 200 100 m. w. **2**

St. 1273 24.III.22
17°43′ N. 64°56′ W.
E 300 1200 m. w. **1**

St. 1286 7.IV.22
15°17′ N. 61°29′ W.
E 300 1000 m. w. **3**

St. 1287 8.IV.22
16°04′ N. 61°52′ W.
S 200 100 m. w. **2**

St. 1289 15.IV.22
17°43′ N. 64°56′ W.
S 200 50 m. w. **4**

St. 1292 16.IV.22
17°43′ N. 64°56′ W.
S 150 50 m. w. **2**

St. 1294 18.IV.22
17″43′ N. 64°56′ W.
S 200 100 m. w. **60**
S 200 600 m. w. **5**

St. 1314 22.IV.22
17°43′ N. 64°56′ W.
S 200 100 m. w. **1**

St. 1334 7.V.22
27°28′ N. 59°29′ W.
P 100 400 m. w. **1**

St. 1349 21.V.22
36°16′ N. 74°33′ W.
S 150 50 m. w. **1**

St. 1365 8.VI.22
31°47′ N. 41°41′ W.
S 150 150 m. w. **1**

St. 3975 31.I.30
35°42′ S. 18°37′ E.
S 200 50 m. w. **76**
S 200 300 m. w. **2**
S 200 600 m. w. **4**
E 300 1000 m. w. **1**
S 150 1000 m. w. **2**
S 150 1500 m. w. **7**
S 150 2000 m. w. **10**
S 150 2500 m. w. **9**

St. 3978 13.II.30
30°15′ S. 13°15′ E.
S 200 50 m. w. **35**
S 200 100 m. w. **60**
S 200 300 m. w. **2**
S 200 600 m. w. **3**

St. 3998 1.III.30
7°34′ S. 8°48′ W.
S 200 50 m. w. **26**
S 200 100 m. w. **5**
S 150 2000 m. w. **1**
S 150 3000 m. w. **1**

St. 4000 4.III.30
0°31′ S. 11°02′ W.
S 50 surface **4**
S 200 50 m. w. c. **250**
S 200 100 m. w. c. **400**
S 200 300 m. w. **53**
S 200 600 m. w. **13**
E 300 1000 m. w. **3**
S 150 1000 m. w. **11**
S 150 2000 m. w. **6**
S 150 3000 m. w. **6**
S 150 4000 m. w. **11**
S 150 5000 m. w. **17**
E 300 6000 m. w. **1**

St. 4003 9.III.30
8°26′ N. 15°11′ W.
S 200 50 m. w. **19**
S 200 100 m. w. **2**
S 200 300 m. w. **3**
S 150 2000 m. w. **3**
S 150 3000 m. w. **1**
S 150 4000 m. w. **2**

St. 4005 12.III.30
13°31′ N. 18°03′ W.
S 50 surface **2**
S 200 50 m. w. **18**
S 200 100 m. w. **4**
S 200 600 m. w. **1**
S 150 1000 m. w. **1**
S 150 2000 m. w. c. **50**
S 150 2500 m. w. **2**
S 150 3500 m. w. **1**
E 300 4000 m. w. **1**

St. 4007 15.III.30
18°22′ N. 18°14′ W.
S 200 50 m. w. c. **80**
S 200 100 m. w. **12**
S 200 300 m. w. **25**
S 200 600 m. w. **4**
S 150 1000 m. w. **5**
S 150 2000 m. w. **11**
S 150 3000 m. w. **3**
S 150 3500 m. w. **8**
E 300 4000 m. w. **10**

St. 4009 18.III.30
24°36.5′ N. 17°27′ W.
S 200 100 m. w. **23**
S 200 300 m. w. **2**
S 150 1000 m. w. **3**
S 150 2000 m. w. **1**

St. 4014 25.III.30
28°09′ N. 15°19′ W.
S 200 300 m. w. **5**
S 200 600 m. w. **47**
S 200 900 m. w. **3**
S 200 1200 m. w. **1**

St. 4017 27.III.30
29°11′ N. 14°14′ W.
S 50 surface **1**
S 200 50 m. w. **22**
S 200 100 m. w. **28**
S 200 600 m. w. **3**
S 150 1000 m. w. **4**
S 150 1500 m. w. **1**
S 150 2000 m. w. **1**
S 150 3000 m. w. **1**
S 150 4000 m. w. **1**

St. 4019 30.III.30
33°08′ N. 10°22′ W.
S 50 surface **1**
S 200 50 m. w. **27**
S 200 100 m. w. **34**
S 200 300 m. w. **2**
S 150 1000 m. w. **5**
S 150 2000 m. w. **4**
S 150 3000 m. w. **3**
S 150 3500 m. w. **2**
E 300 4000 m. w. **2**

St. 4025 9.IV.30
35°57′ N. 5°30′ W.
S 200 50 m. w. **9**
S 200 100 m. w. **16**
S 200 200 m. w. **2**
S 200 300 m. w. **15**
S 200 400 m. w. **2**
S 200 600 m. w. **29**

St. 4050 2—3.V.30
38°48′ N. 12°06′ E.
S 200 100 m. w. **2**
S 200 250 m. w. **1**
S 200 300 m. w. **2**

St. 4197 25.VI.31
43°39′ N. 24°04′ W.
S 200 50 m. w. **1**

This widely distributed, epipelagic medusa was collected in numerous localities among and north of the West-Indian islands, between the West Indies and the Azores, off the entire west coast of Africa, and in the Mediterranean. None of the localities are outside the previously known areas of distribution. Most of the samples contain only some few specimens, but in some scattered localities, and at different seasons, it was taken in great abundance (St. 882 in July 1920, St. 1192 in December 1921, St. 1294 in April 1921, and at some of the stations off the west coast of Africa in Februar—March 1930). In the latter series of stations the variation in number of specimens was very remarkable; enormous quantities were taken at St. 4000 off Liberia, and the medusa was also rather abundant near the Cape of Good Hope (St. 3975 and 3978) and along the the coast between Cape Verde and Morocco (St. 4007—4019, comp. *Rhopalonema velatum*). The vast majority of the specimens were undoubtedly captured near the surface of the water.

Distribution: *Liriope tetraphylla*, the only species of the genus, is a very common medusa, generally distributed in the warm parts of all the oceans, including the Mediterranean. Its southern limit of distribution is at about 40° S. in all the oceans, though in the Atlantic it is recorded from a single locality as far south as 54°48′ S., north-east of the South Sandwich Islands (Kramp 1957). In the Pacific it occurs as far north as Japan and northern California. In the western Atlantic it is rarely found north of 40° N., south of Cape Cod, and it does not penetrate into the Gulf of Maine. In the eastern Atlantic it occurs regularly in the Bay of Biscay and is frequently carried into the western part of the English Channel, mainly in autumn, but also sometimes at other seasons (Russell 1953).

Geryonia proboscidalis (Forskål).

Medusa proboscidalis Forskål 1775 p. 108. Icon. tab. 36 fig. 1.
Geryonia proboscidalis Eschscholtz 1829 p. 88.
Geryonia proboscidalis + *Carmarina hastata* etc. Haeckel 1879 pp. 295—298.
Geryonia proboscidalis Mayer 1910 p. 425. Pl. 53 fig. 1—3, Pl. 54 fig. 10; text-fig. 282.

Material:

"Ingolf"
St. 250 2.III.11
20°38′ N. 64°35′ W.
S 150 19 m. w. **3**

St. 252 4.III.11
23°53′ N. 61°36′ W.
S 150 25 m. w. **2**

St. 403 3.III.11
27°10′ N. 21°53′ W.
S 150 56 m. w. **1**

"Dana"
St. 844 29.IV.20
25°49′ N. 51°55′ W.
P 100 surface **1**

St. 845 30.IV.20
24°46′ N. 54°08′ W.
P 150 300 m. w. **1**

St. 847 2.V.20
22°34′ N. 57°07′ W.
P 150 200 m. w. **1**

St. 848 2.VI.20
18°00′ N. 64°41′ W.
S 200 300 m. w. **1**

St. 850 4.VI.20
20°39′ N. 61°48′ W.
P 150 50 m. w. **1**
P 150 100 m. w. **1**
P 150 300 m. w. **1**

St. 854 8.VI.20
27°53′ N. 59°23′ W.
S 200 150 m. w. **1**

St. 855 9.VI.20
29°15′ N. 59°45′ W.
S 200 24 m. w. **2**

St. 866 23.VI.20
28°32′ N. 56°38′ W.
S 200 50 m. w. **1**
S 200 100 m. w. **2**

St. 868 24.VI.20
27°10′ N. 55°52′ W.
S 150 100 m. w. **1**

St. 870 26.VI.20
27°29′ N. 59°20′ W.
S 150 100 m. w. **2**

St. 882 13.VII.20
33°00′ N. 54°02′ W.
S 200 50 m. w. **4**
S 200 100 m. w. **1**

St. 891 24.VII.20
29°28′ N. 69°25′ W.
S 150 50 m. w. **1**
S 200 100 m. w. **2**

St. 892 25.VII.20
30°49′ N. 73°30′ W.
S 150 150 m. w. **1**

St. 1178 18.XI.21
10°24′ N. 54°38′ W.
E 300 1000 m. w. **1**

St. 1322 30.IV.22
27°02′ N. 53°37′ W.
E 300 400 m. w. **2**

St. 3996 25.II.30
15°41′ S. 5°50′ W.
S 200 100 m. w. **1**

St. 3998 1.III.30
7°34′ S. 8°48′ W.
S 200 50 m. w. **45**
S 200 100 m. w. **60**
S 200 300 m. w. **2**

St. 4000 4.III.30
0°31′ S. 11°02′ W.
S 200 300 m. w. **1**

St. 4014 25.III.30
28°05′ N. 15°19′ W.
E 300 1500 m. w. **1**

St. 4017 27.III.30
29°11′ N. 14°14′ W.
S 200 50 m. w. **2**
S 200 100 m. w. **3**

St. 4050 2—3.V.30
38°48′ N. 12°06′ E.
S 200 100 m. w. **1**
S 200 150 m. w. **1**
S 150 1500 m. w. **1**

St. 4197 25.VI.31
43°39′ N. 24°04′ W.
S 200 100 m. w. **1**

Most of these localities are in the waters north and north-east of the West Indies; St. 1178 is off British Guiana, St. 403 west of the Canary Islands, St. 3996—4017 off the west coast of Africa, St. 4050 in the Mediterranean near Sicily, and St. 4197 north-east of the Azores which up to now is the northernmost locality from which this species has been found in the Atlantic Ocean. All the other localities are inside the areas from which it was known before.

The only locality in which the medusa was taken in any considerable number was at St. 3998, outside the Gulf of Guinea in March 1930, where also *Rhopalonema velatum* was particularly abundant; specimens of all sizes were taken there, many of them very small. Young specimens were also taken at several other localities and at very different seasons: March (1911 and 1930), April, June and July (1920), and November (1911). The development of this epipelagic medusa thus seems to be independent of the seasons.

Distribution: *Geryonia proboscidalis* has a circumglobal distribution in tropical and subtropical seas. It is common in the Mediterranean, and in the great oceans it occurs approximately between 35° S. and 35° N. It belongs to the upper strata.

Narcomedusae.

Fam. **Aeginidae.**

Aegina citrea Eschscholtz.

Aegina citrea Eschscholtz 1829 p. 113. Pl. 11 fig. 4.
Aegina rosea Eschscholtz 1829 p. 115. Pl. 10 fig. 3.
Aegina rhodina Haeckel 1879 p. 338. Pl. 20 fig. 11—15.
Aegina rhodina Mayer 1910 p. 452. Pl. 52 fig. 5, Pl. 54 fig. 11.
Aegina citrea Russell 1953 p. 467. Pl. 28 fig. 1; text-fig. 308—310.

Material:

"Ingolf"
St. 256 8.III.11
28°55′ N. 55°25′ W.
S 150 25 m. w. **1**

"Dana"
St. 844 29.IV.20
25°54′ N. 51°47′ W.
P 100 surface **1**

St. 1163 7.XI.21
12°59′ N. 32°49′ W.
E 300 1000 m. w. **1**

St. 1183 25.XI.21
14°00′ N. 61°40′ W.
E 300 4000 m. w. **1**

St. 1192 16.XII.21
17°43.4′ N. 64°54.3′ W.
S 200 100 m. w. **2**

St. 1203 11.I.22
7°30′ N. 79°19′ W.
E 300 3500 m. w. **1**

St. 1208 16.I.22
6°48′ N. 80°33′ W.
E 300 1000 m. w. **2**
E 300 3500 m. w. **1**

St. 1209 17.I.22
7°15′ N. 78°54′ W.
E 300 3500 m. w. **1**

St. 1214 26.I.22
14°21′ N. 76°50′ W.
E 300 1200 m. w. **3**

St. 1215 27.I.22
16°06′ N. 76°02′ W.
E 300 1200 m. w. **3**

St. 1225 2.II.22
23°58′ N. 83°22′ W.
E 300 1000 m. w. **1**

St. 1230 5.II.22
23°13′ N. 82°21′ W.
E 300 1500 m. w. **2**

St. 1231 6.II.22
24°30′ N. 80°00′ W.
E 300 1000 m. w. **2**

St. 1239 12.II.22
25°50′ N. 76°55′ W.
S 150 3000 m. w. **1**

St. 1242 14.II.22
24°05′ N. 74°36′ W.
S 150 2500 m. w. **1**

St. 1267 14.III.22
17°56′ N. 64°50′ W.
E 300 4500 m. w. **1**

St. 1283 5.IV.22
14°38′ N. 61°16′ W.
E 300 4000 m. w. **1**

St. 3978 13.II.30
30°15′ S. 13°15′ E.
S 150 4000 m. w. **1**

St. 3980 17.II.30
23°26′ S. 3°56′ E.
S 150 4000 m. w. **1**

St. 3996 25.II.30
15°41′ S. 5°50′ W.
S 200 600 m. w. **2**
E 300 1000 m. w. **2**
S 150 1500 m. w. **1**
S 150 3000 m. w. **10**

St. 3999 2.III.30
3°45′ S. 10°00′ W.
E 300 1000 m. w. **1**

St. 4000 4.III.30
0°31′ S. 11°02′ W.
S 150 3000 m. w. **2**

St. 4003 9.III.30
8°26′ N. 15°11′ W.
S 150 1000 m. w. **1**
S 150 2000 m. w. **1**

St. 4005 12.III.30
13°31′ N. 18°03′ W.
S 200 300 m. w. **1**
S 200 600 m. w. **5**
E 300 1000 m. w. **2**
S 150 1000 m. w. **3**
S 150 2500 m. w. **17**
S 150 3500 m. w. **17**
E 300 4000 m. w. **26**

St. 4007 15.III.30
18°22′ N. 18°14′ W.
S 200 100 m. w. **4**
S 200 300 m. w. **4**
S 200 600 m. w. **5**
E 300 1000 m. w. **2**
S 150 1000 m. w. **9**
S 150 2000 m. w. **5**
S 150 2500 m. w. **2**
S 150 3000 m. w. **3**
S 150 3500 m. w. **1**
E 300 4000 m. w. **2**

St. 4009 18.III.30
24°36.5′ N. 17°27′ W.
S 150 3000 m. w. **7**
S 150 3500 m. w. **1**

St. 4014 25.III.30
28°09′ N. 15°19′ W.
E 300 1500 m. w. **1**

St. 4019 30.III.30
33°08′ N. 10°22′ W.
E 300 4000 m. w. **1**

St. 4158 18.VI.30
46°28′ N. 8°01′ W.
S 150 2000 m. w. **2**
S 150 3000 m. w. **1**
S 150 4000 m. w. **16**
S 150 4500 m. w. **18**
E 300 5000 m. w. **37**
S 150 5000 m. w. **3**
S 150 5500 m. w. **2**

St. 4197 25.VI.31
43°39′ N. 24°04′ W.
S 200 50 m. w. **1**
S 200 100 m. w. **4**

St. 256 and 844 are between the Azores and the West Indies, St. 1163 is south-west of the Cape Verde Islands, St. 1203—1209 in the Gulf of Panama, St. 1183, 1192 and 1214—1283 in West-Indian waters and north of Cuba. St. 3978—4019 are off the west coast of Africa, St. 4158 in the Bay of Biscay, and St. 4197

north-east of the Azores. As a rule the samples contain only one or two specimens, but at St. 4005 and 4158 numerous specimens were taken in some of the deep hauls. Throughout its extensive area of distribution this medusa mainly occurs in the deep and intermediary strata but is also occasionally met with in the uppermost layers as also seen in some of the samples listed above (St. 1192, 4005, 4007, and 4197). In cold areas its occurrence is restricted to deep water. Some of the specimens found at St. 4005 (1000 and 2500 m. wire) and St. 4158 (2000 and 4000 m. wire) are young stages.

The normal number of tentacles and marginal lappets in this medusa is four, but specimens with five or six tentacles and lappets have frequently been observed. In the present collection the variation is very insignificant; among 248 specimens examined only three were found with six tentacles; on the other hand, there are six specimens with only three tentacles and lappets. In the various geographical areas the variation was as follows:

Number of tentacles and lappets	Gulf of Panama	West Indies	Bay of Biscay	West Africa	Total
3	0	3	1	2	6
4	5	16	78	139	238
5	0	1	0	0	1
6	0	1	0	2	3

Distribution: *Aegina citrea* is widely distributed in the warm and temperate parts of the oceans and may occasionally be carried into boreal and antiboreal regions. There are very few records from the central parts of the Pacific, but along the borders it is known from south-eastern Australia to Kamchatka and from Peru to the Bering Sea. In the Indian Ocean it has not yet been observed south of about 40° S. The southernmost localities where it has been found in the Atlantic are near South Georgia, about 54° S. In the eastern Atlantic it is sometimes carried into the waters west of Scotland and south of Iceland, whereas in the western Atlantic its northward distribution seems to stop at the Bermudas. Besides a single record from the Bahamas (Mayer 1910) it has not previously been recorded from West-Indian waters.

Aeginura grimaldii Maas.

Aeginura grimaldii Maas 1904 p. 38. Pl. 3 fig. 19—28.
Aeginura weberi Maas 1905 p. 77. Pl. 11 fig. 73, Pl. 12 fig. 76, Pl. 14 fig. 90—99.
Aeginura grimaldii Mayer 1910 p. 470, fig. 309.
Aeginura grimaldii Bigelow 1913 p. 61.
Aeginura lanzerotae Thiel 1936 p. 86.
Aeginura grimaldii Bigelow 1938 p. 132.
Aeginura grimaldii Russell 1953 p. 472; text-fig. 311, 312.

Material:

St. 1365 8.VI.22
31°47′ N. 41°41′ W.
E 300 5000 m. w. **1**

St. 4005 12.III.30
13°31′ N. 18°03′ W.
E 300 1000 m. w. **1**
S 150 3500 m. w. **6**
E 300 4000 m. w. **53**

St. 4007 15.III.30
18°22′ N. 18°14′ W.
S 150 3500 m. w. **3**
E 300 4000 m. w. **34**

St. 4009 18.III.30
24°36.5′ N. 17°27′ W.
E 300 4000 m. w. **24**

St. 4014 25.III.30
28°09′ N. 15°19′ W.
E 300 1500 m. w. **1**

St. 4017 27.III.30
29°11′ N. 14°14′ W.
E 300 5000 m. w. **2**

St. 4158 17.VI.30
46°28′ N. 8°01′ W.
E 300 5000 m. w. **10**

St. 1365 is south-west of the Azores, St. 4158 in the Bay of Biscay; the other localities, St. 4005—4017, are off the northern part of the west coast of Africa. In some of the West-African localities the medusa was taken in great abundance. All the records are from deep water.

Distribution: *Aeginura grimaldii* is a widely distributed bathypelagic medusa occurring in all of the three great oceans, but apparently it is not equally common everywhere, and it is one of the bathypelagic species which do not approach the slope of the Antarctic Continent. In the Pacific it is recorded from the

eastern tropical seas north of Peru, from the Bering Sea, Japan, and southern China. *A. weberi*, which was described from the Malayan Archipelago (MAAS 1905), belongs to the same species. The records from the Indian Ocean are all from the western part (in the map given by THIEL, 1936, a signature is placed south of Australia; the medusa found there was, however, *A. myosura* HAECKEL which is a doubtful species). In the Atlantic Ocean its northward distribution is limited by the submarine ridges between Scotland, Iceland, Greenland and Baffin Land. It is recorded from deep water south of Nova Scotia and near the Bermudas, but it has neven been found in West-Indian waters. Whereas this species is very common in the deep strata of the entire northern Atlantic it seems to be fairly rare in the southern parts of the ocean. As mentioned above it was taken in great numbers off the northern part of the west coast of Africa by the "Dana" in 1930, but it was not met with at any of the stations between Cape Verde and the Cape of Good Hope; other expeditions have taken it in some scattered localities further south as far as about 15° S. An altogether isolated occurrence is that recorded by THIEL from a locality south-west of Tristan da Cunha, about 41° S. It does not occur in the Mediterranean.

Solmundella bitentaculata (QUOY & GAIMARD).

Charybdea bitentaculata QUOY & GAIMARD 1833 p. 295. Pl. 25 fig. 4, 5.
Aeginopsis mediterranea J. MÜLLER 1851 p. 272. Pl. 11.
Aeginella bitentaculata HAECKEL 1879 p. 341.
Solmundella mediterranea HAECKEL 1879 p. 352.
Solmundella bitentaculata BROWNE 1904 p. 741. Pl. 56 fig. 3.
Solmundella bitentaculata MAYER 1910 p. 455. Fig. 301.
Solmundella bitentaculata var. *mediterranea* MAYER 1910 p. 456. Pl. 54 fig. 1—3, Pl. 55 fig. 4; text-fig. 302.
Solmundella bitentaculata KRAMP 1957 p. 64.

Material:

St. 849 3.VI.20
19°00′ N. 63°53′ W.
P 150 surface **1**

St. 3975 31.I.30
35°42′ S. 18°37′ E.
S 200 50 m. w. **31**
S 200 600 m. w. **5**
S 150 1000 m. w. **1**
S 150 1500 m. w. **2**
S 150 2000 m. w. **1**

St. 3978 13.II.30
30°15′ S. 13°15′ E.
S 150 1000 m. w. **1**

St. 3998 1.III.30
7°34′ S. 8°48′ W.
S 200 50 m. w. **1**
S 200 600 m. w. **1**
S 150 2000 m. w. **2**
S 150 4000 m. w. **2**

St. 4000 4.III.30
0°31′ S. 11°02′ W.
S 200 600 m. w. **2**
E 300 1000 m. w. **14**
S 150 2000 m. w. **2**
S 150 3000 m. w. **2**
S 150 4000 m. w. **2**
S 150 5000 m. w. **2**

St. 4003 9.III.30
8°26′ N. 15°11′ W.
S 200 50 m. w. **1**
S 150 1000 m. w. **1**
S 150 3000 m. w. **1**

St. 4005 12.III.30
13°31′ N. 18°03′ W.
S 50 surface **4**
S 200 50 m. w. **2**
S 200 100 m. w. **1**
S 200 600 m. w. **2**
S 150 1000 m. w. **3**

St. 4007 15.III.30
18°22′ N. 18°14′ W.
S 200 50 m. w. **9**
S 200 300 m. w. **13**
S 200 600 m. w. **106**
S 150 2000 m. w. **8**
S 150 3000 m. w. **2**

St. 4025 9.IV.30
35°57′ N. 5°30′ W.
S 200 50 m. w. **8**
S 200 100 m. w. **1**
S 200 600 m. w. **1**

St. 849 is in the West Indies, St. 4025 in the Straits of Gibraltar, the others are off the west coast of Africa. No specimens are at hand from other expeditions of the "Dana". All the specimens were undoubtedly captured in the upper strata.

Distribution: This well-known and very common epipelagic medusa is widely distributed in all the great oceans; it is very common in the Mediterranean, but in the great oceans it is particularly abundant in the southern hemisphere. In the eastern Pacific it occurs from California to the southern part of Chile, in the western Pacific from southern Japan to North-East Australia and the Fiji and Tuamotu Islands, and it has been recorded from a number of localities near the Antarctic Continent. It is probably generally distributed in the Indian Ocean, and also here it penetrates to the coastal area of the Antarctic Continent. In the Atlantic Ocean it is common everywhere south of 20° N. until South Georgia and the South Sandwich Islands with scattered occurrences further south. In the northern Atlantic it seems to be rare; it is recorded from the Canary

Islands, the Bay of Cadiz, the Azores and from the Strait of Florida. According to the map given by THIEL (1936) it has also been taken in a locality south of Newfoundland, about 41° N. 52° W., but I have found no records in the literature from that locality.

Fam. **Solmaridae.**

Genus **Pegantha.**

In a recent revision of the genus *Pegantha* (KRAMP 1957 pp. 65 ff.) I have reduced the number of 29 species previously referred to that genus, to seven, including the two species "*Polycolpa*" *forskali* HAECKEL and *Pegantha magnifica* HAECKEL, which have not been observed since they were described by HAECKEL (1879). The five valid species are: *P. triloba* HAECKEL, *martagon* HAECKEL, *laevis* H. B. BIGELOW, *clara* R. P. BIGELOW, and *rubiginosa* (KÖLLIKER); this latter was transferred from the genus *Cunina* in which it has generally been included. Most of the other species, dating from FORSKÅL 1775 to HAECKEL 1879, are beyond recognization, others are more or less doubtful synonyms, and only a few may, with certainty, be referred to any of the five species which have been properly described. All of these five species are represented in the "Dana" collections.

Pegantha martagon HAECKEL.

Pegantha martagon HAECKEL 1879 p. 333. Pl. 19 fig. 4—7.
Pegantha simplex H. B. BIGELOW 1904 p. 260. Pl. 5 fig. 19, 20.
Pegantha martagon H. B. BIGELOW 1909 *a* p. 83. Pl. 18 fig. 1—8.
Pegantha martagon MAYER 1910 p. 443; text-fig. 295, 296.
Pegantha martagon H. B. BIGELOW 1918 p. 395.
Pegantha martagon H. B. BIGELOW 1940 p. 308.
Pegantha martagon KRAMP 1955 p. 277.
Pegantha martagon KRAMP 1957 p. 67.

Material:

"Ingolf"
St. 251 3.III.11
22°16′ N. 63°05′ W.
S 100 47 m. w. **1**

St. 260 13.III.11
34°39′ N. 40°54′ W.
S 150 25 m. w. **3**

St. Croix"
St. 272 22.II.11
30°30′ N. 49°57′ W.
S 150 116 m. w. **2**

St. 293 18.VI.11
26°35′ N. 53°59′ W.
S 150 66 m. w. **2**

"St. Thomas
St. 337 14.VIII.11
37°25′ N. 41°00′ W.
S 200 16 m. w. **4**

"Ingolf"
St. 404 3.XI.11
26°12′ N. 23°02′ W.
S 200 surface **1**

St. 405 5.XI.11
24°42′ N. 24°50′ W.
S 200 surface **2**

"Dana"
St. 846 1.V.20
23°40′ N. 55°22′ W.
P 150 100 m. w. **1**

St. 882 13.VII.20
33°00′ N. 54°02′ W.
S 200 50 m. w. **2**

St. 1162 6.XI.21
13°35′ N. 30°11′ W.
E 300 1000 m. w. **3**

St. 1208 14.I.22
6°48′ N. 80°33′ W.
E 300 3600 m. w. **1**

St. 1209 17.I.22
7°15′ N. 78°54′ W.
E 300 3500 m. w. **1**

St. 3980 17.II.30
23°26′ S. 3°56′ E.
E 300 1000 m. w. **1**
S 150 3000 m. w. **1**

St. 3996 25.II.30
15°41′ S. 5°50′ W.
S 200 50 m. w. **1**
S 200 100 m. w. **1**
S 200 300 m. w. **6**
S 150 1000 m. w. **1**
S 150 1500 m. w. **3**
S 150 2000 m. w. **1**
S 150 3000 m. w. **3**

St. 4000 4.III.30
0°31′ S. 11°02′ W.
S 200 50 m. w. **2**
S 200 100 m. w. **2**
S 200 300 m. w. **2**
E 300 1000 m. w. **3**
S 150 3000 m. w. **1**
S 150 5000 m. w. **1**

St. 4003 9.III.30
8°26′ N. 15°11′ W.
S 200 100 m. w. **1**

St. 4005 12.III.30
13°31′ N. 18°03′ W.
S 200 50 m. w. **5**
S 200 600 m. w. **3**
S 150 1000 m. w. **6**
S 150 2000 m. w. **2**
S 150 2500 m. w. **1**
S 150 3500 m. w. **2**
E 300 4000 m. w. **1**

St. 4006 13.III.30
15°31′ N. 18°05′ W.
E 300 1000 m. w. **1**

St. 4007 15.III.30
18°22′ N. 18°14′ W.
S 200 300 m. w. **5**
S 200 600 m. w. **1**
S 150 2000 m. w. **1**
S 150 2500 m. w. **1**

St. 4009 18.III.30
24°36.5′ N. 17°27′ W.
S 150 2000 m. w. **12**
S 150 2500 m. w. **1**

St. 4017 27.III.30
29°11′ N. 14°14′ W.
S 200 50 m. w. **1**
S 200 100 m. w. **3**
S 200 300 m. w. **1**
E 300 1000 m. w. **1**
E 300 5000 m. w. **1**

St. 4019 30.III.30
33°08′ N. 10°22′ W.
S 200 50 m. w. **1**
S 200 100 m. w. **3**

St. 4192 19.VI.31
39°57′ N. 24°59′ W.
S 200 50 m. w. **5**
S 200 100 m. w. **1**
S 200 600 m. w. **3**

St. 4195 22.VI.31
41°55′ N. 32°22′ W.
S 200 100 m. w. **2**

St. 251—337 and 846—882 are between the Azores and the West Indies, St. 1162 S.W. of the Cape Verde Islands, St. 1208 and 1209 in the Gulf of Panama, St. 4192 and 4195 near the Azores; the other localities are off the west coast of Africa. The occurrence near the Azores is somewhat farther north than known before. The species was nowhere taken in great abundance. As seen from the list above it may occur in the uppermost strata, and according to previous records it generally inhabits the epipelagic region; the specimens taken in the deep hauls were, therefore, most probably taken at higher levels.

The diameter has been measured and the tentacles and lappets counted in as many specimens as possible, with the following results:

Diameter mm.	Number of tentacles 9	10	11	12	13	14	Average number
4	..	1	..	..	..	..	10.0
5	1	..	..	..	..	..	9.0
6	..	2	..	..	..	..	10.0
7	..	1	..	..	..	..	10.0
8	..	4	2	..	..	..	10.3
9	2	1	1	1	..	..	10.2
10	..	2	..	1	..	..	10.7
11	..	1	2	1	..	..	11.0
12	1	1	1	..	..	..	10.0
13	..	..	1	..	..	..	11.0
14	..	..	..	..	..	1	14.0
15	..	..	..	..	..	1	14.0
16	..	..	..	..	..	1	14.0
17	..	..	..	1	..	..	12.0
18	..	..	..	..	..	..	..
19	..	..	..	..	1	..	13.0
Number of specimens	4	13	7	4	1	3	..

A similar table, based on 85 specimens from the "Discovery" collections, was recently given by me (KRAMP 1957 p. 69). I then found that the number of tentacles most frequently met with was 12 which was counted in 32 of the 85 specimens examined. In the present collection most of the specimens have 10 or 11 tentacles. In other respects the two tables agree fairly well, showing that within each size-group the number of tentacles is variable, but each specimen usually attains its final number at an early stage of development, though during further growth some few tentacles and lappets may occasionally be added.

The table comprises the specimens from the eastern Atlantic; the two specimens from the Gulf of Panama are 10 and 12 mm. wide with 10 and 9 tentacles respectively. The two specimens from St. 251 and 846 are young stages, 4 mm. wide, with only 8 tentacles.

Distribution: *Pegantha martagon* occurs in the eastern tropical Pacific, in the China Sea (from where it was first described), in the tropical Indian Ocean, and in the Atlantic as far north as the Azores; it has now for the first time been observed in the western Atlantic north of the equator, but it is recorded from off the east coast of South America. Moreover it is circumpolar in the subantarctic seas, being particularly common around South Georgia.

Pegantha laevis H. B. Bigelow.

Pegantha laevis H. B. Bigelow 1909 *a* p. 97. Pl. 16 fig. 1, Pl. 20 fig. 4—6, Pl. 27 fig. 1—7.
Pegantha laevis H. B. Bigelow 1918 p. 396.
Pegantha laevis Kramp 1955 p. 279.
Pegantha laevis Kramp 1957 p. 70, Pl. 6 fig. 2.

Material:

"St. Thomas"
St. 337 14.VIII.11
37°25′ N. 41°00′ W. **1**

"Ingolf"
St. 403 3.XI.11
27°10′ N. 21°53′ W.
S 200 surface **1**

"Ingolf"
St. 405 5.XI.11
24°42′ N. 24°50′ W.
S 200 surface **10**

"Dana"
St. 4003 9.III.30
8°26′ N. 15°11′ W.
S 200 100 m. w. about **10**

St. 4007 15.III.30
18°22′ N. 18°14′ W.
S 150 3500 m. w. **1**
E 300 4000 m. w. **1**

St. 4009 18.III.30
24°36.5′ N. 17°27′ W.
S 200 300 m. w. **1**

St. 4158 17.VI.30
46°28′ N. 8°01′ W.
S 200 950 m. w.
fragments of a large specimen

St. 4192 19.VI.31
39°57′ N. 24°59′ W.
S 200 500 m. w. **14**

St. 337 is west of the Azores, St. 4154 in the Bay of Biscay, St. 4192 near the Azores, the other localities are off the northern part of the west coast of Africa. All the specimens were probably taken in the upper strata.

The specimens collected by the "Dana" are all in a very bad condition; they vary in size between about 12 and 32 mm. in diameter, but they cannot be measured exactly. The specimens from "Ingolf" St. 405, south-west of the Canary Islands, have the following dimensions:

Diameter, mm.	8	10	14	16	21	22	27	29	35
Number of tentacles.....	15	15	16	18	16	18	20	15	18

which is in good accordance with the measurements of specimens from the "Discovery" collection (Kramp 1957).

Distribution: Eastern tropical Pacific off Peru and further west, about 14° S. and 115° W.; near the Hawaiian Islands. In the Indian Ocean it is known only from two localities south-east of Africa. It is widely distributed, but not very common, in the Atlantic Ocean; the previous records comprise the area from a line between South Africa and Patagonia to somewhat north of the Cape Verde Islands, now also taken west and east of the Azores and in the Bay of Biscay.

Pegantha clara R. P. Bigelow.

Polycolpa forskali Vanhöffen 1908 p. 56, 1912 *a* p. 391, 1912 *b* p. 32 (*non* Haeckel).
Pegantha clara R. P. Bigelow 1909 p. 80, 2 fig.
Pegantha smaragdina H. B. Bigelow 1909 *a* p. 90. Pl. 14 fig. 1, 2, Pl. 19 fig. 1—9, Pl. 22—26.
Pegantha clara H. B. Bigelow 1918 p. 397.
Pegantha clara Kramp 1947 p. 33. Pl. 4 fig. 7, Pl. 5 fig. 1—10.
Pegantha clara Kramp 1957 p. 73.

Material:

"Ingolf"
St. 251 3.III.11
22°16′ N. 63°05′ W.
S 150 19 m. w. **1**

St. 258 11.III.11
32°54′ N. 46°44′ W.
S 100 47 m. w. **1**

St. 260 13.III.11
34°39′ N. 40°54′ W. **2**

St. 406 5.XI.11
23°49′ N. 26°25′ W. **1**

"Dana"
St. 842 28.IV.20
25°48′ N. 49°22′ W.
P 150 100 m. w. **2**

St. 855 9.VI.20
29°15′ N. 59°45′ W.
P 200 24 m. w. **2**

St. 856 11.VI.20
30°27′ N. 60°53′ W.
P 150 800 m. w. **1**

St. 870 26.VI.20
27°29′ N. 59°20′ W.
S 150 50 m. w. **1**

St. 882 13.VII.20
33°00′ N. 54°02′ W.
S 200 50 m. w. **1**
P 150 150 m. w. **1**

St. 885 16.VII.20
26°46′ N. 54°14′ W.
P 150 25 m. w. **8**
S 200 50 m. w. **1**

St. 892 25.VII.20
30°49′ N. 73°30′ W.
S 150 150 m. w. **1**

St. 1157 27.X.21
21°57′ N. 22°58′ W.
E 300 1000 m. w. **1**

St. 1332 5.V.22
26°58′ N. 56°58′ W.
E 300 700 m. w. **1**

St. 1353 23.V.22
33°51′ N. 66°43′ W.
E 300 1000 m. w.
fragments

St. 1366 9.VI.22
32°30′ N. 40°04′ W.
S 150 150 m. w. **1**

St. 1369 12.VI.22
35°44′ N. 29°33′ W.
S 200 **1**

St. 3980 17.II.30
23°26′ S. 3°56′ E.
S 200 50 m. w. **2**

St. 3996 25.II.30
15°41′ S. 5°50′ W.
S 200 50 m. w. **4**
S 200 100 m. w.
about **5**
S 200 300 m. w. **1**
S 200 600 m. w. **3**
S 150 1000 m. w.
about **10**
S 150 1500 m. w. **25**
S 150 2000 m. w. **1**
S 150 3000 m. w. **1**
E 300 4000 m. w. **1**

St. 4003 9.III.30
8°26′ N. 15°11′ W.
S 200 300 m. w. **1**
S 150 1000 m. w. **1**

St. 4007 15.III.30
18°28′ N. 18°14′ W.
S 200 100 m. w. **1**

St. 4009 18.III.30
24°36.5′ N. 17°27′ W.
S 150 2000 m. w.
fragments
E 300 4000 m. w. **1**

St. 4014 25.III.30
28°09′ N. 15°19′ W.
S 200 900 m. w. **1**

St. 4017 27.III.30
29°11′ N. 14°14′ W.
S 200 50 m. w. **3**
S 200 100 m. w. **1**
S 150 2000 m. w.
fragments of **7—8**
S 150 3000 m. w. **3**
E 300 5000 m. w. **2**

St. 4019 30.III.30
33°08′ N. 10°22′ W.
S 200 100 m. w. **5**

St. 4192 20.VI.31
39°57′ N. 24°59′ W.
S 200 400 m. w. **2**

St. 251—260 and 842—892 are between the Azores and the West Indies, St. 1353 near Bermuda, St. 1332 and 1366 between the West Indies and the Azores, St. 1369 and 4192 near the Azores; the other stations are off the west coast of Africa.

Most of the specimens are small. Some few large specimens were, however, taken at St. 1366 (diam. 67 mm. with 27 tentacles), St. 1369 (57 mm. with 35 tentacles), and St. 3980 (about 40 mm. with about 32 tentacles, 75 mm. with 32 tentacles). Ten specimens are in a condition which makes it possible to measure their diameter and count the tentacles and marginal lappets, as follows:

Diameter, mm.	6	11	12	14	14	17	40	57	67	75
Number of tentacles.....	c. 22	c. 16	17	21	25	21	c. 32	35	27	32

This confirms my previous statement (KRAMP 1957 p. 76) that an increase in number of tentacles and lappets generally takes place when the growth of the medusa is continued beyond a diameter of about 35 mm. In the specimen from St. 1369, 57 mm. wide, the 35 tentacles are of very different sizes, though not regularly alternating; also in the other large specimens some of tentacles are distinctly smaller than the others.

Distribution: In the Pacific this species occurs off the coast of South America from Panama to about 25° S., and it has been found between the Hawaiian and the Caroline Islands. In the Indian Ocean it is only recorded from the westernmost part off the east coast of Africa. It is widely distributed in the Atlantic Ocean between about 50° N. and 40° S.

Pegantha rubiginosa (KÖLLIKER).

Eurystoma rubiginosa KÖLLIKER 1853 p. 322.
Aegineta gemmifera KEFERSTEIN & EHLERS 1861 p. 93. Pl. 14 fig. 10, 11.
Cunina rhododactyla + *rubiginosa* HAECKEL 1879 p. 321.
Cunina prolifera MAYER 1910 p. 480 (*non* GEGENBAUR 1854).
Cunina rubiginosa KRAMP 1924 p. 37.
Pegantha rubiginosa KRAMP 1955 p. 280.
Pegantha rubiginosa KRAMP 1957 p. 76.

Material:

"Ingolf"
St. 251 3.III.11
22°16′ N. 63°05′ W.
S 150 19 m. w. **1**

St. 252 4.III.11
23°53′ N. 61°36′ W.
S 150 25 m. w. **2**

St. 404 3.XI.11
26°02′ N. 23°02′ W.
S 200 surface **1**

"Dana"
St. 882 13.VII.20
33°00′ N. 54°32′ W.
P 150 150 m. w. **1**

St. 3996 25.II.30
15°41′ S. 5°50′ W.
S 50 surface **1**

St. 3998 1.III.30
7°34′ S. 8°48′ W.
S 150 1000 m. w. **1**

St. 4003 9.III.30
8°26′ N. 15°11′ W.
E 300 1000 m. w. **2**

St. 4050 2—3.V.30
38°48′ N. 12°06′ E.
S 200 100 m. w. **2**
S 200 3000 m. w. **1**

St. 251, 252 and 882 are between the Azores and the West Indies, St. 4050 in the Mediterranean near Sicily, the other localities are off the west coast of Africa. All the specimens were undoubtedly taken in the upper strata.

Distribution: This is a common species in the Mediterranean. In the Atlantic Ocean it has been taken in some scattered localities. It was previously known from the Gulf of Guinea northwards to the Bay of Biscay, and has now been taken somewhat further south, off Angola. Moreover it is recorded from the Azores, from a locality far west of these islands, about 45° W., and from two localities between the Cape Verde Islands and Brazil. Now for the first time recorded from the western Atlantic north of the equator.

Pegantha triloba Haeckel.

Pegantha triloba Haeckel 1879 p. 333. Pl. 19 fig. 4—7.
Polyxenia cyanogramma Vanhöffen 1908 p. 56. Pl. 2 fig. 8. (*non* Quoy & Gaimard 1824).
Pegantha triloba Bigelow 1909 *a* p. 87. Pl. 14 fig. 3, Pl. 16 fig. 3, Pl. 20 fig. 1—3, Pl. 45 fig. 1, 2.
Pegantha triloba Kramp 1957 p. 77.

Material:

St. 1157 27.X.21
21°57′ N. 22°58′ W.
E 300 5000 m. w. **1**

St. 1163 7.XI.21
12°59′ N. 32°49′ W.
E 300 1000 m. w. **1**

St. 1173 15.XI.21
6°18′ N. 48°58′ W.
E 300 1000 m. w. **2**

St. 1216 28.I.22
18°22′ N. 78°38′ W.
E 300 1000 m. w. **1**

St. 3998 1.III.30
7°34′ S. 8°48′ W.
S 200 300 m. w. **3**
S 200 600 m. w. **2**

St. 1216 is in the West Indies south of Cuba, the others are scattered between West Africa and Brazil. All the specimens were probably taken in the upper strata.

Owing to the rigidity of the gelatinous substance this species is not so difficult to preserve as the other species of *Pegantha*, and most of the present specimens are in a tolerable or even good condition. In the largest specimen (St. 1157, 30 mm. wide) and in one of the smaller specimens (St. 3998, about 17 mm. wide) it was possible to count the marginal sense organs; they have 15—20 marginal clubs in each of the lappets.

The tentacles and marginal lappets are counted in specimens of the following sizes:

Diameter, mm.	15	17	17	18	18	20	21	23	30
Number of tentacles.....	12	14	15	12	13	14	13	13	21

Distribution: Widely distributed in the warm parts of the three great oceans: eastern tropical Pacific between the equator and about 15° S., central Pacific and the Hawaiian Islands, the Philippines, tropical Indian Ocean. In the Atlantic it has been found in several localities between Africa and South America, penetrating southwards to about 48° S., northwards to about 32° N. not previously recorded from the West Indies. Records by Vanhöffen from antarctic seas near the Gauss Station (1912 *a*) and from near the Balearic Isles in the Mediterranean (1912 b) seem doubtful and may be due do erroneous identification.

Fam. **Cuninidae.**

Cunina octonaria McCrady.

Cunina octonaria McCrady 1857 p. 109. Pl. 12 fig. 4, 5.
Cunina köllikeri Müller 1861 p. 42. Pl. 4.
Cunoctantha octonaria Haeckel 1879 p. 316.
Cunoctantha parasitica Metschnikoff 1881 p. 437. Pl. 28 fig. 7—16.
Cunoctantha octonaria Bigelow 1909 *a* p. 52. Pl. 14 fig. 4, Pl. 15 fig. 5, 6, Pl. 17 fig. 2, 4, 5.
Cunina octonaria Kramp 1953 p. 304.

Material:

"Ingolf"
St. 406 5.XI.11
23°49′ N. 26°25′ W.
S 200 56 m. w. **1**

"Dana"
St. 850 4.VI.20
20°39′ N. 61°48′ W.
P 150 100 m. w. **3**

St. 870 26.VI.20
27°29′ N. 59°20′ W.
S 150 100 m. w. **1**

St. 3998 1.III.30
7°34′ S. 8°48′ W.
S 50 surface **9**

St. 4007 15.III.30
18°22′ N. 18°14′ W.
S 200 50 m. w. **10**

St. 850 and 870 are north-east of the West Indies, the other localities are off the west coast of Africa.

Distribution: Widely distributed in the warm parts of the oceans. In the eastern Pacific it is only recorded from Acapulco Harbour, Mexico. Moreover found at the Fiji Islands, off North-East and South-East Australia, in several localities in the Malayan Archipelago and in the tropical parts of the Indian Ocean. In the Atlantic it seems to be generally distributed between about 35° S. and 40° N., and it is common in the Mediterranean.

Cunina frugifera Kramp.

Cunina frugifera Kramp 1948 *b* p. 18. Pl. fig. 1—6.
Cunina frugifera Kramp 1955 p. 285.
Cunina frugifera Kramp 1957 p. 82.

Material:

"Ingolf"
St. 406 5.XI.11
23°49′ N. 26°25′ W.
S 200 56 m. w. **2**

"Dana"
St. 855 9.VI.20
29°15′ N. 59°45′ W.
P 150 300 m. w. **1**

St. 882 13.VII.20
33°00′ N. 54°02′ W.
S 200 50 m. w. **1**
S 200 100 m. w. **1**

St. 4000 4.III.30
0°31′ S. 11°02′ W.
S 200 300 m. w. **1**

St. 4003 9.III.30
8°26′ N. 15°11′ W.
S 200 100 m. w. **1**

St. 4017 27.III.30
29°11′ N. 14°14′ W.
S 200 50 m. w. **6**

St. 4019 30.III.30
33°08′ N. 10°22′ W.
S 200 100 m. w. **3**
S 200 300 m. w. **1**

St. 4195 22.VI.31
41°55′ N. 32°22′ W.
S 200 50 m. w. **1**

St. 855 and 882 are between the Azores and the West Indies, St. 4195 near the Azores, the others are off the west coast of Africa. Specimens with medusa buds were found at stations 4017 and 4019. The tentacles are counted in six specimens, as follows:

Diameter, mm.	4	5	6	6	7	8
Tentacles	6	6	7	8	7	9

Thus these specimens vary within the same limits as the specimens previously examined by me.

Distribution: This little medusa, which is remarkable because of its peculiar asexual reproduction, has now been recorded from numerous localities in the Atlantic Ocean ranging from the Cape of Good Hope to the Bay of Cadiz and the Azores. Moreover it has been found off the coast of Uruguay in South America and off the east coast of Africa as far north as the Somali Coast. It belongs to the surface waters.

Cunina peregrina Bigelow.

Cunina peregrina Bigelow 1909 *a* p. 59. Pl. 1 fig. 6, Pl. 15 fig. 1, 2, Pl. 28 fig. 1—7, Pl. 45 fig. 8.
Cunina peregrina Bigelow 1918 p. 393.
Cunina peregrina Kramp 1955 p. 282.
Cunina peregrina Kramp 1957 p. 84.

Material:

"Ingolf"
St. 257 9.III.11
30°05′ N. 52°58′ W.
S 100 47 m. w. **1**

St. 259 12.III.11
33°55′ N. 43°40′ W.
S 150 25 m. w. **1**

St. 260 13.III.11
34°39′ N. 40°54′ W.
S 150 25 m. w. **2**

St. 261 14.III.11
35°27′ N. 37°18′ W.
S 100 47 m. w. **11**

"Agent Petersen"
St. 299 13.VI.11
37°05′ N. 54°34′ W.
S 100 34 m. w. **2**

"Caroline Kock"
St. 315 28.V.11
39°50′ N. 49°30′ W.
S 100 38 m. w. **9**

"Ingolf"
St. 403 3.XI.11
27°10′ N. 21°53′W.
S 200 surface **23**

St. 405 5.XI.11
24°42′ N. 24°50′ W.
S 200 surface **5**

St. 406 5.XI.11
23°49′ N. 26°25′ W.
S 200 surface **3**

"Dana"
St. 1157 27.X.21
21°57′ N. 22°58′ W.
E 300 1000 m. w. **1**

St. 3996 25.II.30
15°41′ N. 5°50′ W.
S 200 50 m. w. **4**
S 200 100 m. w. **7**
S 200 300 m. w. **3**
S 200 600 m. w. **3**
S 150 3000 m. w. **1**
E 300 4000 m. w. **3**

St. 4003 9.III.30
8°26′ N. 15°11′ W.
S 150 3000 m. w. **1**

St. 4005 12.III.30
13°31′ N. 18°03′ W.
S 200 100 m. w. **1**

St. 4014 25.III.30
28°09′ N. 15°19′ W.
E 300 1500 m. w. **1**

St. 257—315 are between the Azores and the West Indies; all the other localities are off the west coast of Africa. All the specimens were probably taken in the upper strata.

Countings of tentacles and marginal lappets in eight specimens give the following results:

Diameter, mm	5	5	5	5	6	7	8	8
Tentacles	12	12	14	14	14	14	12	14

In comparison with previous countings (Bigelow 1909*a*, Kramp 1955 and 1957) these numbers are fairly high, the average number being 13.2. Most of the specimens from the eastern Pacific described by Bigelow had 10 tentacles, the number varying from 8 to 12; among the numerous specimens from West Africa, taken by the "Atlantide" (Kramp 1955) the majority had 11 or 12 tentacles, width of variation 7—13; in the "Discovery" collection from East Africa and various localities in the Atlantic the average number was 11.1, varying from 7 to 14. The species is, however, so characteristic that an erroneous identification seems excluded.

Distribution: Originally described from the eastern tropical Pacific between 12° S. and 20° N. First recorded from the Atlantic by Bigelow (1918), who found it north of the Bahamas; later on taken in numerous localities in the Atlantic between about 35° S. and 32° N. and off the southern part of the east coast of Africa and in the Mozambique Channel (for details, see Kramp 1957).

Cunina duplicata Maas.

Cunina duplicata Maas 1893 p. 52. Pl. 5 fig. 9, 10.
Cunina duplicata Kramp 1957 p. 86 Pl. 6 fig. 5. Pl. 7 fig. 1, 2.

Material:

"St. Thomas"
St. 337 14.VIII.11
37°25′ N. 41°00′ W.
S 200 16 m. w. **4**
S 100 30 m. w. **3**
depth unknown **6**

"Dana"
St. 1157 27.X.21
21°57′ N. 22°58′ W.
E 300 5000 m. w. **2**

St. 1173 15.XI.21
6°18′ N. 48°58′ W.
E 300 1000 m. w. **1**

St. 4005 12.III.30
13°31′ N. 18°03′ W.
S 150 2500 m. w. **2**

St. 4007 15.III.30
18°22′ N. 18°14′ W.
S 200 300 m. w. **1**

St. 4014 25.III.30
28°08′ N. 15°19′ W.
S 200 300 m. w. **1**

St. 4017 27.III.30
29°11′ N. 14°14′ W.
S 200 100 m. w. **3**

St. 337 is west of the Azores, St. 1173 off the north coast of Brazil, the other localities are off the northern part of the west coast of Africa. The specimens collected in 1911 and 1921 are fairly well preserved, whereas those from 1930 are more or less mutilated. Tentacles and marginal lappets are counted in eleven specimens:

Diameter, mm.	15	18	25	25	25	28	31	31	33	35	37
Tentacles	21	18	16	20	24	26	21	25	25	29	30

Moreover a specimen taken at St. 4050, in the Mediterranean near Sicily, 38°48′ N. 12°06′ E., 2.-3. V. 30, S 200, 150 m. w., may possibly belong to this species, but it is too badly preserved for a sure identification. It is a small specimen, about 12 mm. in diameter; it has at least 12 tentacles, possibly more. In some details, still retained, it resembles *C. duplicata*. It may also belong to *Cunina lativentris*, but the stomach pouches are of equal width throughout, not broadened towards the distal ends as generally stated in *C. lativentris*. A few of the lappets are seen to carry three sense organs, mounted on small cushions as in *C. duplicata*; in *lativentris* the number of sense organs is said to be four on each lappet. The lateral parts of the peripheral canals are very broad.

The affinity of *Cunina duplicata*, which was described from a single individual taken south of the Cape Verde Islands (Maas 1893) has been much discussed. I have recently demonstrated (Kramp 1957) that it is a valid and very characteristic species widely distributed in the Atlantic Ocean, from where I have seen several well-preserved specimens, up to 58 mm. in diameter and with up to 29 tentacles and marginal lappets. The species may be recognized in all stages of development by means of the gastric pouches which are elongated, rectangular with parallel sides, and as wide or somewhat narrower as the interradial spaces between them. Large and smaller gastric pouches are frequently more or less regularly alternating. Moreover the lateral parts of the peripheral canals are remarkably broad.

Distribution: Found in several localities off the west coast of Africa from the Cape of Good Hope to the Canary Islands and also off the east coast of South America as far south as about 53° S. Moreover in a locality south-east of Africa and in the Mozambique Channel. It has most frequently been taken in the upper strata, but apparently it may also descend into deeper water. Also recorded from South-East Australia (Blackburn 1955).

Solmissus marshalli Agassiz & Mayer.

Solmissus marshalli Agassiz & Mayer 1902 p. 151. Pl. 5 fig. 23—25.
Solmissus marshalli Bigelow 1909 *a* p. 64. Pl. 16 fig. 5—6, Pl. 21 fig. 4, 6—8.
Solmissus marshalli Kramp 1957 p. 79.

Material:

St. 1166 11.XI.21
10°16′ N. 40°41′ W.
E 300 1000 m. w. **1**

St. 1168 12.XI.21
9°30′ N. 42°41′ W.
E 300 1000 m. w. **1**

St. 3996 25.II.30
15°41′ S. 5°50′ W.
S 200 100 m. w. **1**

E 300 1000 m. w. **1**
S 150 1000 m. w. **1**
S 150 2000 m. w. **1**

St. 3998 1.III.30
7°34′ S. 8°48′ W.
S 150 1000 m. w. **1**

St. 4000 4.III.30
0°31′ S. 11°02′ W.
S 200 300 m. w. about **4**

St. 4003 9.III.30
8°26′ N. 15°11′ W.
S 200 300 m. w. **4**
E 300 1000 m. w. **1**

St. 4005 12.III.30
13°31′ N. 18°03′ W.
S 200 50 m. w. **6**
S 200 600 m. w. **1**
S 150 1000 m. w. **1**
S 150 2500 m. w. **1**

St. 4007 15.III.30
18°22′ N. 18°14′ W.
S 150 3500 m. w. **2**
E 300 4000 m. w. **1**

St. 4009 18.III.30
24°36.5′ N. 17°27′ W.
S 200 100 m. w. **1**

St. 4158 17.VI.30
46°28′ N. 8°01′ W.
S 150 4000 m. w. **2—3**
S 150 5500 m. w. **1**

St. 1166 and 1168 are off the north-east coast of Brazil, St. 4158 in the Bay of Biscay; the other stations are off the west coast of Africa. All the present specimens are fragmentary. Remarks on morphology and synonymy are given by me in a recent paper (Kramp 1957).

Distribution: Eastern tropical Pacific, Hawaiian Islands, Marshall Islands, southern Japan, Hongkong, the Philippines, several localities in the tropical Indian Ocean and south-east of Africa. In the western Atlantic it was previously known from only one locality east of Rio de Janeiro, now also found off the north-east coast of Brazil. In the eastern Atlantic it was found in several localities from somewhat south of the Cape of Good Hope to the Cape Verde Islands, now taken somewhat further north off the African coast and in the Bay of Biscay. It may occur in the surface layers, but on several occasions it has also been taken in deep water.

Solmissus incisa (FEWKES).

Solmaris incisa FEWKES 1886 p. 954. Pl. 9.
Solmissus incisa BIGELOW 1909 *a* p. 67. Pl. 21 fig. 1—3, 5.
Solmissus incisa RANSON 1936 p. 206.
Solmissus incisa RUSSELL 1953 p. 464. Fig. 305—307.
Solmissus incisa KRAMP 1955 p. 287.

Material:

St. 1208 16.I.22
6°48′ N. 80°33′ W.
E 300 1000 m. w. **1**

St. 3978 13.II.30
30°15′ S. 13°15′ E.
S 150 3000 m. w. **1**

St. 3996 25.II.30
15°41′ S. 5°50′ W.
E 300 4000 m. w.
1 or **2**

St. 4005 12.III.30
13°31′ N. 18°03′ W.
S 150 3500 m. w. **2—4**

St. 4007 15.III.30
18°22′ N. 18°14 ′W.
S 150 2000 m. w.
fragments
S 150 2500 m. w.
fragments
S 150 3000 m. w.
fragments of several
specimens

St. 4009 18.III.30
24°36.5′ N. 17°27′ W.
E 300 4000 m. w.
fragments of several
specimens

St. 4158 17.VI.30
46°28′ N. 8°01′ W.
E 300 1000 m. w. **1**

St. 1208 is in the Gulf of Panama, St. 4158 in the Bay of Biscay, the others off the west coast of Africa. All the specimens are in fragmentary condition. They were all taken in deep water.

Distribution: Widely distributed in the Pacific and Atlantic Oceans. In the Pacific it has been found in the eastern tropical part, the northern part south of Alaska and among the Aleutian Islands; in addition near Japan.

The three medusae identified by VANHÖFFEN (1908 p. 60) as *Solmaris rhodoloma* (BRANDT) undoubtedly belonged to *Solmissus incisa*; two specimens were taken near the Cape of Good Hope. St. 135, 2.I.1899, south of St. Paul in the Indian Ocean, is given for the third specimen. "Valdivia" St. 135 was, however, near Bouvet Island in the southern Atlantic, 56°30′ S. 14°29′ E., 2.XII.1898, whereas the townetting made on 2.I.99 south of St. Paul (41°06′ S. 76°23.5′ E.) has the station number 163. One or the other statement is accordingly erroneous. If we presume that the error applies to the station number, the locality south of St. Paul is the only record of this species from the Indian Ocean.

In the Atlantic it has been taken in numerous localities from the Cape of Good Hope northwards almost to Nova Scotia in the west and to the waters west of Scotland in the east. It mainly occurs in the deep strata.

Indeterminable Narcomedusae.

"Ingolf" St. 261. 14.III.11. 35°27′ N. 37°18′ W. S 100, 47 m. w.
"St. Croix" St. 290. 12.V.11. 37°31′ N. 35°24′ W. S 150, 56 m. w., S 200, 28 m.
"St. Croix" St. 292. 17.V.11. 25°00′ N. 55°59′ W. S 200, 47 m. w.

"Dana":
St. 840. 27.IV.20. 25°16′ N. 48°05′ W. P 150, surface.
St. 841. 27.IV.20. 25°42′ N. 48°05′ W. P 150, 100 m. w.

St. 842. 28.IV.20. 25°48′ N. 49°22′ W. P 150, 50, 200, 300 m. w.
St. 844. 29.IV.20. 25°49′ N. 51°55′ W. P 150, 100 m. w.
St. 846. 1.V.20. 23°40′ N. 55°22′ W. P 150, 150 m. w.
St. 847. 2.V.20. 22°34′ N. 57°07′ W. P 150, 200 m. w.
St. 848. 2.VI.20. 18°00′ N. 64°41′ W. S 200, 300 m. w.
St. 849. 3.VI.20. 19°00′ N. 63°53′ W. P 150, surface and 200 m. w.
St. 855. 9.VI.20. 29°15′ N. 59°45′ W. S 200, 500 m. w.
St. 866. 23.VI.20. 28°32′ N. 56°38′ W. S 200, 50 m. w.
St. 868. 24.VI.20. 27°10′ N. 55°52′ W. S 150, 100 m. w.
St. 875. 1.VII.20. 28°58′ N. 67°09′ W. S 150, 100 m. w.
St. 886. 17.VII.20. 24°40′ N. 54°19′ W. P 150, 25 m. w.

Commensal larvae of Narcomedusae.

Larvae of Narcomedusae were found attached to the subumbrella of several specimens of *Bougainvillia platygaster* and some *Rhopalonema velatum* and *R. funerarium*. Such larvae were thoroughly described by me in my paper on the hydromedusae of the "Discovery" Collections (KRAMP 1957 pp. 89 ff., Pl. VII fig. 3—11). In their structure the larvae in the present collections agree entirely with those previously described, so that apart from a few additional remarks I can restrict myself to an account of their occurrence.

Attached to Bougainville platygaster.

"Ingolf" St. 256. 8.III.11. 28°55′ N. 55°25′ W. S 150, 25 m. w. Among 27 specimens of the medusa 2 are infected with larvae.

Same station, 47 m. w. 4 infected among 7 medusae.

"Dana":

St. 845. 30.IV.20. 24°46′ N. 54°08′ W. P 150, 150 m. w. 1 (4).
St. 846. 1.V.20. 23°40′ N. 55°22′ W. P 150, 150 m. w. 1 (3).
St. 849. 3.VI.20. 19°00′ N. 63°53′ W. P 150, 100 m. w. 2 (2).
St. 850. 4.VI.20. 20°39′ N. 61°48′ W. P 150, 50 m. w. 3 (35).
St. 885. 16.VII.20. 26°46′ N. 54°14′ W. S 200, 50 m. w. 1 (18).
St. 886. 17.VII.20. 24°40′ N. 54°19′ W. P 150, 25 m. w. 2 (4).
St. 891. 24.VII.20. 29°28′ N. 69°25′ W. S 150, 50 m. w. 1 (5).
St. 1223. 1.II.22. 22°06′ N. 84°58′ W. E 300, 1000 m. w. 1 (2).
St. 1261. 9.III.22. 19°04′ N. 65°43′ W. S 150, 3500 m. w. 1 (1).
St. 1294. 18.IV.22. 17°43′ N. 64°56′ W. S 200, 600 m. w. 2 (2).
St. 1296. 19.IV.22. 17°43′ N. 64°56′ W. E 300, 1000 m. w. 1 (1).

The specimens taken in the deep hauls were most probably caught at higher levels during the hauling in of the nets.

There are usually two clusters of larvae in each medusa, but sometimes one or three, rarely four, and in each cluster there is always one larva in a much more advanced stage of development than the others, which are only minute buds. When the larva has attained a certain size, and its umbrella has begun to develop, the margin becomes divided into a number of lappets, and later on a corresponding number of tentacles appear. The normal number of lappets and tentacles is eight, but in the present material I have found one with 7, two with 9, and one particularly well developed larva with as many as 14 lappets and tentacles. In all structural details this larva resembles the others; each lappet is somewhat pointed at the end, where a large statocyst is situated, and from which a very long otoporp runs along an elevated keel almost to the summit of the umbrella. In spite of the unusually large number of marginal lappets I feel sure, therefore, that this larva belongs to the same species as all the other larvae observed in *B. platygaster*, possibly *Pegantha triloba*, as presumed in my previous paper.

As in the three specimens from the "Discovery" collection the specimens of *B. platygaster* in the present collection infected with narcomedusa-larvae are destitute of gonads and carry no medusa buds. In one specimen, however (St. 1223), two opposite quadrants of the stomach wall carry medusa buds, and in these quadrants no clusters of larvae are found, whereas clusters of larvae are present in the two other quadrants, and in these there are no medusa buds. The three specimens from the "Discovery" were 9 mm. in diameter; in the present collection the medusae vary in diameter from 4 to 7 mm.

All the localities enumerated above are among or north-east of the West-Indian Islands; the three specimens found by the "Discovery" were taken in two localities off the east coast of Brazil. Larvae of narcomedusae have not been found in specimens of *B. platygaster* from the eastern Atlantic or the waters off the east coast of Africa.

Attached to Rhopalonema velatum.

St. 3998. 1.III.30. 7°34′ S. 8°48′ W. S 200, 50 m. w. 1 specimen infected among about 600 examined.
Same station, S 200, 100 m. w. 1 (500).
St. 4014. 25.III.30. 28°08′ N. 15°19′ W. S 200, 600 m. w. 1 (65).
St. 4017. 27.III.30. 29°11′ N. 14°14′ W. S 200, 600 m. w. 1 (24).
St. 4019. 30.III.30. 33°08′ N. 10°22′ W. S 200, 100 m. w. 2 (265).
Same station, S 150, 1000 m. w. 2 (120).

The specimens taken in the deep hauls were most probably caught at higher levels during the hauling in or setting out of the nets.

None of the infected medusae contain more than one cluster of narcomedusa larvae, but some of the clusters are large, consisting of 20 or more buds, one of which is always much further developed than the others. As in the specimens taken by the "Discovery", the hosts are more or less degenerated, destitute of gonads and usually without a manubrium. They vary in diameter from 4 to 8 mm.

The localities are off the west coast of Africa. Larvae of the same appearance were found by the "Discovery" in three localities between South Africa and the east coast of Brazil.

Attached to Rhopalonema funerarium.

St. 3996. 25.II.30. 15°41′ S. 5°50′ W. S 200, 600 m. w. 2 specimens infected among 13 examined.
Same station, S 150, 1000 m. w. 3 (50).
St. 4007. 15.III.30. 18°22′ N. 18°14′ W. S 200, 600 m. w. 1 (19).

Most of the infected medusae carry only one cluster of narcomedusa larvae, but the specimen from St. 4007 contains three clusters, two small and one very large with numerous buds in all stages of development. In contradistinction to the two previous species there is not one single individual much larger than the others in the same cluster, but several buds may be almost equally developed. The usual number of marginal lappets in well-developed buds is 8, but a few have 7 or 9. The hosts are usually in good condition, though without gonads; they are 12—15 mm. in diameter.

The localities are off the west coast of Africa, one of them near the locality where similar larvae were taken by the "Discovery". They presumably belong to some species of *Cunina*.

B. A SURVEY OF THE HYDROMEDUSAE OCCURRING IN THE ATLANTIC OCEAN AND ADJACENT WATERS

In the following pages I shall try to give a survey of all the species of Hydromedusae recorded from the Atlantic Ocean and adjacent waters, including the Caribbean Sea and Gulf of Mexico, the Davis Strait and Baffin Bay, the Mediterranean Sea, the North Sea and the Baltic, the Norwegian Sea, and the waters north of European Russia.

It will contain brief diagnoses of the families, genera and species accompanied by keys for identification of the species which may be considered as valid. Doubtful or obsolete species are just mentioned; a complete revision is yet premature. A summarized account of the geographical distribution of each species will be given.

Only the most indispensable references to the literature are included. A complete bibliography up to 1910 may be found in A. G. MAYER: Medusae of the World, vol. I—III, 1910 and, for the Antho- and Leptomedusae, in M. BEDOT: Matériaux pour servir à l'histoire des Hydriodes, I—VII, 1901—1925. For species described before 1910 I shall usually restrict myself to reference to MAYER's work, unless more thorough descriptions and important revisions have been given later. A new complete bibliography for the period after 1910 is under preparation and it is hoped that it will be issued before long.

In the division into families I have mainly followed F. S. RUSSELL: The Medusae of the British Isles, 1953, from which most of the diagnoses of the forms occurring in British waters are also derived, and I have likewise made use of his elaborate keys.

As far as the terminology is concerned I refer to the adjacent figure (fig. 9) which may facilitate determination for those who are not specially aquainted with the morphology of the medusae.

Within many groups it is extremely difficult to identify young developmental stages, and as a rule no attention is paid to them in the keys. It must especially be mentioned that as a rule young specimens have not acquired the final number of tentacles characteristic of the species. The statements of size always apply to adult specimens. It must also be remembered that abnormal specimens may occur with other numbers of radial canals or tentacles than those stated in the diagnoses. Colours are only mentioned where they are especially conspicuous. Ocelli are sometimes difficult to see, or they have almost entirely disappeared after long preservation. On the whole, identification is frequently difficult in badly preserved material.

More or less doubtful species are retained in the present survey, mainly in order to call attention to them in case they might be rediscovered and perhaps be recognized by future investigations. Where nothing else is stated, Antho-, Lepto- and Limnomedusae are neritic. Some of the information on geographical occurrence is derived from papers which have not yet been published.

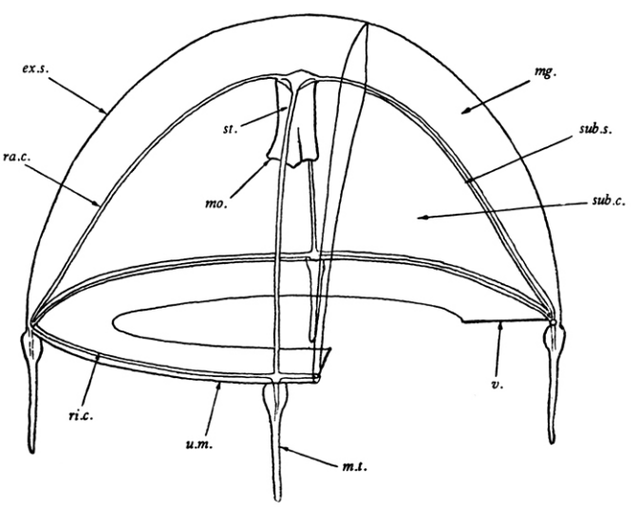


Fig. 9. Diagram of a medusa with one quadranth cut away. *ex.s.* exumbrella surface; *mg.* mesogloea; *mo* mouth; *m.t.* marginal tentacle; *ra.c.* radial canal; *ri.c.* ring canal; *st.* stomach; *sub.c.* subumbrellar cavity; *sub.s.* subumbrellar surface; *u.m.* umbrella amargin; *v.* velum. (After RUSSELL).

In the explanations of the figures P.W. means that the figure has been redrawn by Mr. POUL H. WINTHER. Pl. Sh. means the Plankton Sheets edited by the Conseil international pour l'exploration de la mer.

Key to the Orders of Hydromedusae.

Gonads only on stomach, or occasionally both on stomach and extending for a short distance along radial canals; no statocysts ..... *Anthomedusae.*
Gonads only on radial canals, but occasionally contiguous with base of stomach; with or without statocysts, statocysts velar ectodermal when present ..... *Leptomedusae.*
Gonads either only on stomach, or both on stomach and extending for a short distance along radial canals, or only on radial canals; with or without statocysts; statocysts in form of enclosed sensory clubs with endodermal axes when present ..... *Limnomedusae.*
Umbrella margin entire; with radial canals; gonads usually only on radial canals; with statocysts in form of free or enclosed sensory clubs with endodermal axes ..... *Trachymedusae.*
Umbrella margin lobed; gonads only on stomach; without true radial canal system; with statocysts in form of free sensory clubs with endodermal axes ..... *Narcomedusae.*

I. Order **Anthomedusae.**

Hydromedusae with considerable variation in form, with umbrella usually deep bell-shaped; with gonads almost invariably situated on stomach, very rarely extending perradially on subumbrella; with or without ocelli; without statocysts.

Key to the families of Anthomedusae.

1. Mouth simple and tubular ..... 2.
   Mouth with four lips ..... 10.
2. Reduced medusae with four permanently rudimentary tentacles ..... *Pennariidae.*
   Medusae with one or more well-developed tentacles ..... 3.
3. Without oral tentacles ..... 4.
   With oral tentacles[1]) ..... 9.
4. Marginal tentacles simple ..... 5.
   Marginal tentacles branched or with stalked nematocyst capsules ..... 7.
5. Marginal tentacles solitary ..... 6.
   Marginal tentacles in four groups ..... *Margelopsidae.*
6. Tentacle bulbs with abaxial ocelli ..... *Corynidae.*
   Tentacle bulbs without ocelli ..... *Tubulariidae.*
7. Marginal tentacles branched ..... 8.
   Marginal tentacles unbranched, but with stalked capsules containing nematocysts ..... *Zancleidae.*
8. Marginal tentacles bifurcating ..... *Eleutheriidae.*
   Marginal tentacles with several branches ..... *Cladonemidae.*
9. Oral tentacles simple, situated on mouth rim ..... *Cytaeidae.*
   Oral tentacles simple or branched, inserted above mouth opening ..... *Bougainvilliidae.*
10. Mouth with four lips with clusters of nematocysts ..... 11.
    Mouth with four simple or folded lips without clusters of nematocysts ..... 13.
11. Lips with continuous row of nematocyst clusters along margin ..... *Clavidae.*
    Lips elongated to form tentacles each with one or a few nematocyst clusters ..... 12.
12. Marginal tentacles solitary ..... *Hydractiniidae.*
    Marginal tentacles in eight groups ..... *Rathkeidae.*

[1]) In *Oonautes* (Zancleidae) the manubrium is surrounded by three whorls of tentacles.

13. With simple, pointed oral tentacles inserted above mouth opening; marginal tentacles in groups ..... *Russelliidae.*
    Without oral tentacles, marginal tentacles solitary ..... 14.
14. Gonads sausage-like or spiral (only occurring in the Pacific) ..... *Polyorchidae.*
    Gonads in walls of stomach, rarely extending perradially on subumbrella ..... 15.
15. No marginal cordylus-like structures ..... 16.
    With marginal cordylus-like structures ..... *Tiarannidae.*
16. Marginal tentacles with basal swelling, without terminal nematocyst cluster ..... *Pandeidae.*
    Marginal tentacles without basal swelling, with terminal cluster of nematocysts ..... *Calycopsidae.*

Family **Corynidae.**

Anthomedusae with a simple circular mouth; with four radial canals; with gonads completely surrounding the manubrium; with 2—4 hollow marginal tentacles; with ocelli on the abaxial side of the tentacle bulbs.— Hydroids *Coryne*-like.

Key to the genera.

1. Gonad divided into two or more rings ..... *Dipurena.*
   Gonad undivided ..... 2.
2. Exumbrella with eight irregular longitudinal rows of nematocysts; manubrium cruciform in transverse section ..... *Linvillea.*
   Exumbrella without rows of nematocysts; manubrium tubular ..... 3.
3. With only two opposite tentacles ..... *Sarsiella.*
   With four tentacles ..... 4.
4. With two well-developed and two rudimentary tentacles ..... *Dicodonium.*
   With four equally developed tentacles ..... 5.
5. Hydroid with capitate and reduced filiform tentacles ..... *Stauridiosarsia.*
   Hydroid without filiform tentacles ..... *Sarsia.*

Sarsia LESSON 1843. Corynidae with four similar, perradial tentacles; with gonad forming a single continuous ring or cylinder surrounding the manubrium. Hydroid with capitate tentacles only.

Type species: *S. tubulosa* (M. SARS).

Stauridiosarsia MAYER 1910. Medusa similar to *Sarsia.* Hydroid with some filiform tentacles on the proximal part of the hydranth.

Type species: *S. producta* (WRIGHT).

Key to the speeies of Sarsia and Stauridiosarsia.

1. Manubrium much longer than the height of the bell cavity ..... 2.
   Manubrium short, rarely projecting slightly below the velar opening ..... 5.
2. Distal part of manubrium bulb-like, proximal part with a whorl of sac-shaped gonads ... *hargitti.*
   Manubrium of almost equal width throughout ..... 3.
3. Gonads surrounding almost entire length of manubrium, leaving both ends free; no medusa buds ..... *tubulosa.*
   With clusters of medusa buds along manubrium ..... 4.
4. Tentacles with clasps of nematocysts and a distinct terminal knob; gonad around distal end of manubrium above stomach ..... *gemmifera.*
   Tentacles without a terminal knob; gonad unknown ..... *siphonophora.*

5 Manubrium with a distinct apical canal widened in its upper end; umbrella large, conical . . *princeps.*
Umbrella bell-shaped or egg-shaped; manubrium without or with a faintly developed apical chamber 6.
6. Tentacle bulbs with medusa buds ..... *prolifera.*
No medusa buds ..... 7.
7. Tentacles with a distinct terminal knob ..... 8.
Tentacles without a terminal knob ..... 10.
8. Manubrium with a conical apical chamber ..... *Stauridiosarsia producta.*
No apical chamber; height not exceeding 5 mm. ..... 9.
9. Jelly fairly thin, tentacles long ..... *eximia.*
Jelly thick, tentacles fairly short ..... *gracilis.*
10. Distal part of tentacles fairly thick, spindle-shaped ..... *angulata.*
No dilatation of distal part of tentacles ..... 11.
11. Manubrium S-shaped; height of bell 3—4 mm. ..... *barentsi.*
Manubrium straight; height of bell 15—18 mm. ..... *brachygaster.*

Sarsia tubulosa (M. SARS 1835). Up to 18 mm. high, somewhat higher than wide, bell-shaped, with moderately thick walls; manubrium very long, with both ends free of gonads; a distinct apical chamber of varying shape, usually globular; tentacle bulbs broad, tentacles very long, with numerous clusters of nematocysts,

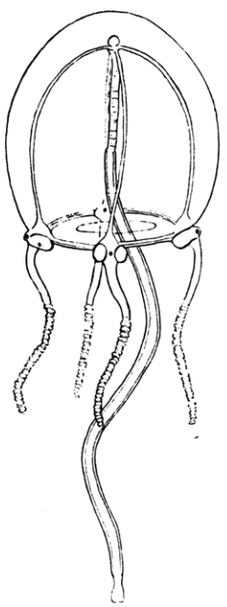


Fig. 10. *Sarsia tubulosa* (from PL. SH.).

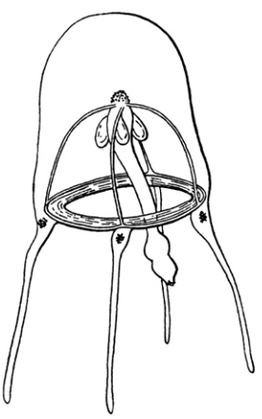


Fig. 11. *Sarsia hargitti* (after HARGITT, from MAYER).

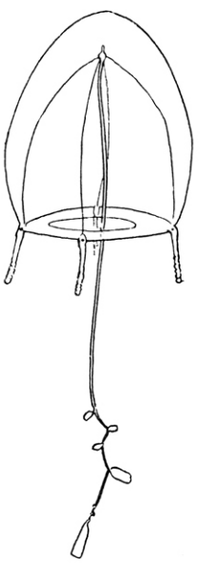


Fig. 12. *Sarsia gemmifera* (from PL. SH.).

no terminal knob.—Boreal and subarctic coastal waters, very common. (MAYER 1910 pp. 52—57, figs.). Synonyms: *S. pulchella* FORBES 1848, *mirabilis* L. AGASSIZ 1849, *reticulata* L. AGASSIZ 1862, *densa* HARTLAUB 1897, *litorea* HARTLAUB 1907.

Sarsia hargitti MAYER 1910. 1.5 mm. high, 1 mm. wide, apex dome-like, very thick; manubrium may project far beyond the velar opening, its terminal part bulb-like, in its proximal part a whorl of sac-shaped gonads; a small round apical chamber; tentacles with large bulbs, ocelli large.—Woods Hole, New England. (MAYER 1910 p. 63, fig. 26).

Sarsia gemmifera FORBES 1848. Up to 5 mm. high, pyriform; manubrium very long and thin, with short, conical apical chamber; gonad around the distal end of manubrium above the stomach; medusa buds at intervals along the manubrium; tentacles with small bulbs, with transverse clasps of nematocysts and a distinct terminal knob.—North-western Europe and in the Adriatic Sea. (MAYER 1910 p. 62, fig. 25; RUSSELL 1953 p. 61, Pl. 1 fig. 1, 4, text-fig. 24, 24 A—C). Synonym: *Purena gemmifera* HARTLAUB 1907.

Sarsia siphonophora HAECKEL 1879. 8 mm. high, 6 mm. wide, egg-shaped; manubrium very long, numerous medusa buds spirally arranged; tentacle bulbs large, tentacles long, with alternating nematocyst warts, without a terminal knob. Gonad not described.—Canary Islands, not observed since it was described by HAECKEL. (MAYER 1910 p. 62, as synonym of *S. gemmifera*; KRAMP 1955 p. 307, probably not identical with *S. gemmifera*).

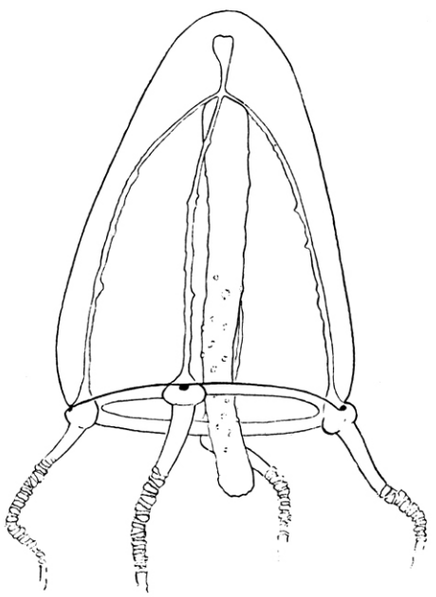


Fig. 13. *Sarsia princeps* (from PL. SH.).

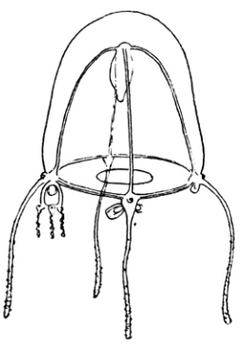


Fig. 14. *Sarsia prolifera* (from PL. SH.).

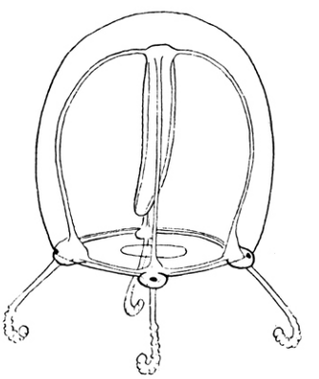


Fig. 15. *Sarsia eximia* (from PL. SH.).

Sarsia princeps (HAECKEL 1879). Up to 40 mm. high, somewhat conical; manubrium about as long as bell cavity, cylindrical, almost completely covered by gonad; a distinct apical canal, widened in its upper end; radial canals with jagged edges; tentacles long, with numerous prominent clasps of nematocysts; ocelli small.—Arctic, circumpolar. (MAYER 1910 p. 60, fig. 22; KRAMP 1926 p. 2, Pl. 1 fig. 1—4, text-fig. 1—5). Synonym: *Codonium princeps* HAECKEL 1879.

Sarsia prolifera FORBES 1848. About 3 mm. high and wide, bell-shaped, walls fairly thin, margin quadrangular; manubrium about two-thirds as long as bell cavity; gonad surrounding almost whole length of manubrium leaving both ends free; the tentacle bulbs, even in young stages, with clusters of medusa buds.—British coasts; ? Black Sea. (MAYER 1910 p. 61, fig. 23; RUSSELL 1953 p. 52, Pl. 2 fig. 1, text-fig. 17 B, 19, 20, 25 D).

Sarsia eximia (ALLMAN 1859). 3—4 mm. high, a little higher than wide, bell-shaped; manubrium cylindrical, about as long as bell cavity, entirely surrounded by gonad, females with few and large eggs; no apical chamber; tentacles with large, oval bulbs, each with a large ocellus; tentacles with many round nematocyst warts and a distinct terminal knob.—North-western Europe; western part of the Mediterranean; west coast of North America; ? Chile. (MAYER 1910 p. 57, fig. 19—21; RUSSELL 1953 p. 50, Pl. 2 fig. 3, text-fig. 17 A, 18 A, B).

Sarsia gracilis BROWNE 1902. 5 mm. high, 3 mm. wide, cylindrical, walls moderately thick, margin quadrangular; manubrium two-thirds as long as bell cavity, nearly whole length surrounded by gonad; tentacles

with a large terminal knob.—Falkland Islands; South Africa. (BROWNE & KRAMP 1939 p. 271, Pl. 14 fig. 1, 2, Pl. 15 fig. 1).

Sarsia angulata (MAYER 1900). 3 mm. high, half-egg-shaped, moderately thick walls; manubrium spindle-shaped, without apical chamber, two-thirds as long as bell cavity, gonad from base almost to the mouth; tentacles slender, with fairly thick, spindle-shaped ends.—Bahamas and Tortugas, Florida. (MAYER 1910 p. 60, Pl. 5 fig. 1, Pl. 6 fig. 3).

Sarsia barentsi LINKO 1905. 3—4 mm. high, 3 mm. wide, conical; manubrium shorter than bell cavity, always S-shaped; tentacle bulbs heart-shaped.—Barents Sea. (MAYER 1910 p. 53, as synonym of *S. tubulosa* var. *mirabilis*).

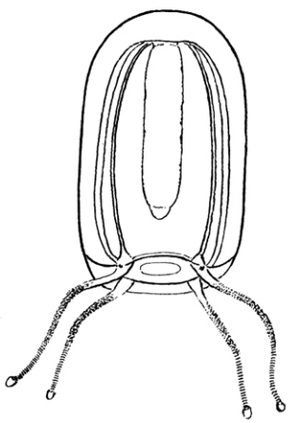


Fig. 16. *Sarsia gracilis* (after BROWNE & KRAMP, redrawn by P. W.).

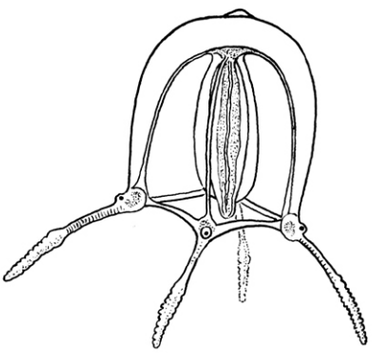


Fig. 17. *Sarsia angulata* (after MAYER, redrawn by P. W.).

Sarsia brachygaster GRÖNBERG 1898. 15—18 mm. high, 8—10 mm. wide, egg-shaped; manubrium two-thirds as long as bell cavity, cylindrical, without apical chamber, completely surrounded by gonad; tentacle bulbs of medium size, ocelli very small.—Spitzbergen (also, but erroneously, recorded from West Greenland). (HARTLAUB 1907 p. 11, fig. 3; MAYER 1910 p. 59).

Stauridiosarsia producta (WRIGHT 1858). Up to 10 mm. high and 7 mm. wide, with thick walls; manubrium cylindrical, about as long as bell cavity, usually with a conical apical chamber; tentacles fairly long, with a small terminal knob and with large bulbs, each with an ocellus.—North-western Europe; Adriatic Sea; Brazil. (MAYER 1910 p. 65, fig. 28—30; RUSSELL 1953 p. 64, fig. 26 A—C, 27 A, B).

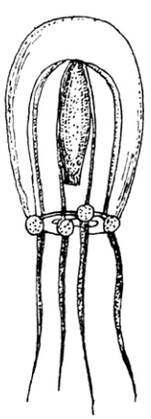


Fig. 18. *Sarsia brachygaster* (after GRÖNBERG, from HARTLAUB).

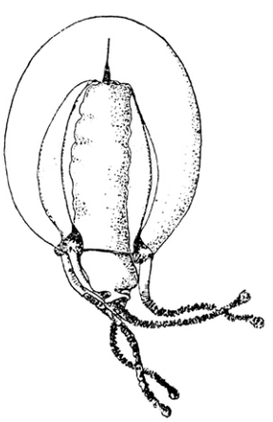


Fig. 19. *Stauridiosarsia producta* (after HARTLAUB).

The genera *Sarsia* and *Stauridiosarsia* are separated only by their hydroids. The species of *Sarsia* most frequently met with are *S. tubulosa, gemmifera, princeps, prolifera* and *eximia,* and they are easily distinguished from each other. The remaining species have only been found on very few occasions and are more or less doubtful; their distinguishing features are not very characteristic and may be due partly to the state of contraction; this may, e. g., apply to the spindle-shaped ends of the tentacles in *S. angulata* and the S-shaped manubrium in *S. barentsi. Stauridiosarsia producta* is very similar to *Sarsia eximia* but may usually be distinguished by the development of a conical apical chamber which, in young specimens, terminate in a fine apical canal. This medusa has rarely been found under natural conditions but has frequently been reared in aquaria from the hydroid.

An altogether doubtful species of *Sarsia* is *S. codonophora* HAECKEL from the Mediterranean; MAYER (1910 p. 62) regards it as a large and highly coloured specimen of *S. prolifera,* but this seems most doubtful; it should rather be placed among the obsolete species.

Dipurena MCCRADY 1857. Corynidae with four similar, perradial tentacles; with gonad divided into two or more distinct rings surrounding the manubrium; tentacle bulbs with abaxial ocelli. Synonym: *Slabberia* FORBES 1848, preoccupied. Type species *D. strangulata* MCCRADY.

Key to the species of Dipurena.

1. Tentacles stiff, each with only one, terminal knob of nematocysts ..... *strangulata.*
   Tentacles with rings or groups of nematocysts in parts of their length ..... 2.
2. Tentacles with 3—6 large nematocyst rings and a terminal knob ..... *halterata.*
   Tentacles with irregularly distributed nematocyst clusters and no distinct rings *ophiogaster* and *reesi.*

Dipurena strangulata MCCRADY 1857. 2—4 mm. high, 3—4 mm. wide, ellipsoidal to hemispherical; manubrium long, gonads a small ring near middle and a longer distal ring; distinct apical chamber; tentacles stiff, with one, terminal knob of nematocysts.—East coast of North America from Cape Cod to Florida; Gulf

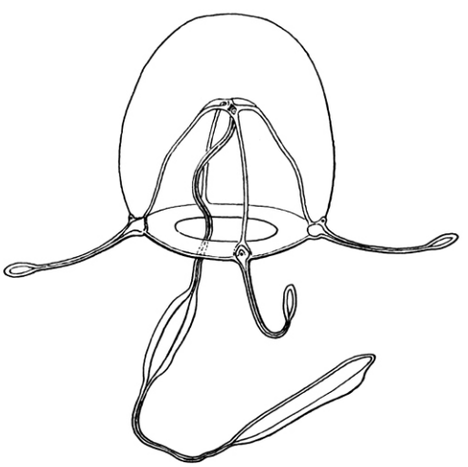


Fig. 20. *Dipurena strangulata* (after MAYER, redrawn by P. W.).

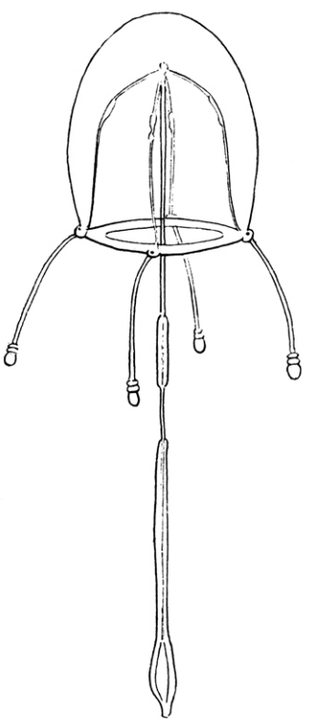


Fig. 21. *Dipurena halterata* (from PL. SH.).

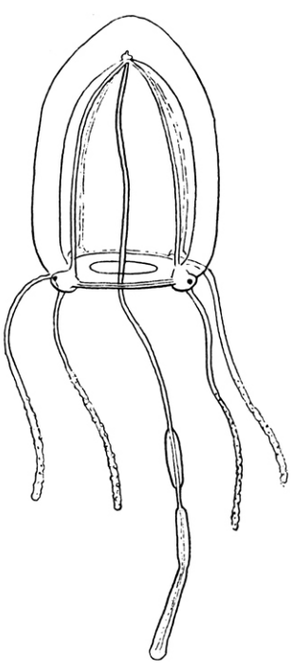


Fig. 22. *Dipurena ophiogaster* (from PL. SH.).

of Guinea, West Africa. (MAYER 1910 p. 76, Pl. 7 fig. 1—3, Pl. 7 fig. 4). Synonyms: *Dipurena conica* A. AGASSIZ 1865, *D. fragilis* MAYER 1900 *b*.

Dipurena halterata (FORBES 1846). Up to 8 mm. high and 6 mm. wide, bell-shaped; manubrium very long; gonads with two or more segments surrounding manubrium, leaving upper half free; distinct, globular apical chamber; a small swelling in the middle of each radial canal; tentacles each with a large terminal knob and 3—6 distinct rings immediately above.—British coasts; Adriatic Sea; Great Fishbay, west coast of Africa; Florida. (RUSSELL 1953 p. 67, Pl. 1 fig. 3, Pl. 2 fig. 2, text-fig. 28, 29). Synonyms: *Slabberia catenata* FORBES & GOODSIR 1851, *Dipurena picta* MAYER 1900.

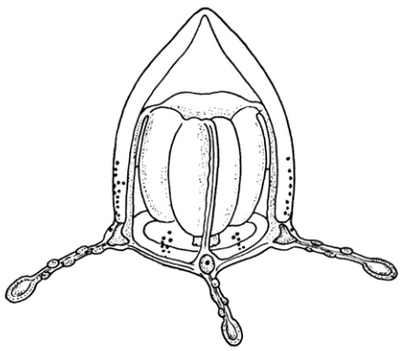


Fig. 23. *Linvillea agassizi* (from MAYER, redrawn by P. W.).

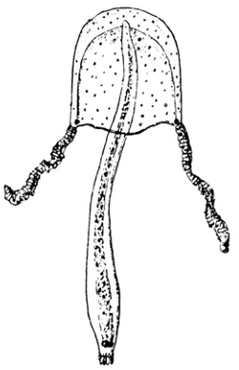


Fig. 24. *Sarsiella ocellata* (after BUSCH, from HARTLAUB).

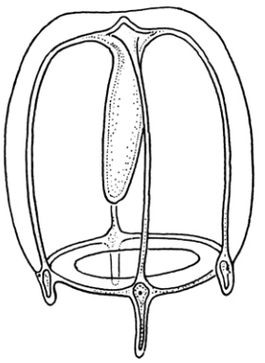


Fig. 25. *Dicodonium jeffersoni* (after MAYER, redrawn by P. W.).

Dipurena ophiogaster HAECKEL 1879. 5 mm. high, bell-shaped, higher than wide; manubrium, when extended, very long; gonads with 2—6 or more segments surrounding the manubrium; distinct apical chamber; tentacles with irregularly distributed clusters of nematocysts. Hydroid with scattered capitate tentacles in addition to basal whorl of filiform tentacles.—Southern parts of the British coasts; Skagerrak; Ceylon; southern Japan; Pelew Islands in central Pacific; west coast of Mexico. (RUSSELL 1953 p. 71, Pl. 1 fig. 5, Pl. 2 fig. 4, text-fig. 25 E, 30 A, B, 31). Synonym: *Purena brownei* BIGELOW 1909.

Dipurena reesi VANNUCCI 1956. Medusa similar to *D. ophiogaster*, but hydroid with only a single whorl of capitate tentacles in addition to basal whorl of filiform tentacles.—Brazil. (VANNUCCI 1956 *a* pp. 479—487, Pl. 1—2, text-fig. 1—2).

Doubtful species: *Bathycodon pyramis* HAECKEL 1879 (*Slabberia pyramis* MAYER 1910 p. 79), Mediterranean.

Linvillea MAYER 1910. Corynidae with eight irregular, longitudinal rows of nematocysts on exumbrella; with manubrium cross-shaped in transverse section; with four tentacles each terminating in a knob-like cluster of nematocysts; with abaxial ocelli. (Synonym: *Corynitis* MCCRADY 1857). Type species: *L. agassizi* (MCCRADY).

Linvillea agassizi (MCCRADY 1857). 2.5 mm. high, exumbrella with four long perradial and four shorter interradial rows of nematocysts; manubrium very large and swollen, mouth without lips; a large conical apical projection with large apical chamber; gonad swollen, with four deep, interradial furrows; four straight, stiff tentacles, each with a large terminal knob; bulbs large, with abaxial ocellus.—East coast of North America from Charleston Harbour, South Carolina, to Woods Hole. (MAYER 1910 p. 72, Pl. 5 fig. 2, text-fig. 35 (hydroid), as *Corynitis agassizi*; p. 719 as *Linvillea* n. gen.).

Sarsiella HARTLAUB 1907. Corynidae with two opposite tentacles with ocelli. (Synonym: *Dinema* HAECKEL 1879, *non* VAN BENEDEN 1866). Type species: *S. dinema* HARTLAUB.

This is a somewhat doubtful genus; the three species referred to it may be either abnormal or juvenile specimens of *Sarsia*. MAYER (1910) unites it with *Dicodonium*, whereas HARTLAUB (1917 p. 393) retains it as a distinct genus.

Sarsiella dinema HARTLAUB 1907. 3 mm. high, 2 mm. wide, exumbrella besprinkled with nematocysts; manubrium very long, gonad encircling entire manubrium, no apical canal; two tentacles, no rudimentary bulbs.—Normandy, Atlantic coast of France (not Norway as erroneously stated by MAYER 1910); ? Mediterranean. (HARTLAUB 1907 p. 67, MAYER 1910 p. 47).

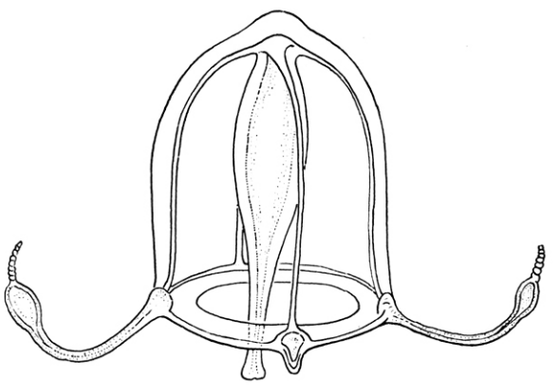


Fig. 26. *Dicodonium floridana* (after MAYER, redrawn by P. W.).

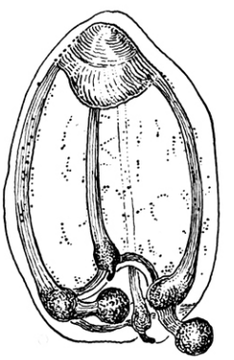


Fig. 27. *Dicodonium punctatum* (after VANHÖFFEN, redrawn by P. W.).

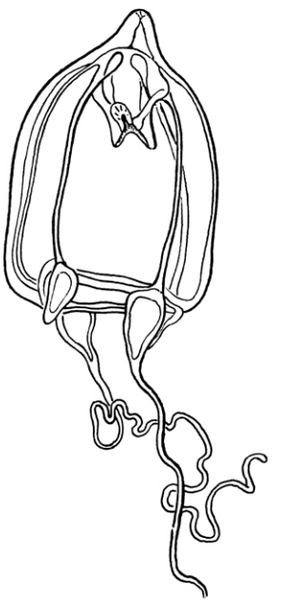


Fig. 28. *Dicodonium adriaticum* (after NEPPI & STIASNY, redrawn P. W.).

Dicodonium HAECKEL 1879. Corynidae with two well-developed and two rudimentary tentacles; no meridional lines of nematocysts. Type-species: *D. cornutum* HAECKEL.

This is likewise a doubtful genus. Among the species which have been referred to it, only one, *D. floridana* MAYER, is sufficiently well described and figured to be recognizable, and it differs so much from the type species, *D. cornutum*, that it might seem resonable to separate it as a representative of another genus. *D. cornutum* from the Red Sea and *D. dissonema* from Australia have not been observed since they were described by HAECKEL. The five other species shall be mentioned briefly here:

Dicodonium floridana MAYER 1910. 4 mm. high, 3 mm. wide, cylindrical with dome-like apex; manubrium flask-shaped, as long as bell cavity; gonad around manubrium; no apical canal. Two tentacles with a knob-like swelling near tip, extreme tip thin; ocelli are not observed; rudiments small, tapering, occasionally developing into tentacles.—Florida. (MAYER 1910 p. 46, Pl. 2 fig. 5).

Dicodonium ocellata (BUSCH 1851). 5 mm. high, 4—5 mm. wide; exumbrella with tufts of nematocysts. Manubrium club-shaped, long; gonad encircling manubrium, thickest near mouth; no apical canal; two tentacles with fairly large bulbs with ocelli, two rudiments as mere bulbs.—Trieste, Adriatic Sea (HARTLAUB 1907 p. 67, fig. 63; MAYER 1910 p. 46). An altogether doubtful species.

Dicodonium jeffersoni (MAYER 1910). 0.75 mm. high, 0.5 mm. wide, dome-like; manubrium tubular, as long as bell cavity; gonad encircling entire manubrium; a small apical canal; two tentacles and two rudiments with ocelli.—Tortugas, Florida. (MAYER 1910 p. 46, Pl. 2 fig. 4, Pl. 3 fig. 1).

Dicodonium punctatum VANHÖFFEN 1911. 1 mm. high, bell-shaped; exumbrella besprinkled with pigment granules (? zooxanthellae); manubrium very short and broad; two short opposite tentacles, each with a large spherical, terminal swelling; two rudiments small, pointed.—North coast of South America. (VANHÖFFEN 1911 p. 196, fig. 1).

Dicodonium adriaticum GRAEFFE 1884. 4 mm. high, 3.5 mm. wide, with a small apical projection; manubrium short, thick; mouth simple, with four lips (!); no apical canal; two long perradial tentacles and two perradial rudimentary bulbs; four ocelli present, bordered by stiff sensory hairs; four small interradial bulbs without ocelli (!).—Adriatic Sea. (MAYER 1910 p. 47; NEPPI & STIASNY 1913 p. 9, Pl. 1 fig. 1). The possession of four mouth-lips and four interradial marginal bulbs separates this medusa from any other members of the family Corynidae; the systematic position of the species must, therefore, be regarded as doubtful. The four interradial bulbs are, however, not seen in the figure given by NEPPI & STIASNY.

Family **Tubulariidae.**

Anthomedusae with a simple circular mouth; with four radial canals; with manubrium not extending beyond umbrella margin; with gonads completely surrounding manubrium; with four or fewer marginal tentacles; without ocelli on marginal bulbs.—Hydroids *Tubularia*-like or *Corymorpha*-like.

Key to the genera.

1. Gonad with four sausage-like processes from the interradial sides of the stomach (with one thick, hollow tentacle with a round terminal knob) ..... *Gotoea.*
   Gonad simple, annular ..... 2.
2. Exumbrella with longitudinal tracks of nematocysts ..... 3.
   Exumbrella without nematocyst tracks ..... 4.
3. With two or four tentacles; eight tracks of nematocysts ..... *Ectopleura.*
   With one tentacle, or a cluster of two or three arising from a common bulb; five tracks of nematocysts *Hybocodon.*
4. One or four tentacles, each terminating in a large knob of nematocysts ..... 5.
   Tentacles without a large terminal knob ..... 8.
5. Four tentacles ..... 6.
   One tentacle ..... 7.
6. Well-developed gastric peduncle; asexual budding from stomach ..... *Eucodonium.*
   No gastric peduncle; no asexual budding ..... *Plotocnide.*
7. Tentacle solid ..... *Paragotoea.*
   Tentacle hollow ..... *Hybocodon forbesi.*
8. Three short or rudimentary tentacles and one long differing from the others in structure *Euphysora.*
   1—4 tentacles of equal structure, though sometimes of unequal length ..... 9.
9. Four equally developed tentacles with adaxial clusters of nematocysts; stomach quadrangular *Euphysilla.*
   1—4 tentacles unequally developed, with nematocysts in rings or groups, not restricted to the adaxial side; stomach tubular ..... 10.
10. Umbrella with a pointed apical projection containing an apical canal; one tentacle ... *Steenstrupia.*
    Umbrella without a pointed apical projection; 1—4 tentacles ..... *Euphysa.*

Euphysa FORBES 1848. Tubulariidae without pointed apical projection to umbrella; without exumbrellar nematocyst tracks; without apical canal; with 1—4 tentacles unequally developed but all of the same structure; tentacles usually moniliform. Type species: *E. aurata* FORBES.

Key to the species of Euphysa.

1. With one tentacle, nematocysts in rings (moniliform) ..... *aurata.*
   With more than one tentacle ..... 2.
2. One long tentacle and two half as long, moniliform ..... *tentaculata.*
   Four tentacles, with groups of nematocysts, all alike in adult but developed in succession *flammea.*

Euphysa aurata FORBES 1848. About 4 mm. high, higher than wide, jelly thick, especially in apical region; bell-shaped; manubrium shorter than bell cavity; gonad encircling almost whole stomach; one tentacle,

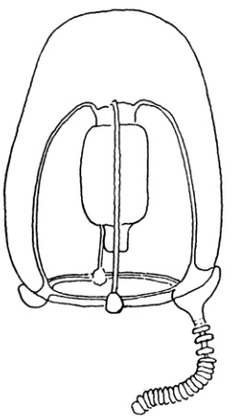


Fig. 29. *Euphysa aurata* (from PL. SH.).

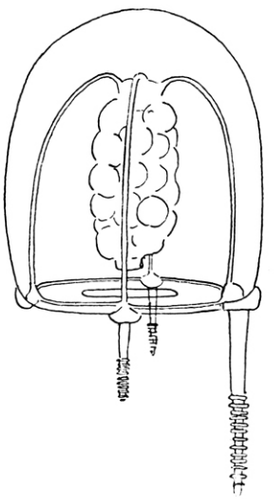


Fig. 30. *Euphysa tentaculata* (from PL. SH.).

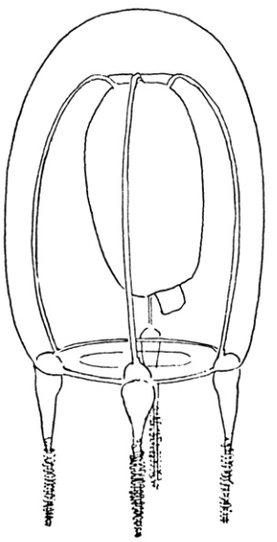


Fig. 31. *Euphysa flammea* (from PL. SH.).

moniliform.—Very common in north-western Europe; northern Norway and Murman Coast; Adriatic Sea; west coast of Greenland; Massachusetts Bay in North America; also recorded from the Patagonia Bank in southern Atlantic (THIEL 1938); ? Japan. (HARTLAUB 1907 p. 81, fig. 76—78, as *Corymorpha aurata*; p. 84, fig. 79, as *C. virgulata* AGASSIZ; MAYER 1910 p. 35, as *Steenstrupia aurata*; RUSSELL 1953 p. 90, Pl. 3 fig. 2, text-fig. 35 E, 38, 39).

Euphysa tentaculata LINKO 1905. 6 mm. high, higher than wide, cylindrical, walls moderately thick; manubrium slightly shorter than bell cavity, in almost whole length covered by gonad; tentacles moniliform, one long, two about half as long, one small bulb opposite the long tentacle.—Barents Sea; arctic survivor in the Baltic and Kattegat; west coast of Greenland. (KRAMP 1926 p. 22, Pl. 1 fig. 8, text-fig. 17—20). MAYER (1910 p. 42) is inclined to identify this species with "*Hybocodon pendula*", which is most improbable, see below.

Euphysa flammea (LINKO 1904). 12 mm. high, 7 mm. wide, bell-shaped, walls fairly thin; manubrium about two-thirds as long as bell cavity, in whole length encircled by gonad; four tentacles with scattered groups of nematocysts, all alike in adult, but developed in succession, youngest stages with only one tentacle, a second, third and fourth added successively.—Arctic, circumpolar, southwards to Newfoundland in the Atlantic and to Vancouver in the Pacific. (HARTLAUB 1907 p. 12, fig. 4—6, as *Sarsia flammea*; MAYER 1910 p. 64, fig. 27, as *Sarsia flammea*, p. 119 as *Pandea maasi* n. sp.; KRAMP 1926 p. 19 Pl. 1 fig. 12—14, as *Euphysa flammea*).

Steenstrupia FORBES 1846. Tubulariidae with a pointed apex and a well-developed apical canal; without exumbral nematocyst tracks; with one moniliform tentacle. Type specimen: *S. nutans* (M. SARS 1835).

Steenstrupia nutans (M. Sars 1835). 5—6 mm. high, 3—4 mm. wide, with a high, conical apical projection and a long, narrow apical canal; manubrium about as long as bell cavity, upon a short, broad gelatinous peduncle; gonad surrounding entire length of stomach; one moniliform tentacle, very long, and three rudimentary bulbs.—Common in north-western Europe, northwards to Lofoten, Norway; south coast of Iceland; Mediterranean and Adriatic Seas; also recorded from the Black Sea. (Mayer 1910 p. 31, text-fig. 4—7, as *S. rubra* in part; Russell 1953 p. 84, Pl. 3 fig. 1, text-fig. 35 A—D, 36, 37 A—C). Synonyms: *rubra* Forbes 1848, *flaveola* Forbes 1848, *lineata* Leuckart 1856, *cranoides* Haeckel 1864, *galanthus* Haeckel 1879.

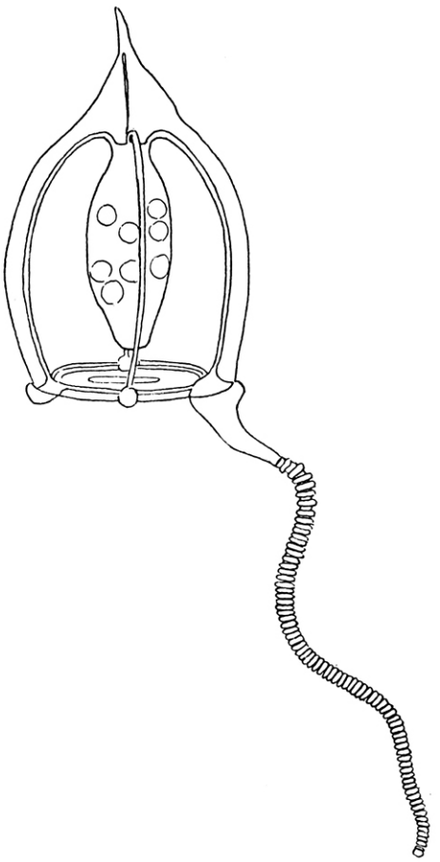
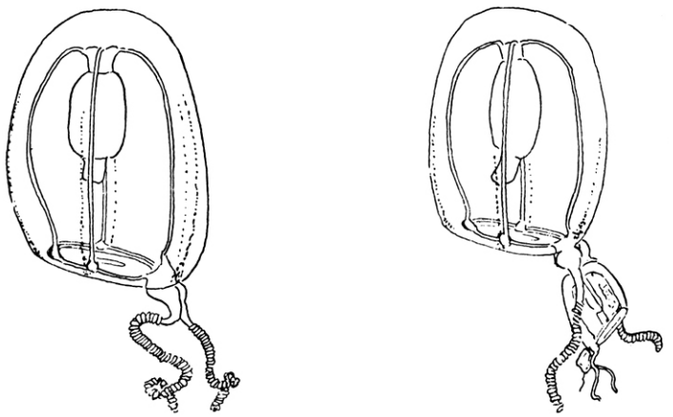


Fig. 32. *Steenstrupia nutans* (from Pl. Sh.).



a. b.

Fig. 33. *Hybocodon prolifer*, *a* without, *b* with medusa buds (from Pl. Sh.).

Hybocodon L. Agassiz 1862. Tubulariidae without pointed apical projection to umbrella; with umbrella margin at oblique angle; usually with five meridional exumbrellar nematocyst tracks; with one simple or compound tentacular bulb with 1—3 tentacles, remaining three marginal bulbs rudimentary; asexual budding from tentacle base; nematocyst tracks two from tentacular bulb, one from each of the rudimentary bulbs. Type species: *H. prolifer* L. Agassiz. Synonym: *Amphicodon* Haeckel 1879.

Hybocodon prolifer L. Agassiz 1862. 4 mm. high, 3 mm. wide, bell-shaped, with rounded apex; umbrella margin oblique to vertical axis, sloping upwards from tentacular side; exumbrella with five meridional nematocyst tracks, two of which issue from the tentacular bulb; stomach large, cylindrical, mounted upon a short gelatinous peduncle, never reaching beyond umbrella margin; mouth simple, surrounded by a ring of nematocyst batteries; gonad completely surrounding stomach, leaving peduncle and mouth free; eggs amoeboid, developing into actinulae; the radial canal leading to the tentacular bulb longer than the others; the tentacular bulb with one or more moniliform tentacles and with medusa buds, at least in immature stages.—North-western Europe, northwards to Beren Island; Iceland; west coast of Greenland; Newfoundland and Massachusetts Bay in America; Aleutian Islands; Kamchatka; northern Japan. (Mayer 1910 p. 38, Pl. 2 fig. 1, Pl. 3 fig. 3, text-fig. 10; Russell 1953 p. 79, Pl. 3 fig. 3—4, text-fig. 34). Synonyms: *Amphicodon fritillaria* + *amphipleurus* Haeckel 1879, *H. christinae* Hartlaub 1907.

Species provisionally referred to *Hybocodon*.

Hybocodon pendula (L. AGASSIZ 1862). 5 mm. high, pyriform, walls moderately thick, thickest at apex; exumbrella with five tracks of nematocysts; manubrium about as long as bell cavity; tentacles moniliform, one long, usually also two short ones, one small bulb opposite the long tentacle; no medusa buds.—Woods Hole to Nova Scotia on the east coast of North America. (MAYER 1910 p. 41, Pl. 2 fig. 2).

This species resembles *Euphysa tentaculata*, and HARTLAUB (1907 p. 85) was inclined to identify it with that species; at least he would refer it to the same genus, because its hydroid presumably is a *Corymorpha*, whereas the hydroid of *Hybocodon* is *Tubularia*-like. The connection between the medusa and hydroid, both described by L. AGASSIZ, has, however, never been proved. Moreover the possession of five nematocyst tracks on the exumbrella, like those in *Hybocodon prolifer*, separates this medusa from all known species of *Euphysa*.

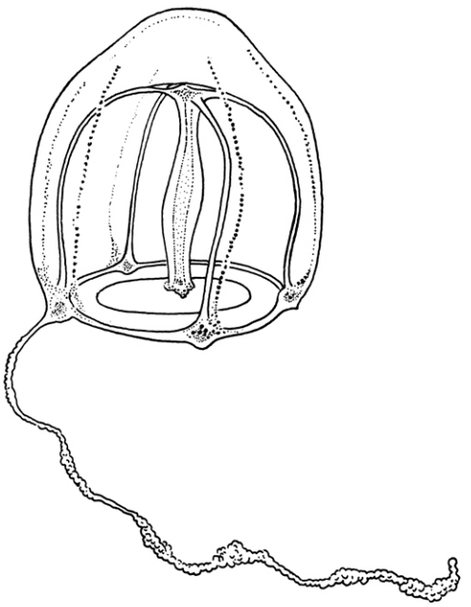


Fig. 34. *Hybocodon pendula* (after MAYER, redrawn by P. W.).

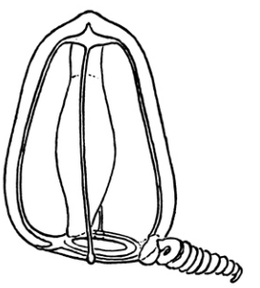


Fig. 35. *Hybocodon unicus* (after BROWNE & KRAMP, redrawn by P. W.)

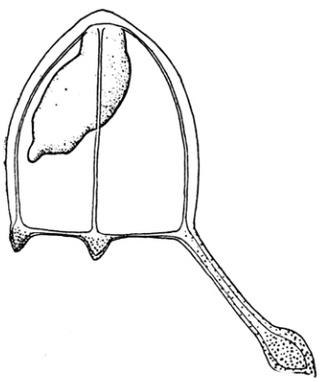


Fig. 36. *Hybocodon forbesi* (after UCHIDA).

Hybocodon unicus (BROWNE 1902). 3 mm. high, 2 mm. wide, bell-shaped; umbrella margin slightly oblique; exumbrella with scattered nematocysts, not arranged in lines; manubrium almost of the same length as bell cavity, mounted upon a short peduncle; stomach in almost whole length surrounded by gonad; one solitary tentacle, moniliform, on a very small bulb placed between two large swellings of nematocysts on bell margin; no medusa buds.—Falkland Islands; south-west coast of India. (BROWNE & KRAMP 1939 p. 273, Pl. 15 fig. 2, 3).

The description of this medusa was based on one single specimen taken at the Falkland Islands; NAIR (1951 p. 50) records the species from Trivandrum Coast, India, but gives no new description. It may have been correct to refer this species to *Hybocodon*, though the exumbrellar nematocysts are not arranged in longitudinal tracks.

Hybocodon forbesi MAYER 1894. 3 mm. high, ellipsoidal, oblique, of uniform thinness; no lines of nematocysts on exumbrella; manubrium spindle-shaped and swollen, extending slightly beyond the velar opening; a single well-developed tentacle at the base of the longest radial canal, with a small basal bulb and a large terminal swelling with nematocysts; the bulb opposite the tentacle sometimes has a short, conical tentacle; no medusa buds.—Bahamas and Tortugas, Florida; Trivandrum and Madras, India; southern Japan. (MAYER 1910 p. 42, Pl. 1 fig. 8, Pl. 2 fig. 3; UCHIDA 1927 p. 193, fig. 30; NAIR 1951 p. 50, Pl. 1 fig. 1). The specimens found in the three geographical areas undoubtedly belong to the same species, but it seems doubtful to refer it to *Hybocodon*.

Ectopleura L. AGASSIZ 1862. Tubulariidae without a pointed apical projection to umbrella; with eight longitudinal tracks of nematocysts on exumbrella, extending from the four tentacle bulbs to apex; with two or four simple tentacles. Hydroid *Tubularia*-like. Type species: *E. dumortieri* VAN BENEDEN.

Key to the species of Ectopleura.

1. Manubrium with planula-like buds (doubtful species) ..... *octagona.*
   No buds on manubrium ..... 2.
2. With four equally developed tentacles ..... *dumortieri.*
   With two tentacles and two rudimentary bulbs ..... *minerva.*

Ectopleura dumortieri (VAN BENEDEN 1844). 2—3 mm. high, nearly spherical, gelatinous substance very thick; manubrium short and blunt, apical canal sometimes present; mouth rim with nematocysts; eight longitudinal tracks of nematocysts, issuing in pairs from the four marginal bulbs, reaching apex; four ten-

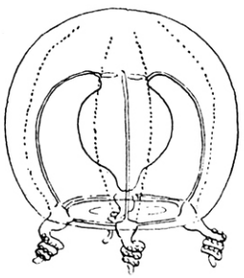


Fig. 37. *Ectopleura dumortieri* (from PL. SH.).

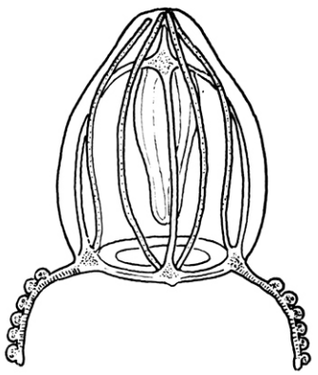


Fig. 38. *Ectopleura minerva* (after MAYER, redrawn by P. W.).

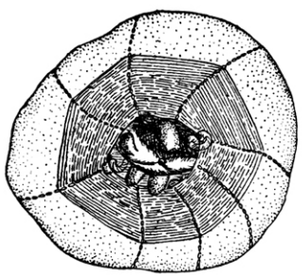


Fig. 39. *Epleura ctooctagona* (after THIEL).

tacles with large basal bulbs and with prominent nematocyst clusters on abaxial side.—North-western Europe; Portugal; Mediterranean and Adriatic Seas; west coast of Africa; east coast of North America from South Carolina to Cape Cod; near Cape Frio, Brazil; Trivandrum Coast, India; Pacific coast of Mexico. (MAYER 1910 p. 69, Pl. 5 fig. 4, 5, Pl. 6 fig. 1, 2; RUSSELL 1953 p. 76, Pl. 3 fig. 5, 6, text-fig. 33 A—C).

The specimens found in the Adriatic Sea (NEPPI & STIASNY 1913 p. 15) were young stages with only two tentacles; as a rule *E. dumortieri* is liberated from the hydroid with all four tentacles equally developed, but it seems probable that the Adriatic specimens nevertheless belong to this species.

Ectopleura minerva MAYER 1900. 2.5 mm. high, pear-shaped, moderately thick, with a well-developed, blunt apical projection; manubrium pear-shaped, about two-thirds as long as bell cavity; a short, conical apical canal; eight tracks of nematocysts on exumbrella; two tentacles and two small rudimentary bulbs, each tentacle with 6—9 nematocyst swellings on the abaxial side.— Bermudas and Florida. (MAYER 1910 p. 70, Pl. 5 fig. 3).

Ectopleura octagona THIEL 1938. 1—1.5 mm. high, 2—2.5 mm. wide; umbrella octagonal in transverse section, no apical projection and no apical canal; two opposite tentacles; on the walls of the manubrium are three leaf-shaped organs which may be some kind of buds.—Fernando Po in Gulf of Guinea. (THIEL 1938 p. 292, fig. 1).

The description was based on one crumpled specimen, and the nature of the "buds" was not closely examined. The specimen may have belonged to *E. dumortieri* which occurs in the same region.

Euphysora MAAS 1905. Tubulariidae with three short, simple tentacles and one long tentacle which differs from the others not merely in size, but also in structure. Type species: *E. bigelowi* MAAS. Several species

in Indo-Pacific waters, three in the Atlantic Ocean. The structure of the main tentacle is very different in the different species; the genus may, therefore, be designated as rather artificial.

Euphysora gracilis (BROOKS 1882). Up to 5 mm high, including the apical projection which is almost as long as the bell, slender and pointed; stomach about as long as the bell cavity; gonad encircling whole length of stomach; apical canal narrow, extending almost to the top of the apical projection; principal tentacle very long, moniliform and with prominent swellings at irregular intervals and with a distinct terminal knob; the opposite tentacle short, cone-shaped, the two others mere bulbs. New England coast and Florida; recently found off São Paulo, Brazil[1]). (MAYER 1910 p. 31, Pl. 1 fig. 7, as *Steenstrupia rubra*).

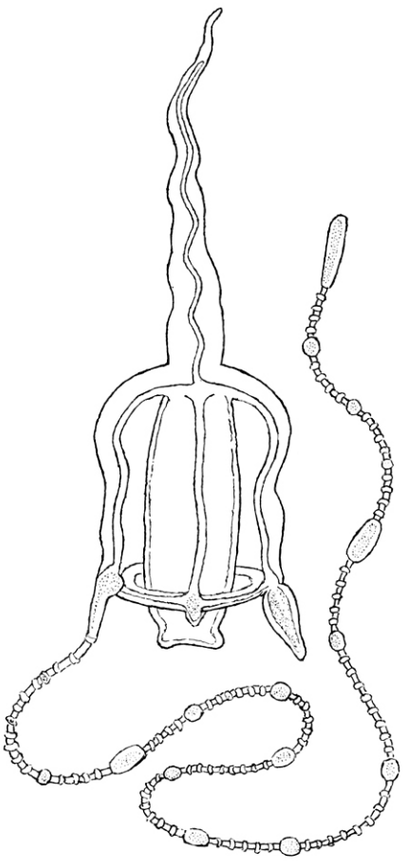


Fig. 40 *a*. *Euphysora gracilis* (after MAYER, redrawn by P.K.).

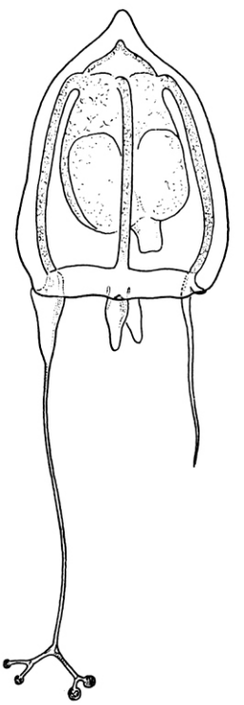


Fig. 40 *b*. *Euphysora furcata* (after KRAMP, redrawn by P. W.).

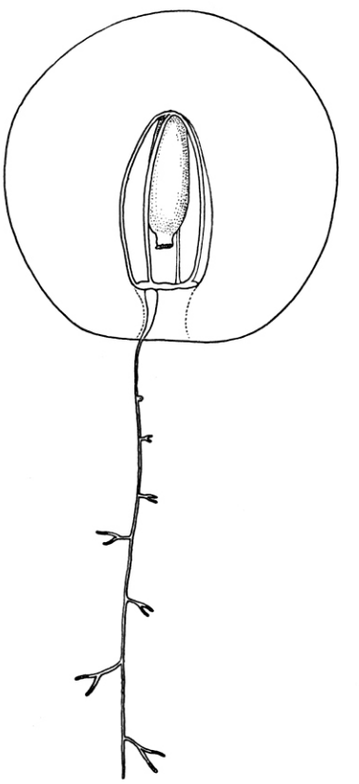


Fig. 41. *Euphysora gigantea* (after KRAMP, redrawn by P. W.).

Euphysora furcata KRAMP 1948. Up to 8 mm. high and 6.5 mm. wide, with pointed apex and fairly thin walls; stomach barrel-shaped, two-thirds as long as bell cavity, with a broad, conical apical chamber; radial canals thick, with large, vacuolated endoderm cells; main tentacle long, but very contractile, its terminal end twice bifurcated, with four knobs of nematocysts; opposite this a fairly long filiform tentacle; two lateral tentacles short and conical.—Widely distributed in the Atlantic Ocean between about 40° N. and 40° S.; also taken off Somaliland, East Africa. (KRAMP 1948 *b* p. 19, Pl. 1 fig. 7, 8; 1957 p. 5; see also the present paper p. 4).

Euphysora gigantea KRAMP 1957. Up to 28 mm. high and wide, globular, jelly very thick, bell cavity narrow, about half as high as the umbrella; manubrium cylindrical or slightly barrel-shaped, less than two-thirds as long as bell cavity, completely encircled by gonad; mouth simple, circular; radial canals and ring canal moderately broad, without vacuolated endoderm cells; one tentacle with a well-developed conical basal bulb, the tentacle very long and thin carrying several bifurcated lateral branches separated by long

[1]) Specimens kindly sent to me by Dr. M. VANNUCCI, São Paulo.

intervals; no bulbous swellings in the three other perradii.—Weddell Sea in the Antarctic; east of the Falkland Islands, and near Tristan da Cunha in southern Atlantic. In deep water. (KRAMP 1957 p. 6, Pl. 1 fig. 3—4).

Euphysilla KRAMP 1955. Tubulariidae without exumbrellar nematocyst tracks; with broad, quadrangular stomach and a simple, quadrate mouth without lips; without a stomachal peduncle; with four equally developed hollow, perradial tentacles provided with adaxial clusters of nematocysts. Type species: *E. pyramidata* KRAMP.

Euphysilla pyramidata KRAMP 1955. 2.3 mm. high and wide, somewhat conical, with a bluntly rounded and somewhat thickened apex, lateral walls moderately thin; stomach pyramidal, with a broad, quadrate base; no apical canal; mouth about half as wide as the base of the stomach, quadrate, no indication of per-

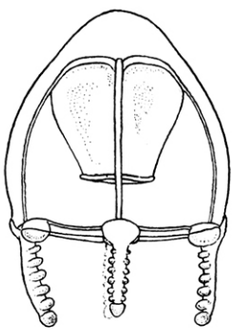


Fig. 42. *Euphysilla pyramidata* (after KRAMP, redrawn by P.W.).

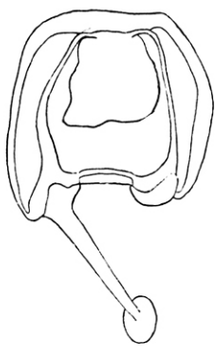


Fig. 43. *Paragotoea bathybia* (from PL. SH.).

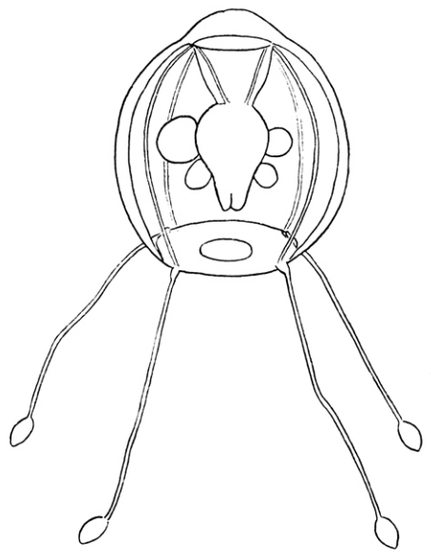


Fig. 44. *Eucodonium brownei* (from PL. SH.).

radial lips; gonad covering entire walls of stomach; stomach about two-thirds as long as bell cavity; four tentacles rather short and stout, each with 5—7 prominent, transversal clasps of nematocysts on the adaxial side and a small terminal knob.—Gulf of Guinea. (KRAMP 1955 p. 245, Pl. 1 fig. 1, Pl. 2 fig. 3).

Gotoea UCHIDA 1927. Tubulariidae without meridional lines of nematocysts on exumbrella; gonad surrounding stomach, but with four sausage-like processes on the interradial sides; with one well-developed, hollow tentacle with a terminal knob of nematocysts and three large, swollen exumbrellar nematocyst pads at the bases of the radial canals without tentacles.—Type species: *G. typica* UCHIDA 1927.

As given here, UCHIDA's original diagnosis is slightly altered, in so far as the expression "short exumbrellar nematocyst tracts" is substituted by "nematocyst pads", because they are quite different from the elongated tracks of nematocysts as seen in *Hybocodon* and *Ectopleura*, but are merely ordinary marginal bulbs which have attained a much swollen appearance and grown somewhat upwards above the umbrella margin.

Gotoea similis KRAMP 3.5 mm. high, 3 mm. wide, cylindrical, with flat top and very thin walls; manubrium flask-shaped, extending slightly beyond velar opening; gonad with four large, pendent, interradial sacs hanging down from upper part of manubrium; four very large, swollen marginal bulbs of unequal size, one of them carrying a long, stiff tentacle terminating in a large, spherical knob of nematocysts.—Near St. Helena (described as a new species in the present paper p. 5, Pl. II fig. 1). Possibly identical with *G. typica* UCHIDA.

Paragotoea KRAMP 1942. Tubulariidae without meridional lines of nematocysts on exumbrella; with simple, annular gonad; with one well-developed, solid tentacle terminating in a large knob of nematocysts, and three marginal bulbs of unequal size without tentacles. Type species: *P. bathybia* KRAMP.

Paragotoea bathybia KRAMP 1942. 2 mm. high, 3 mm. wide, with thin walls; exumbrella sprinkled with scattered nematocysts, especially densely crowded in the immediate neighbourhood of the four marginal bulbs; manubrium short and thick, with a simple mouth opening, completely surrounded by gonad; four, radial canals widened in their distal parts; four marginal bulbs of unequal size, each with an ectodermal. abaxial spur; one stiff and solid tentacle with a large terminal knob of nematocysts; the tentacle has a thick mesosarc and its endoderm consists of a single core of disk-shaped cells.—Deep water in Baffin Bay west of Greenland, and in southern Atlantic near the Cape of Good Hope. (KRAMP 1942 p. 26, fig. 7 *a—c*; see also the present paper p. 5).

Eucodonium HARTLAUB 1907. Tubulariidae with umbrella without pointed apical projection; without exumbrellar nematocyst tracks; with stomach attached to a peduncle; with asexual budding; with four perradial tentacles, each with terminal knob of nematocysts. Type species: *E. brownei* HARTLAUB.

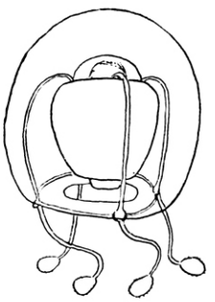


Fig. 45. *Plotocnide borealis* (from PL. SH.).

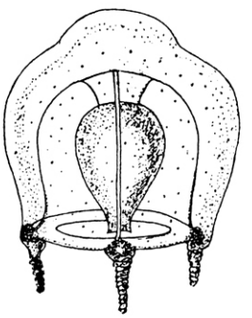


Fig. 46. *Plotocnide incerta* (after LINKO, from HARTLAUB).

Eucodonium brownei HARTLAUB 1907. 1 mm. high and wide, pyriform, with thin walls; stomach short, on a well developed, conical peduncle; mouth a simple round opening; medusa buds on the sides of the stomach; four equally developed tentacles, very thin, each with a large terminal knob of nematocysts; tentacle bulbs small.—English Channel; Kattegat; Adriatic Sea; Mediterranean coast of France. (HARTLAUB 1907 p. 71, fig. 67; RUSSELL 1953 p. 93, fig. 40).

Plotocnide WAGNER 1885. Tubulariidae without pointed apical projection; with scattered nematocysts on exumbrella; without a gastric peduncle; with four equally developed, solid tentacles, each with a large, terminal knob of nematocysts. Type species: *P. borealis* WAGNER.

Plotocnide borealis WAGNER 1885. 3 mm. high and almost as wide, apex rather thick, rounded; manubrium about half as long as bell cavity, with a broad, dome-shaped apical chamber lined by large, vacuolated endoderm cells; gonad a thick ring; mouth simple with a ring of nematocysts; tentacle bulbs well-developed; tentacles with solid endoderm consisting of one core of disk-shaped cells, and with an oval terminal swelling studded with nematocysts.—White Sea; west coast of Greenland; Tschoukotsky Sea north of Bering Strait; Oslo fjord in Norway; ? Kamchatka. (MAYER 1910 p. 106; JASCHNOV 1939 pp. 108, 113, fig. 1—4; KRAMP 1942 p. 22, fig. 5—6).

MAYER erroneously referred this medusa to the genus *Protiara* and indicated that it might be identical with *Protiara haeckeli,* HARGITT 1902; this was contradicted by HARTLAUB 1913 p. 250; KRAMP (1942) refers it to the *Tubulariidae.* It may be identical with *Sarsia inabai* UCHIDA 1933 p. 128, fig. 2, from Kamchatka.

Doubtful species: *Plotocnide incerta* (LINKO 1900). 3 mm. high and wide, walls thick; exumbrella with scattered nematocysts; manubrium almost reaching bell margin, almost completely covered by gonad; well-developed gastric peduncle; four tentacles without terminal knob.—White Sea. (HARTLAUB 1907 p. 70, fig. 66; MAYER 1910 as doubtful synonym of "*Protiara beroe*" (SLABBER)). According to KRAMP (1942) it belongs to the Tubulariidae, but not to *Plotocnide.*

Family **Margelopsidae.**

Anthomedusae without exumbrellar nematocyst tracks; with simple circular mouth without oral tentacles; with gonads completely surrounding stomach; with four radial canals; with solid, moniliform tentacles in perradial clusters on margin, or at different levels on exumbrella; without ocelli. Hydroids, where known, pelagic.—In the Atlantic area only one genus.

Margelopsis HARTLAUB 1897. Margelopsidae with four perradial clusters of tentacles on bell margin. Hydroids: *Margelopsis*. Type species: *M. haeckeli* HARTLAUB.

Key to the Atlantic species of Margelopsis.

1. With two tentacles in each cluster ..... 2.
   With three or more tentacles in each cluster ..... 3.
2. The two tentacles in each cluster placed one behind the other ..... *australis*.
   The two tentacles in each cluster placed beside each other ..... *hartlaubi*.
3. With 3—4 tentacles in each cluster; a wide axial canal above stomach; eggs develop into actinulae on stomach ..... *haeckeli*.
   With 5—6 tentacles in each cluster; no axial canal in adult; actinulae not observed ..... *gibbesi*.

Margelopsis haeckeli HARTLAUB 1897. 2 mm. high, pyriform with flat apex, walls very thick; manubrium wide, spindle-shaped, two-thirds as long as bell cavity; a wide axial canal above stomach; four marginal bulbs, fairly large, each with 3—4 tentacles; the eggs develop into actinulae on the walls of the stomach.—Common in the North Sea. (MAYER 1910 p. 80, fig. 38; RUSSELL 1953 p. 95, fig. 41, 42). The peculiar reproduction and development is described by WERNER, 1954 *a* and 1954 *b*.

Margelopsis gibbesi (MCCRADY 1857). 2.5 mm. high, bell-shaped, walls thin and uniform; manubrium wide, shorter than bell cavity; no apical canal in adult; four marginal bulbs fairly large, each with 5—6 tentacles.—North and South Carolina, east coast of America. (MAYER 1910 p. 82, Pl. 9 fig. 4—7).

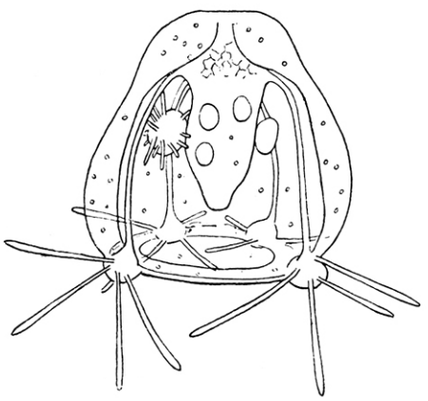


Fig. 47. *Margelopsis haeckeli* (from PL. SH.).

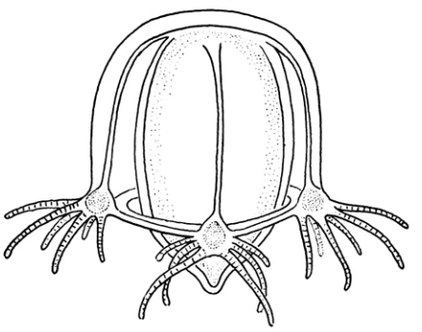


Fig. 48. *Margelopsis gibbesi* (after MAYER, redrawn by P. W.).

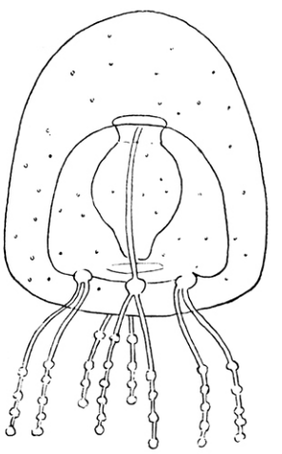


Fig. 49. *Margelopsis hartlaubi* (from PL. SH.).

Margelopsis hartlaubi BROWNE 1903. 2—4 mm. high and wide, egg-shaped, with thick walls; stomach large, with a broad, flat, quadrangular base, no apical canal; four marginal bulbs, small, each with two (occasionally three) tentacles.—Norway. (KRAMP & DAMAS 1925 p. 252, fig. 4).

Margelopsis australis BROWNE 1910. 1—3 mm. high and wide, almost globular; manubrium cylindrical, almost as long as bell cavity; gonad a globular swelling around middle portion of manubrium; four marginal bulbs very small, each with two small tentacles placed one behind the other.—Antarctic seas: between South Georgia and Bouvet Island; Gauss Station, about 90° E.; McMurdo Sound. (BROWNE 1910 p. 11, Pl. 4 fig. 6, 7; VANHÖFFEN 1912 *a* p. 356, Pl. 24 fig. 1). According to VANHÖFFEN the tentacles are not moniliform.

Family **Pennariidae.**

Anthomedusae with a simple circular mouth; with four radial canals; with manubrium not extending beyond velar opening; with gonads completely surrounding manubrium; with four permanently rudimentary tentacles, usually reduced to mere bulbs. Hydroids: *Pennaria*. Only one genus.

Pennaria GOLDFUSS 1820. With the characters of the family.—Some of the medusae referred to this genus are only known as newly liberated from the hydroids; others, the hydroids of which are unknown, are referred to *Pennaria* because they agree with the diagnosis of this genus, but they may as well be reduced medusoids derived from other hydroids.—Type species: *P. disticha* GOLDFUSS.

Pennaria tiarella (AYRES 1852). Medusa 2 mm. high, ellipsoidal, walls thin; male manubrium slender, female distended with 4—5 large eggs; four small rudimentary bulbs, no ocelli.—East coast of North America from Woods Hole to Florida. (MAYER 1910 pp. 25, 487, 720, Pl. 1 fig. 2—5, text-fig. 2).

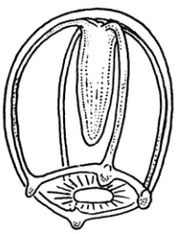


Fig. 50. *Pennaria tiarella* (after MAYER, redrawn by P. W.).

Pennaria disticha GOLDFUSS 1820. Medusa buds similar to *P. tiarella*, seldom set free.—Mediterranean; Amboina. (MAYER 1910 p. 24, fig. 1).

Pennaria pauper KRAMP. 7.2 mm. high, 3.7 mm. wide, cylindrical, with thin walls and a small conical apical projection; manubrium very large; a narrow apical canal reaching to the apex of the bell; four radial canals very narrow; no traces of marginal bulbs.—Near Cape Verde, West Africa. (Described in the present paper p. 4, Pl. I fig. 1). Distinguished from all other species by large size, a long apical canal, and complete absence of marginal bulbs.

Codonida incertae sedis.

The families Corynidae, Tubulariidae, Margelopsidae, and Pennariidae have formerly been united within one family, the Codonidae, established by HAECKEL (1879) and still retained by HARTLAUB in Nordisches Plankton (1907—1917). The Codonidae were characterized as Anthomedusae with a simple mouth opening without oral lappets or oral tentacles, with one or more ring-shaped gonads surrounding the stomach, with four simple radial canals, and with simple, unbranched marginal tentacles. The four families, into which the Codonidae are now divided, establish one large group of related forms, which may be regarded as a superfamily Codonida. Some imperfectly known or degenerate medusae may be designated as species with uncertain affinities but presumably related to the Codonida. They have been described under the following generic names: *Microcampana* FEWKES 1889 (only known from California), *Pachycordyle* WEISMANN 1883, and *Propachycordyle* THIEL 1931.

Pachycordyle WEISMANN 1883. Codonida without tentacles, radial canals or ring canal; manubrium surrounded by a ring-like gonad. Hydroids: *Pachycordyle*. Type species: *P. weismanni* HARGITT.

Pachycordyle weismanni HARGITT 1904. Medusa reared from the hydroid: 2 mm. high, 1.3 mm. wide, pyriform; velum narrow with a small opening; manubrium large, conical, without a peduncle; ripe eggs in the endoderm; mouth lacking; lives only one or two hours.—Naples, Italy. (MAYER 1910 p. 21). Only female medusoids are known to be liberated from the hydroid; *P. napolitana* WEISMANN 1883 may belong to the same species; it was a hydroid with male gonophores which were not set free.

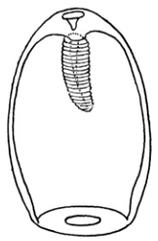


Fig. 51. *Pachycordyle degeneratus* (after MAYER, redrawn by P.W.).

Pachycordyle degeneratus (MAYER 1904). 0.75 mm. high, 0.3 mm. wide, walls thin and rigid; velum powerful and well-developed; manubrium spindle-shaped, one-third as long as bell cavity; deep conical cicatrice in apex of umbrella.—Bahamas. (MAYER 1910 p. 21, Pl. 1 fig. 1). Hydroid unknown.

Propachycordyle THIEL 1931. Codonida with bell-shaped body; manubrium short, spherical; gonads in the ectoderm; four radial canals, ring canal and velum are present; tentacles, tentacle bulbs and ocelli are lacking.—Type species: *P. canalifera* THIEL.

Propachycordyle canalifera THIEL 1931. Up to 2 mm. high, 1.5 mm. wide, walls thin, velum broad; manubrium one-quarter as long as bell cavity.—Weddell Sea, Antarctic. (THIEL 1931 p. 319).

Family **Zancleidae.**

Anthomedusae with, or without, exumbrellar nematocysts confined to specialized tissue in form of oval or club-shaped patches or elongated tracks; with simple circular mouth with or without oral tentacles; with four radial canals (rarely bifurcated); with interradial gonads; with two or four hollow marginal tentacles, each with abaxial stalked capsules (or cnidophores) containing nematocysts, or without marginal tentacles; with or without ocelli.

The aberrant genera *Pteronema* HAECKEL, *Ctenaria* HAECKEL, and *Oonoutes* DAMAS are generally included in this family; *Oonautes* is represented in the Atlantic. *Mnestra* KROHN is probably a *Zanclea* transformed by parasitism.

Key to the genera of Zancleidae.

1. Without marginal tentacles, but with three whorls of simple tentacles around manubrium *Oonautes.*
   No tentacles on manubrium; marginal tentacles with lateral capsules of nematocysts ..... 2.
2. With cup-like depression in centre of exumbrella; 0—4 degenerate tentacles; parasitic, degenerate medusa ..... *Mnestra.*
   Without apical depression; 2—4 well-developed tentacles ..... 3.
3. Exumbrella with meridional tracks of nematocysts; stalks of nematocyst-capsules filiform .. *Zanclea.*
   No exumbrellar tracks of nematocysts; stalks of nematocyst-capsules stout..... *Zancleopsis.*

Zanclea GEGENBAUR. Zancleidae with exumbrellar nematocyst armature; without a brood pouch above stomach; without oral tentacles; with four simple radial canals; with 2—4 tentacles with filiform lateral branches carrying nematocyst-capsules; without ocelli.—Hydroids: *Zanclea.*—Type species: *Z. costata* GEGENBAUR. Synonym: *Gemmaria* MCCRADY 1857.

Zanclea costata GEGENBAUR 1856. Up to 3 mm high and wide; umbrella bell-shaped, jelly moderately thick, sometimes thicker in apical region; exumbrellar nematocysts in oval or club-shaped patches immediately above marginal bulbs or elongated meridional tracks towards apex; manubrium cylindrical, not reaching beyond umbrella margin; mouth circular, with nematocysts along margin; gonads leaving mouth end free; two opposite or four perradial tentacles with elongated conical bases and with stalked capsules along their

abaxial side.—North-western Europe; Mediterranean and Adriatic Seas; west coast of Africa; New England; Florida; West Indies; Red Sea; Nicobars and Malayan Archipelago; north-eastern Australia; Pelew Islands; Japan; Pacific coast of Mexico. (Mayer 1910 pp. 87, 88, 89, 90, Pl. 6 fig. 7, Pl. 7 fig. 5, Pl. 8 fig. 2—7, text-fig. 41—44; Russell 1953 p. 99, Pl. 4 fig. 1—3, text-fig. 43—48). Synonyms: *gemmosa* McCrady 1857, *implexa* Allmann 1864, *cladophora* A. Agassiz 1865.

Mnestra Krohn 1853. Zancleidae with four radial canals and a ring canal; without a brood pouch above stomach and without gonads; throat blocked by a spongy mass of endoderm; with four degenerate, sometimes completely reduced, hollow tentacles with a row of nematocyst capsules along their aboral sides; with a ring of nematocysts around bell margin and four linear tracks of nematocysts on exumbrella above tentacles. The only species, *M. pararites* Krohn, is parasitic or commensal upon the throat of the pelagic, opistobranch

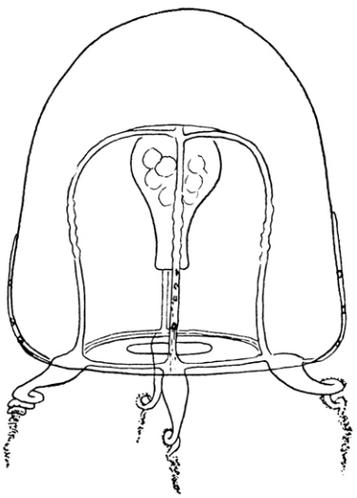


Fig. 52. *Zanclea costata* (from Pl. Sh.).

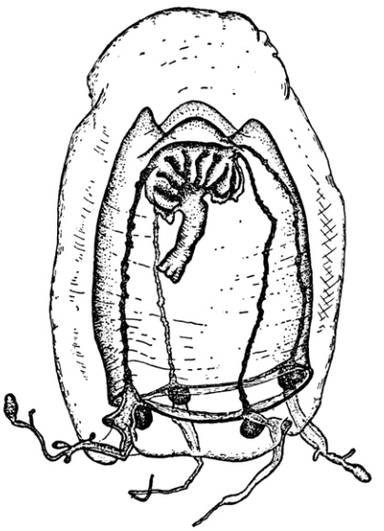


Fig. 53. *Zancleopsis dichotoma* (after Bigelow).

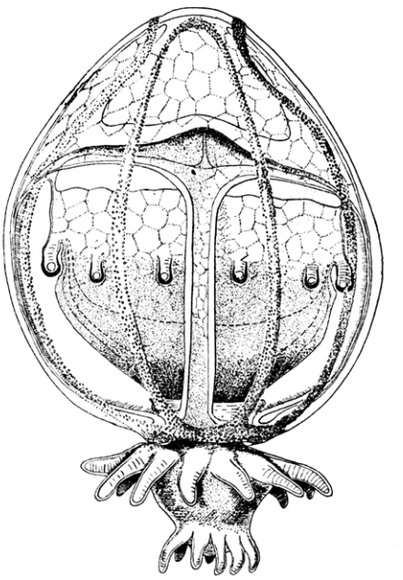


Fig. 54. *Oonautes hanseni* (after Damas).

mollusk *Phyllirhoë bucephalum*.—Mediterranean; Florida. (Mayer 1910 p. 97, fig. 50, 51; Ankel 1952 pp. 91—140, fig.; Rees 1953 p. 219). According to Ankel the gastropod continues its growth, while the parasite becomes more and more reduced in shape and size; according to Rees these parasites are simply specimens of *Zanclea costata* which, to their own mischief, have attached themselves to the gastropods.

Zancleopsis Hartlaub 1907. Resembles *Zanclea*, but with large, stout lateral branches on the tentacles, each branch, as well as the tentacle itself, with a terminal club-shaped knob of nematocysts; with ocelli on the abaxial side of the tentacle bulbs; without meridional tracks of nematocysts on exumbrella; manubrium cross-shaped in transverse section.—Type species: *Z. dichotoma* (Mayer). Hydroids unknown.

Zancleopsis dichotoma (Mayer 1900). 3 mm. high, 2.5 mm. wide, bell-shaped, with a pointed apex; manubrium flask-shaped, mouth rim with nematocysts; two well-developed, opposite tentacles, each with 2—4 lateral branches, some of them fairly long.—Florida; Bahamas. (Mayer 1910 p. 91, Pl. 8 fig. 1; Bigelow 1938 p. 102, fig. 1, 2).

Oonautes Damas. ? Zancleidae with eight adradial nematocyst tracks on exumbrella; with three separated whorls of simple tentacles around manubrium; without marginal tentacles.—Type species *O. hanseni* Damas.

Oonautes hanseni Damas 1936. Umbrella 3 mm. high, egg-shaped; exumbrella with eight adradial tracks of nematocysts, joined in pairs in the perradii near apex; manubrium very large and swollen, narrowed

at the velar level, oral portion widened outside the umbrella opening like a proboscis with two whorls of solid, conical tentacles; a third whorl of minute tentacles around middle portion of manubrium; a broad apical chamber above stomach; four radial canals and a ring canal; no marginal tentacles.—Cadiz Bay. (D. DAMAS 1936 pp. 1—20, fig. 1, 2).

This is a most peculiar little medusa, thoroughly described by DAMAS; only one specimen was observed. Provisionally referred to the Zancleidae.

Family **Cladonemidae.**

Creeping and swimming Anthomedusae; with mouth with oral tentacles armed with nematocyst clusters; with stomach with radial pouches; with variable number of radial canals, some bifurcated, some simple; with gonads completely surrounding stomach; with variable number of hollow, branching marginal tentacles, each furnished with organs of adhension; with ocelli.

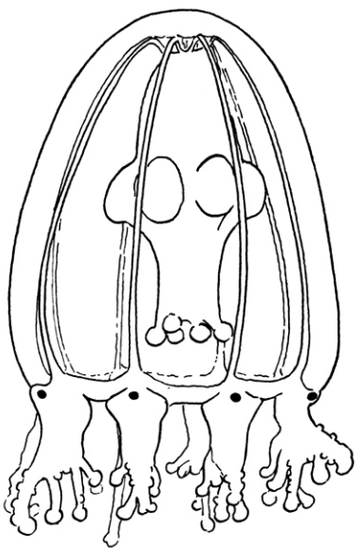


Fig. 55. *Cladonema radiatum* (from PL. SH.).

Cladonema DUJARDIN 1843. Cladonemidae with simple, unbranched oral tentacles; without an apical cavity above stomach.—Type species: *C. radiatum* DUJARDIN.

Cladonema radiatum DUJARDIN 1843. 4 mm. high, 3 mm. wide, with fairly thin walls and rounded apex; manubrium about as long as bell cavity; 4 or 5 simple oral tentacles with a terminal knob of nematocysts; gonad completely surrounding stomach, with 4—5 radial sac-like protrusions; 4 or 5 bifurcated radial canals, or 8—10 more simple, or with some bifurcated and some simple canals; 8—10 marginal tentacles, each with 4—6 branches with clusters of nematocysts and 1—4, usually 3, basal branches with adhesive organs; basal bulbs each with an abaxial ocellus.—North-western Europe; Mediterranean Sea; Black Sea; Bermuda, Bahamas and Florida; Japan. (MAYER 1910 pp. 99 and 101, Pl. 9 fig. 1, Pl. 9 fig. 2, 3, text-fig. 53—55; RUSSELL 1953 p. 105, fig. 49—51). Synonyms: *C. perkinsi* MAYER 1904, *C. mayeri* PERKINS 1906.

Doubtful genus and species: *Dendronema stylodendron* HAECKEL 1879. 9 mm. high, 6 mm. wide, with branched oral tentacles and with an apical cavity above stomach.—Canary Islands. (MAYER 1910 p. 102).

Family **Eleutheriidae.**

Creeping Anthomedusae with continuous or broken thickened ring of nematocysts around umbrella margin; with simple circular mouth without oral tentacles; with variable number of radial canals which may or may not branch; with gonads on subumbrellar surface or in special dorsal brood pouch; with variable number of hollow, bifurcating marginal tentacles, each furnished with an organ of adhesion; with ocelli. Velum well developed.

Key to the genera.

With a brood pouch above stomach; upper branch of tentacles with only one, terminal cluster of nematocysts ..... *Eleutheria.*

No brood pouch above stomach; upper branch of tentacles with several clusters of nematocysts *Staurocladia.*

Eleutheria QUATREFAGES 1842. Eleutheriidae with a brood pouch above stomach; manubrium simple; gonads reduced, hermaphroditic; asexual reproduction by medusa-buds from ring canal; with bifurcated tentacles, lower branch with a terminal adhesive disk, upper branch with a terminal cluster of nematocysts.—Type species: *E. dichotoma* QUATREFAGES.

Key to the species of Eleutheria.

6 radial canals, 5—14 tentacles; medusa-buds exumbrellar ..... *dichotoma.*
4—6 radial canals, 8—10 tentacles; medusa-buds subumbrellar ..... *claparedei.*

Eleutheria dichotoma QUATREFAGES 1842. 0.3—0.5 mm. wide, flattened-hemishperical; thick marginal ring of nematocysts; with 6 short radial canals; up to 14 tentacles, usually 5 or 6, each with an abaxial, basal

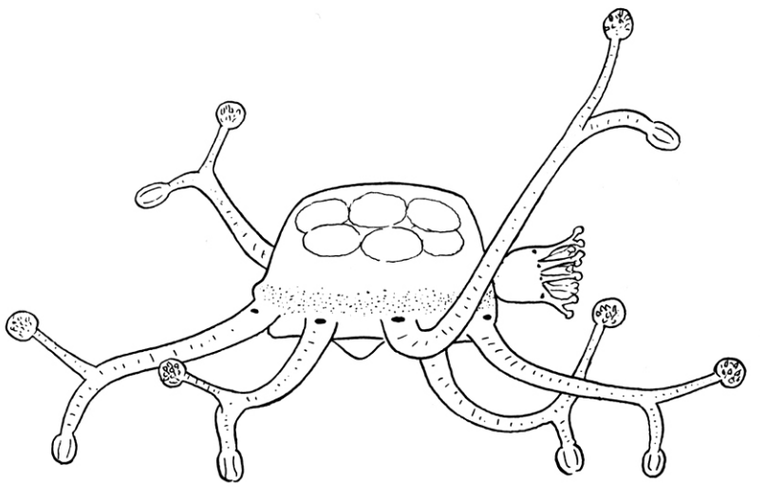


Fig. 56. *Eleutheria dichotoma* (from PL. SH.).

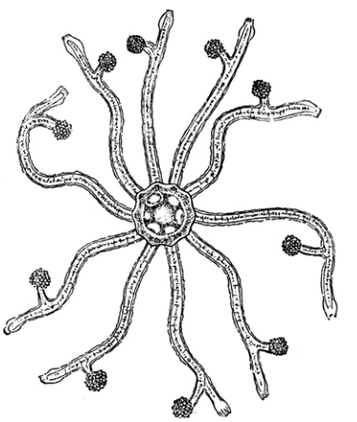


Fig. 57. *Eleutheria claparedei* (after HARTLAUB).

ocellus; medusa-buds on exumbrellar side of ring canal.—North-western Europe; Mediterranean; Black Sea. (MAYER 1910 p. 94, fig. 48; RUSSELL 1953 p. 110, Pl. 4 fig. 4—6, text-fig. 52, 53). Hydroid: *Clavatella prolifera* HINCKS 1861.

Eleutheria claparedei HARTLAUB 1889. 0.4—0.5 mm. wide, irregular in shape; thick marginal ring of nematocysts; 4—6 radial canals; 8—10 tentacles, not corresponding in position to the canals; with abaxial ocelli; medusa-buds from subumbrellar side of ring canal into bell cavity.—English Channel; Naples in the Mediterranean Sea. (MAYER 1910 p. 95, fig. 49; H. MÜLLER 1911 pp. 159—169, Pl. 3 fig. 1). Synonyms: *E. dichotoma* CLAPARÈDE 1863, non QUATREFAGES; *Staurocladia claparedei* HARTLAUB 1917 p. 401.

Staurocladia HARTLAUB 1917. Eleutheriidae without a brood pouch above stomach; gonads well developed, in ectodermal interradial pockets around stomach, sexes separate; asexual budding may occur; with 6 or more radial canals; with numerous tentacles, increasing in number with age, bifurcated, lower branch with a terminal adhesive disk, upper branch with several clusters of nematocysts.—Type species: *S. vallentini* (BROWNE).—Synonym: *Cnidonema* GILCHRIST 1919.

The distinguishing characters of the species are more or less variable, and it will hardly be possible to keep up all the ten species which have been described; it is, however, unreliable to unite them all into one species. There are at least two distinct groups separated by the arrangement of the nematocyst clusters on the tentacles, whether situated in two lateral rows or in a median position on the upper, aboral side of the tentacle; in the latter case there may also be some clusters on the lower, oral side (aberrant arrangements are observed in some species from Hawaii). The relative length of the upper and lower branch is dependent on the state of contraction. Four species are recorded from the Atlantic area, but probably only two of them are valid species.

Key to the species of Staurocladia.

Nematocyst clusters on upper branch of tentacles median in position ..... *vallentini* + *capensis.*
Nematocyst clusters bilateral in position ..... *charcoti* + *hodgsoni.*

Staurocladia vallentini (BROWNE 1902). Up to 2 mm. high and 3 mm. wide when alive; 6—7 radial canals; up to 24 tentacles with two branches, lower branch with terminal sucker, upper branch with clusters of nematocysts, 2 or 3 on aboral side, 1 or 2 on oral side, besides a terminal cluster; medusa-buds not observed.—Falkland Islands; ? Bermuda. ? Australia. All other records erroneous. (BROWNE & KRAMP 1939 p. 274, Pl. 14 fig. 3, 4, Pl. 15 fig. 4, Pl. 19 fig. 2).

Staurocladia capensis (GILCHRIST 1919). Up to 3.3 mm. wide; 6 radial canals; up to about 40 tentacles, upper branch of tentacles with 2 (rarely 3) clusters on aboral side, one on oral side, and a terminal cluster;

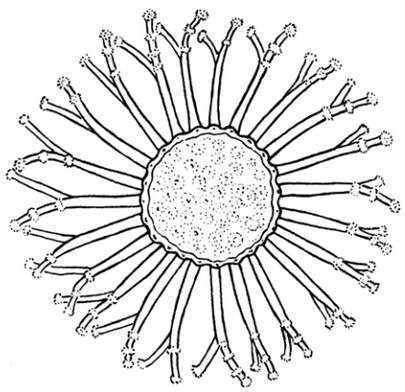


Fig. 58

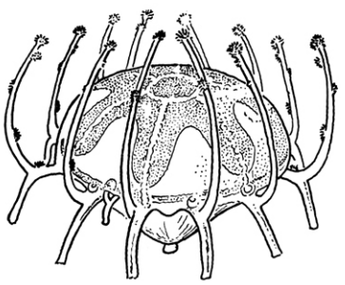


Fig. 59

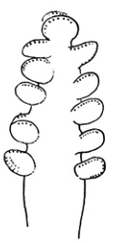


Fig. 60

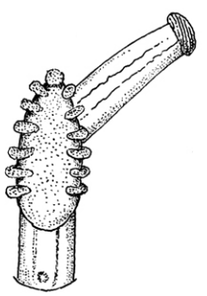


Fig. 61

Fig. 58. *Staurocladia vallentini* (after BROWNE & KRAMP, redrawn by P. W.). Fig. 59. *Staurocladia capensis* (after GILCHRIST, redrawn by P.W.). Fig. 60. *Staurocladia charcoti* (after BEDOT, redrawn by P.W.). Fig. 61. *Staurocladia hodgsoni* (after BROWNE, redrawn by P.W.).

medusa-buds on umbrella margin observed in small specimens.—Cape of Good Hope. (GILCHRIST 1918 p. 509, Pl. 3 fig. 1—8).

The most important distinguishing feature between this species and *S. vallentini* should be that in the latter the gonads are "entirely above stomach", but this does not hold true. The two species are probably identical. *S. haswelli* (BRIGGS 1920) from New South Wales, Australia, is likewise very similar to *S. vallentini.* A single specimen from Bermuda, described by WEILL, 1937, as *S. vallentini,* was in a very young stage of development, and its specific identity cannot be stated with certainty.

Staurocladia charcoti (BEDOT 1908). 1 mm. high, 4 mm. wide; about 10 radial canals; about 35 tentacles, upper branch with about 9 pairs of nematocyst clusters, laterally situated, and a terminal cluster.—Graham Land, Antarctic (BEDOT 1908 pp. 1—5, Pl. 1 fig. 1—10, as *Wandelia charcoti*).

The radial canals are described as branched, but this is not stated with certainty; it is not stated whether the ring of nematocysts around the umbrella margin is continuous or interrupted as in the following species.

Staurocladia hodgsoni (BROWNE 1910). 2 mm. wide; 6—11 radial canals; up to about 32 tentacles, upper branch with 5—6 pairs of nematocyst clusters, laterally situated, and a terminal cluster. The ring of nematocysts around the umbrella margin is not continuous but divided into isolated patches at the bases of the tentacles.—McMurdo Sound, Antarctic; South Georgia in southern Atlantic; Graham Land. (BROWNE 1910 p. 28, Pl. 3 fig. 1—4; KRAMP 1948 p. 2; MANN & ZAPFE 1950 pp. 7—9, 2 fig.).

The interrupted nematocyst ring is very characteristic of this species in contridistinction to all other species of *Staurocladia* and has been stated in all specimens examined. It is the only character by which it might perhaps be distinguished from *S. charcoti,* and unfortunately we know nothing about the structure of the

nematocyst ring in that species. It seems very probable that these two species are identical. In *S. kerguelensis* (GILCHEIST 1918), from Kerguelen Island, which is a very similar species, the nematocyst ring is expressly stated to be continuous; it must accordingly be kept separate, at least provisionally.

Family **Cytaeidae.**

Anthomedusae with simple circular mouth; with simple, unbranched oral tentacles or with four clusters of cnidophores; with interradial gonads; with four simple radial canals; with four solid marginal tentacles.

Cytaeis ESCHSCHOLTZ 1829. With four or more simple, unbranched oral tentacles; without ocelli.

Cytaeis tetrastyla ESCHSCHOLTZ 1829. 6 mm. high, 5 mm. wide; stomach very large, sometimes carrying numerous medusa buds; up to about 32 oral tentacles, each with a terminal cluster of nematocysts; tentacle bulbs large, pyriform, with black pigment in the endoderm.—Generally distributed in tropical and subtropical waters, partly oceanic. (MAYER 1910 p. 133, fig. 71—73, as *C. atlantica*). Synonyms: *C. nigritina* + *macrogaster* HAECKEL 1879, *herdmani* BROWNE 1905, *vulgaris* MAAS 1905, *atlantica* MAYER 1910, *japonica* UCHIDA 1927; doubtful synonyms: *pusilla* GEGENBAUR 1856, *vulgaris* AGASSIZ & MAYER 1899.

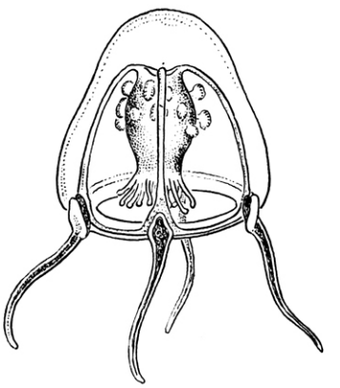


Fig. 62. *Cytaeis tetrastyla* (after BIGELOW, redrawn by P. W.).

Cnidostoma VANHÖFFEN 1911. With four clusters of cnidophores on the mouth rim; with ocelli.

Cnidostoma fallax VANHÖFFEN 1911. 2.5 mm high and wide, with thick dome-shaped apex; stomach small, with several medusa buds; mouth with four clusters of petiolate cnidophores; gonads not seen; four slender marginal tentacles with small, globular basal bulbs with an adaxial ocellus.—Mouth of Congo. (VANHÖFFEN 1911 p. 205, fig. 7*a-c*). Recently rediscovered in the same locality (KRAMP, not yet published).

Family **Clavidae.**

Anthomedusae with mouth with four lips with continuous row of nematocyst clusters along margin; with interradial gonads; with four simple radial canals; with numerous solid marginal tentacles; with adaxial ocelli.—Hydroids *Clava*-like.

Key to the genera.

With an accumulation of highly vacuolated endoderm cells above stomach ..... *Turritopsis.*
With a solid gelatinous gastric peduncle, not vacuolated ..... *Oceania.*

Oceania KÖLLIKER 1853. Clavidae with manubrium mounted upon a short, solid, gelatinous peduncle.—Type species: *O. armata* KÖLLIKER.

Oceania armata KÖLLIKER 1853. 8—10 mm. high and wide, pyriform, flat-topped, with uniform, thin walls; stomach flask-shaped, cruciform in transverse section, upon a short, pyramidal peduncle; four large lips, edges with a row of nematocyst knobs; 60—100 marginal tentacles, crowded.—Mediterranean and adjacent parts of Atlantic Ocean; southern Japan. (MAYER 1910 p. 147, fig. 78—81). Synonym: *Callitiara polyophthalma* HAECKEL 1879. *Clava*-like hydroid reared from the eggs.

Turritopsis McCrady 1856. Clavidae in which the walls of the four radial canals above the stomach consist of highly vacuolated endodermal cells forming a peduncle for the stomach.—Type species: *T. nutricula* McCrady.

Turritopsis nutricula McCrady 1856. 4—5 mm. high and wide, bell-shaped, walls uniformly thin; stomach large, cross-shaped in transverse section; four large lips, edges with a row of nematocyst knobs; vacuolated endoderm cells above stomach; 80—90 marginal tentacles.—North Sea and English Channel; Gulf of Maine to the West Indies; Mediterranean Sea; west coast of Africa; Red Sea; Indian Ocean; western Pacific from

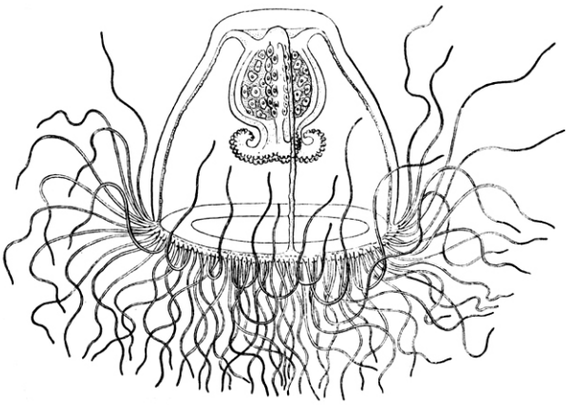


Fig. 63. *Oceania armata* (after Mayer).

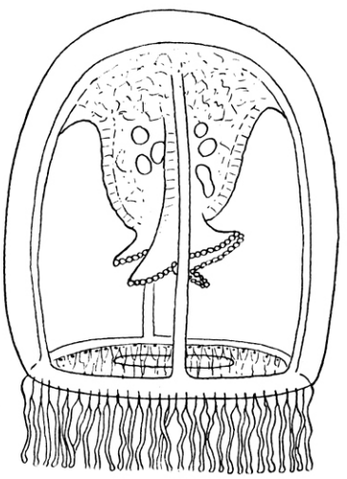


Fig. 64. *Turritopsis nutricula* (from Pl. Sh.).

Japan to New Zealand. (Mayer 1910 p. 143, Pl. 14 fig. 10—13, Pl. 15 fig. 10—13, text-fig. 77—79; Russell 1953 p. 115, Pl. 5 fig. 1—5, Pl. 29 fig. 1—3, text-fig. 54 A—C, 55, 56). Synonyms: *T. polycirrha* (Keferstein 1862), *T. pacifica* Maas 1909.—Hydroid: *Corydendrium*.

Family **Hydractiniidae.**

Anthomedusae with mouth with four simple or branching lips armed with terminal clusters of nematocysts; with four radial canals; with gonads either only on interradial walls of stomach, or on proximal portions of radial canals as well; with 4, 8 or more solid marginal tentacles; with or without ocelli.—Hydroids *Hydractinia*-like.

One of the genera, *Stylactis*, consists of hydroids producing degenerate medusae.

Podocoryne M. Sars 1846. Hydractiniidae with four or more simple marginal tentacles, not in groups; with 4 or 8 simple or slightly branched mouth-arms which are dilatations of the mouth-rim.—Type species: *P. carnea* Sars.

Key to the species of Podocoryne.

1. No oral arms, merely four oral, sessile clusters of nematocysts; 8 tentacles ..... *tenuis.*
   Oral arms well developed ..... 2.
2. Oral arms divided once or twice; 24—32 tentacles ..... *borealis.*
   Oral arms simple, undivided ..... 3.
3. Marginal tentacle bulbs with adaxial ocelli; a small swelling in the middle of each radial canal; 8 tentacles ..... *dubia.*
   Without ocelli; no swellings on radial canals ..... 4.

4. With medusa-buds on manubrium; gastric peduncle present ..... 5.
   Without medusa-buds ..... 6.
5. With 4 tentacles ..... *minima.*
   With 8 tentacles ..... *minuta.*
6. Gonads on stomach and proximal portions of radial canals; 8 large and several small tentacles *hartlaubi.*
   Gonads on stomach only; rarely more than 8 tentacles ..... *carnea.*

Podocoryne carnea M. SARS 1846. European form: 1 mm. high and wide; stomach cylindrical, half as long as bell cavity, with four simple mouth-arms; no peduncle; gonads interradial, mature soon after liberation

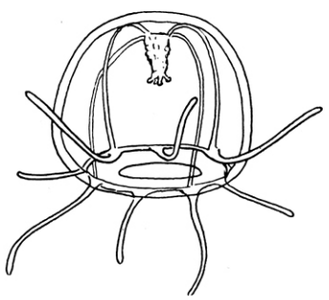


Fig. 65. *Podocoryne carnea* (from PL. SH.).

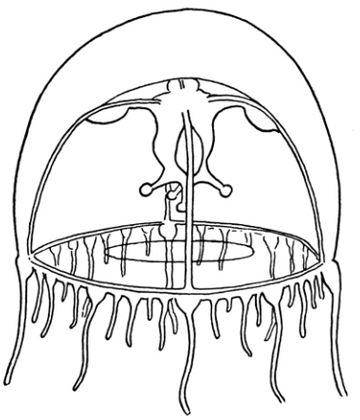


Fig. 66. *Podocoryne hartlaubi* (from PL. SH.).

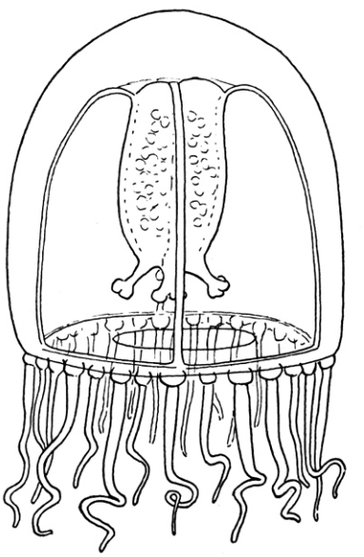


Fig. 67. *Podocoryne borealis* (from PL. SH.).

from the hydroid; no medusa-buds; 4—8 marginal tentacles, without ocelli. In the Mediterranean the medusa may sometimes have as many as 16 tentacles, and in North America it is stated to grow to larger size, 3.5 mm., with up to 32 tentacles; these large specimens may, however, have belonged to *P. borealis.*—North-western Europe; Iceland (hydroid only); Mediterranean Sea; east coast of North America; South Africa and Chile (hydroid). (MAYER 1910 pp. 136, 492, Pl. 14 fig. 2—6, Pl. 15 fig. 14, text-fig. 74; RUSSELL 1953 p. 121, Pl. 6 fig. 2, 3, text-fig. 57 A, 58 A, B, 59 B.).

Podocoryne hartlaubi NEPPI & STIASNY 1911. 3.5 mm. high and wide; stomach cylindrical, about half as long as bell cavity, with very slight peduncle; four simple mouth-arms; gonads interradial on stomach with short extensions along the radial canals; no medusa-buds; up to 57 marginal tentacles of unequal sizes, 8 large, the others small; no ocelli.—Southern England and Ireland; Adriatic Sea. (RUSSELL 1953 p. 130, Pl. 6 fig. 1, 4, text-fig. 60 A—D, 61 A, B).

Podocoryne borealis MAYER 1900. Up to 5 mm. high and wide; stomach elongated, almost as long as bell cavity; four mouth-arms, bifurcated once or twice, each branch with a terminal cluster of nematocysts (undivided in young stages); no peduncle; gonads interradial; no medusa-buds; 16—32 marginal tentacles; no ocelli.—North-western Europe; south coast of Iceland; American coast north of Cape Cod. (MAYER 1910 p. 154, Pl. 15 fig. 1—3, as *Lymnorea borealis*; HARTLAUB 1911 p. 219, fig. 192—194, as *Podocoryne areolata*; p. 225, fig. 195, as *P. borealis*; RUSSELL 1953 p. 125, Pl. 6 fig. 5, text-fig. 57 B, 59 A, C—F, as *Podocoryne borealis*). Synonym: *Limnoria norwegica* BROCH 1905.

This medusa has frequently been recorded as *P. areolata* under the erroneous presumption that it was derived from the hydroid of that name (see below).

Podocoryne minuta (MAYER 1900). 0.3 mm. high, pear-shaped, with thick, solid apex; stomach on a short peduncle; four well developed, simple mouth-arms; medusa-buds on the interradial sides of stomach; 8 marginal tentacles; no ocelli.—Florida; Great Fishbay, West Africa; ? Adriatic Sea. (MAYER 1910 p. 140, Pl. 14 fig. 1).

The specimens from the Adriatic Sea (NEPPI & STIASNY 1913 p. 24) are uncertain; they probably belong to *Lizzia blondina.*

Podocoryne minima (TRINCI 1903). 0.3—1 mm. high and wide, with slightly thickened apex; stomach on well developed peduncle; four well developed mouth-arms; medusa-buds on interradial sides of stomach;

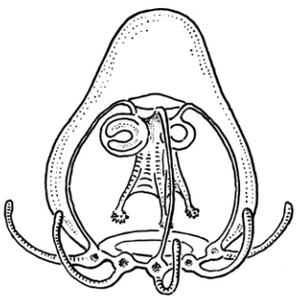


Fig. 68. *Podocoryne minuta* (after MAYER, redrawn by P. W.).

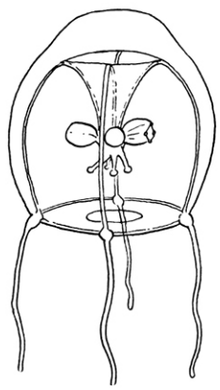


Fig. 69. *Podocoryne minima* (from PL. SH.).

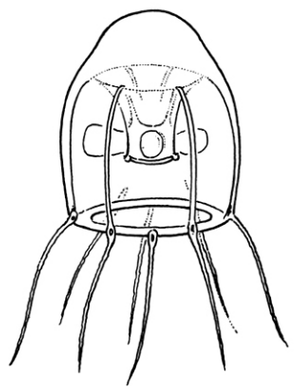


Fig. 70. *Podocoryne tenuis* (after BROWNE & KRAMP, redrawn by P.W.).

4 marginal tentacles; no ocelli.—Naples in the Mediterranean; Plymouth in English Channel. (RUSSELL 1953 p. 134, text-fig. 63, 64). Synonym: ? *P. simplex* KRAMP from Japan.

This species may possibly be identical with *P. minuta*, from which it only differs in the number of tentacles.

Podocoryne tenuis (BROWNE 1902). 2 mm. high, 1.5 mm. wide, somewhat conical with a slight constriction below thickened apex; stomach cubical, on a well developed peduncle about as long as itself; mouth with four short lips each with a cluster of nematocysts, but not prolonged as mouth-arms; medusa-buds on interradial sides of stomach; 8 marginal tentacles of equal size; no ocelli.—Falkland Islands. (BROWNE & KRAMP 1939 p. 280, Pl. 15 fig. 5—6).

Podocoryne dubia (MAYER 1900). 1.5 mm. high and wide; stomach pear-shaped, half as long as bell cavity; four short mouth-arms; no peduncle; gonads not observed; no medusa-buds; a small swelling (glandular?) in the middle of each radial canal; 8 marginal tentacles, each with a large, black, adaxial ocellus.—Florida. (MAYER 1910 p. 141, Pl. 14 fig. 7, 9).

Podocoryne areolata (ALDER 1857). Hydroid; newly liberated medusa: 0.5 mm. high and wide, globular; stomach without a peduncle; four simple mouth-arms; 16 marginal tentacles, the four perradial much larger than the others; no ocelli.—British coasts. (HARTLAUB 1911 fig. 191, after ALDER).

All records of free medusae named *P. areolata* should be referred to *P. borealis*; *P. areolata* may possibly be the hydroid of the medusa *P. hartlaubi.*

Doubful species, probably not belonging to *Podocoryne*.

"*Cytaeandra polystyla*" HAECKEL 1879. 1.5 mm. high and wide; stomach large, cubical, on short peduncle; 16 (!) simple mouth-arms; gonads half-moon-shaped, convex side below; 32 marginal tentacles.—Atlantic coast of France. (MAYER 1910 p. 140, as *Podocoryne polystyla*).

Podocoryne meteoris THIEL 1938. 1—1.5 mm. high, 1.5—2 mm. wide; 12 oral tentacles; no peduncle; medusa-buds on stomach; 8 marginal tentacles.—Cape Verde. (THIEL 1938 p. 298, fig. 3).

Stylactis ALLMAN 1864. Hydroids; in some species degenerate medusae are developed; with a sac-like manubrium without mouth-opening and without oral tentacles; gonad encircling stomach; four simple radial canals and a ring canal; 4—8 rudimentary tentacle bulbs. Type species of hydroid: *S. fucicola* (M. SARS).

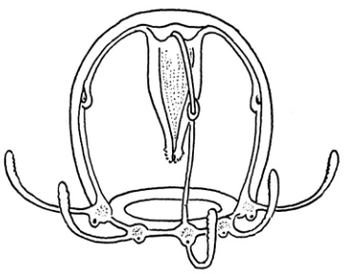


Fig. 71. *Podocoryne dubia* (after MAYER, redrawn by P. W.).

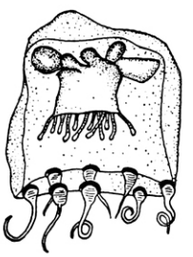


Fig. 72. *Podocoryne meteoris* (after THIEL).

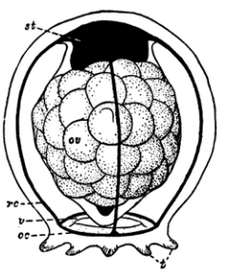


Fig. 73. *Stylactis hooperi*, recently liberated medusa (after SIGERFOOS, from MAYER).

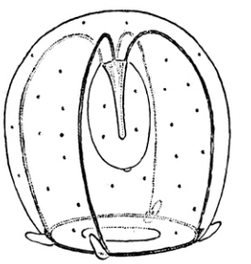


Fig. 74. *Stylactis pruvoti* (after BEHNER, redrawn by P. W.).

Stylactis hooperi SIGERFOOS 1899. Globular; manubrium wide, fills greater part of bell cavity; 8 rudimentary tentacle bulbs.—Woods Hole, New England. (MAYER 1910 p. 150, fig. 82).

Stylactis pruvoti (MOTZ-KOSSOWSKA 1905). 1 mm. high, 0.6—0.7 mm. wide; well developed gastric peduncle; stomach elongated-oval, with ring-shaped gonad; 4 rudimentary tentacles.—Naples. (Medusa described by BEHNER 1914 p. 415, fig. 14—18).

Family **Rathkeidae.**

Anthomedusae with mouth with four lips elongated to form oral arms armed with terminal, usually also lateral, clusters of nematocysts; with or without medusa-buds on stomach walls; with four (rarely eight) radial canals; with solid marginal tentacles arranged in eight groups; without ocelli. Hydroid: *Rathkea*.

Rathkea BRANDT 1837. Rathkeidae with four radial canals;—Type species: *R. octopunctata* (M. SARS). Synonyms: *Lizzia* FORBES 1848 in part; *Margellium* HAECKEL 1879.

Key to the species of Rathkea.

1. Umbrella with large, solid apical projection; well developed gastric peduncle ..... 2.
   Without apical projection and without gastric peduncle ..... *africana.*
2. Oral arms short, each with one or two pairs of nematocyst clusters ..... *octopunctata.*
   Oral arms elongated, each with 7—11 nematocyst clusters in a double row ..... *formosissima.*

Rathkea octopunctata (M. SARS 1835). 3—4 mm. high, somewhat higher than wide, pyriform with solid, rounded apical projection; stomach short, four-sided, on a well developed, conical peduncle; mouth with

four lips, each with one or two pairs of nematocyst clusters; gonads completely surrounding stomach; asexual budding from stomach wall; marginal tentacles 3—5 in each perradial, 3 in each interradial group; tentacle bulbs without ocelli, but with dark interior pigmentation.—North-western Europe; Barents Sea and White Sea; Iceland; west coast of Greenland; Hudson Strait; Newfoundland; New England; Bermuda; Mediterranean Sea; Black Sea; Aleutian Islands; Kamchatka; northern Japan. (MAYER 1910 p. 177, Pl. 20 fig. 11; RUSSELL 1953 p. 137, Pl. 7 fig. 3, 4, text-fig. 65 A—E, 66, 67 A, B). Synonyms: *Oceania blumenbachii* RATHKE 1835, *Lizzia grata* FEWKES 1881, *Lizzia shimiko* KISHINOUYE 1910.

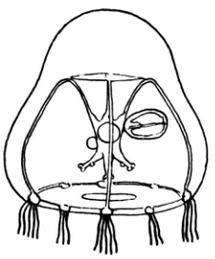


Fig. 75. *Rathkea octopunctata* (from PL. SH.).

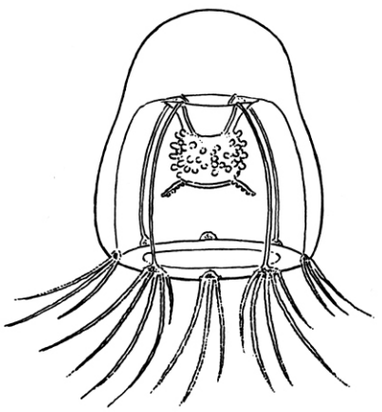


Fig. 76. *Rathkea formosissima* (after BROWNE & KRAMP, redrawn by P. W.).

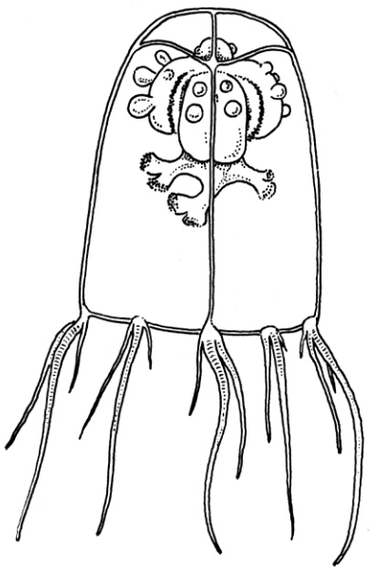


Fig. 77. *Rathkea africana* (after KRAMP, redrawn by P. W.).

There is every reason to believe that the description of *R. octopunctata* by SARS, 1835, was published before that of *blumenbachii* by RATHKE in the same year, so that the name given by SARS has priority.

Rathkea formosissima (BROWNE 1902). 3 mm. high, 2.5 mm. wide; differs from *R. octopunctata* in the shape of the oral arms which are narrow, elongated, each provided with 7—11 nematocyst clusters in a double row; moreover the gonads are four interradial, roundish swellings.—Falkland Islands. (BROWNE & KRAMP 1939 p. 281, Pl. 14 fig. 5, Pl. 19 fig. 1).

Rathkea africana KRAMP 1957. 1.7 mm. high, 1.2 mm. wide; no apical projection and no gastric peduncle; eight adradial gonads; medusa-buds on stomach; oral lips bifurcated, each with two broad, terminal clusters of nematocysts, no lateral clusters; perradial marginal bulbs with 3—4 tentacles of very unequal length, interradial bulbs with 2—3 tentacles; no dark pigmentation in the marginal bulbs.—Gulf of Guinea. (KRAMP 1957 p. 8 Pl. 1 fig. 5).

Family **Bougainvilliidae.**

Anthomedusae with simple tubular mouth with simple or dichotomously branching oral tentacles inserted above mouth opening; with four radial canals; with 2, 4 or more solitary marginal tentacles, or with 4, 8 or 16 large marginal bulbs each with a group of solid tentacles; with or without ocelli.—Hydroids with a single whorl of filiform tentacles.

Key to the genera.

1. Oral tentacles simple, unbranched; marginal tentacles solitary or in eight unequal groups .... *Lizzia.*
   Oral tentacles dichotomously branched ..... 2.
2. Marginal tentacles solitary ..... *Thamnostoma.*
   Marginal tentacles in 4 or 8 groups ..... 3.
3. Marginal tentacles in 8 groups ..... *Köllikerina.*
   Marginal tentacles in 4 groups ..... 4.
4. In each group a median pair of club-shaped tentacles ..... *Nemopsis.*
   Marginal tentacles all alike ..... *Bougainvillia.*

Lizzia FORBES 1846. Bougainvilliidae with simple, unbranched oral tentacles inserted above the mouth-rim; with 8 marginal bulbs, each with one simple tentacle, or with more tentacles on the perradial than on the interradial bulbs; with a gastric peduncle; medusa-buds develop upon the stomach; no ocelli.—Type species: *L. blondina* FORBES.—Frequently confounded with *Podocoryne.*

Key to the species of Lizzia.

1. With more tentacles on perradial than on interradial bulbs ..... 2.
   Marginal tentacles all solitary ..... 3.
2. Without ocelli; interradial bulbs with only one tentacle ..... *blondina.*
   With adaxial ocelli; interradial bulbs with two tentacles ..... *elisabethae.*
3. With 4 oral tentacles; 8, sometimes 16, marginal tentacles ..... *fulgurans.*
   With 8 oral tentacles; 8 marginal tentacles ..... 4.
4. Oral tentacles situated perradially and interradially ..... *gracilis.*
   Oral tentacles situated in four perradial pairs ..... *octostyla.*

Lizzia blondina FORBES 1848. 1—2 mm. high and wide, with fairly thick apex; stomach short, four-sided, on a short, pyramidal peduncle; 4 small, simple oral tentacles, each with a terminal nematocyst knob; gonad ring-shaped; medusa-buds on stomach, before the gonad is ripe; 8 marginal bulbs, perradial bulbs with up to 3 tentacles, interradial bulbs never more than one; frequently not all tentacles developed; no ocelli.—North-western Europe; Iceland; Portugal; Mediterranean. (MAYER 1910 p. 181, as *Rathkea blondina*; HARTLAUB 1911 p. 145, fig. 131—135, as *Lizzia blondina*; RUSSELL 1953 p. 145, Pl. 7 fig. 1, 2, Pl. 34 fig. 5, 6, text-fig. 69, 70 A—C, 71, 72 A, B). Synonyms: *Cubogaster gemmascens* + *Dysmorphosa minima* + *Lizzia claparedei* HAECKEL 1879.

Lizzia elisabethae HAECKEL 1879. 6 mm. high, 4 mm. wide, with thick apex; perradial marginal bulbs with 4, interradial bulbs with 2 tentacles; an ocellus (!) at the base of each tentacle; medusa-buds not observed.—Jersey, English Channel; only seen by HAECKEL. (HARTLAUB 1911 p. 149, fig. 136).

Lizzia fulgurans (A. AGASSIZ 1865). 1 mm. high, somewhat pyriform, very soft and flexible; stomach small, on a well-developed, fairly long, pyramidal peduncle; 4 simple oral tentacles; medusa-buds on stomach; 8, sometimes 16, tentacles, stiff, upward curled, one on each marginal bulb; no ocelli.—North Carolina to Newport, New England. (MAYER 1910 p. 139, Pl. 12 fig. 5—9, Pl. 13 fig. 3—5, as *Podocoryne fulgurans*).

Lizzia gracilis (MAYER 1900). 3 mm. wide, a little broader than high, with slight apical projection; stomach small, on a slightly developed peduncle; 4 perradial and 4 interradial oral tentacles; medusa-buds on stomach; 8 stiff marginal tentacles, upward curled; large basal bulbs; no ocelli.—Florida; Sunda Strait. (MAYER 1910 p. 141, Pl. 16 fig. 1—3, as *Podocoryne gracilis*).

Lizzia octostyla (HAECKEL 1879). 0.4 mm. high, 0.5 mm. wide, with low, conical apex; stomach on a well developed peduncle; 8 oral tentacles situated in pairs in the four perradial corners of the mouth tube; medusa-buds on stomach; 8 short marginal tentacles with small bulbs, old specimens sometimes with an additional tentacle on each perradial bulb; no ocelli, but dark pigmentation in marginal bulbs.—Adriatic Sea. (MAYER 1910 p. 140, as *Podocoryne octostyla*; NEPPI & STIASNY 1913 p. 32, Pl. 2 fig. 22).

Thamnostoma HAECKEL 1879. Bougainvilliidae with four dichotomously branched oral tentacles inserted above the mouth-rim; with 4, 8 or more solitary marginal tentacles; with or without ocelli.—Type species: *T. dibalia* (BUSCH 1851). Hydroid *Thamnitis* HAECKEL.

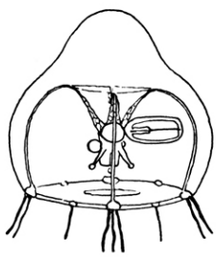


Fig. 78. *Lizzia blondina* (from PL. SH.).

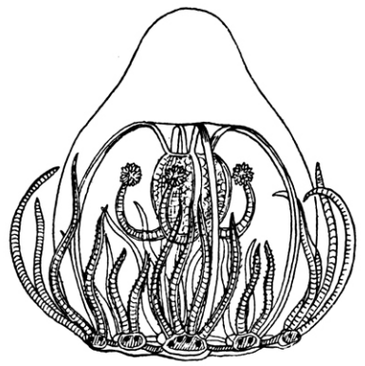


Fig. 79. *Lizzia elisabethae* (after HAECKEL, from HARTLAUB).

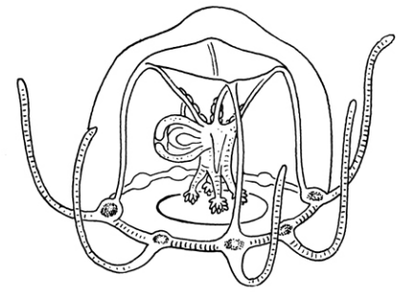


Fig. 80. *Lizzia fulgurans* (after MAYER, redrawn by P. W.).

Some of the species belonging to this genus have erroneously been referred to *Lymnoria* PÉRON & LESUEUR 1809, a doubtful genus comprising only one species, *L. triedra* PÉR. & LES., which is unrecognizable. None of the species of *Thamnostoma* have been found more than a few times, and they are distinguished from each other merely by relative characters.

Thamnostoma dibalia (BUSCH 1851). 7 mm. high, 6 mm. wide; four swollen interradial gonads; oral tentacles divided two or three times; 8 marginal tentacles with adaxial ocelli.—Adriatic Sea. (MAYER 1910 p. 153; NEPPI & STIASNY 1913 p. 27, Pl. 2 fig. 15).

Thamnostoma tetrella (HAECKEL 1879). 6 mm. high, 4 mm. wide; four swollen interradial gonads; oral tentacles divided three times; 4 marginal tentacles with ocelli.—Brazil. (MAYER 1910 p. 152).

Thamnostoma russelli REES 1938. Newly liberated medusa: 1.2—1.6 mm. high, 1.2—1.35 mm. wide; stomach short, cylindrical; oral tentacles divided once; 4 perradial tentacles and 4 interradial bulbs with

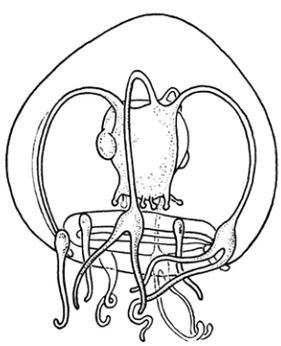


Fig. 81. *Lizzia octostyla* (after NEPPI & STIASNY, redrawn by P. W.).

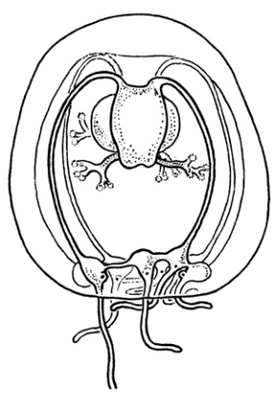


Fig. 82. *Thamnostoma dibalia* (after NEPPI & STIASNY, redrawn by P. W.).

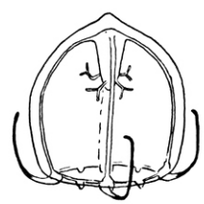


Fig. 83. *Thamnostoma russelli* (from PL. SH.).

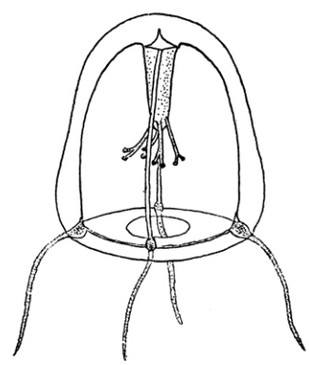


Fig. 84. *Thamnostoma* sp. (after RUSSELL).

developing tentacles; no ocelli.—Near Bergen, Norway. (Rees 1938 p. 22, fig. 7; Russell 1953 p. 151, fig. 73 C—E).

Thamnostoma sp. Russell 1953. 1—1.5 mm. high and wide; stomach elongated conical, half as long as bell cavity; no gonads; oral tentacles divided two or three times; 4 marginal tentacles; no ocelli.—Firth of Clyde, Scotland. (Russell 1953 p. 150, fig. 73 A—B).

Bougainvillia Lesson 1836. Bougainvilliidae with four radially placed groups of marginal tentacles, the tentacles of each group being all of one kind and similar in structure to each other; with four perradial, dichotomously branching oral tentacles, each branch with a terminal nematocyst cluster.—Type species: *B. macloviana* Lesson. Synonyms: *Hippocrene* Brandt 1835 (preoccupied), *Margelis* Steenstrup 1850.

Numerous species have been described, and most of them occur in the Atlantic area only. Some of them are more or less doubtful; some species are very characteristic in structure, others are more vaguely characterized but usually recognizable in adult stages. For determination it is necessary to consult the diagnoses of the species for additional structural remarks. It is difficult to identify young stages, unless a series leading up to the adult is available.

Key to the species of Bougainvillia.

1. With a well developed, gelationous gastric peduncle ..... 2.
   Peduncle absent or weakly developed ..... 4.
2. Peduncle broad, conical; gonads extending radially from stomach upwards on peduncle ..... 3.
   Peduncle cylindrical; gonads interradial, on stomach wall only ..... *superciliaris.*
3. Oral tentacles divided 3—4 times; marginal bulbs each with 6—9 tentacles ..... *pyramidata.*
   Oral tentacles divided 5—7 times; marginal bulbs V-shaped, with 35—65 tentacles .... *macloviana.*
4. Marginal tentacles with adaxial ocelli ..... 5.
   Marginal tentacles without ocelli ..... 11.
5. Basal trunk of oral tentacles short ..... 6.
   Basal trunk of oral tentacles long ..... 7.
6. Marginal bulbs very broad, with 30—40 tentacles; stomach with deep interradial furrows.. *principis.*
   Marginal bulbs with 10—13 tentacles; stomach remarkably flat, quadrangular ..... *platygaster.*
7. Stomach short and broad ..... 8.
   Stomach elongated, narrow ..... 9.
8. Oral tentacles divided 4—6 times; marginal bulbs with about 30 tentacles; ocelli as narrow, transverse lines ..... *britannica.*
   Oral tentacles divided 1—2 (rarely 3) times; marginal bulbs with 3—4 (rarely more) tentacles; ocelli round; male gonads extending cross-wise on subumbrella ..... *ramosa.*
9. Stomach with a long, narrow throat which projects beyond velar opening; marginal bulbs with 4 very short tentacles; walls of umbrella thin ..... *maniculata.*
   Stomach flask-shaped, about half as long as bell cavity; walls thick; marginal bulbs with 8 long tentacles ..... 10.
10. Oral tentacles divided twice; four interradial gonads ..... *carolinensis.*
    Oral tentacles divided 4 times; 8 adradial gonads; frequently with medusa-buds on stomach *niobe.*
11. Basal trunk of oral tentacles short; oral tentacles divided 5—7 times; marginal bulbs with 5—7 tentacles; 4 interradial gonads ..... *nordgaardi.*
    Basal trunk of oral tentacles long; oral tentacles divided 2—3 times; marginal bulbs with 2 tentacles; 8 adradial gonads ..... *frondosa.*

Bougainvillia macloviana Lesson 1836. 15 mm. high, 13 mm. wide, cylindrical, with fairly thick walls and rounded apex; stomach on broad, conical peduncle; oral tentacles with very short trunk, divided 5—7

times; gonads extending along perradial lobes of stomach upwards on peduncle; marginal bulbs V-shaped, each with 35—65 tentacles in double row; ocelli brownish-black.—Subantarctic, circumpolar; North Sea, probably introduced by ships. (MAYER 1910 p. 160; BROWNE & KRAMP 1939 p. 284, Pl. 14 fig. 6, Pl. 15 fig. 7—14).

Bougainvillia pyramidata (FORBES & GOODSIR 1853). 3—6 mm. high and wide, globular, walls moderately thick; stomach flat, cruciform, on a broad, conical peduncle; oral tentacles short, divided 3—4 times; gonads adradial, elongated, on base and four perradial lobes of stomach; marginal bulbs small, oval, each with 6—9 tentacles; ocelli black.—British coasts. (MAYER 1910 p. 168; RUSSELL 1953 p. 167, text-fig. 82 A—C).

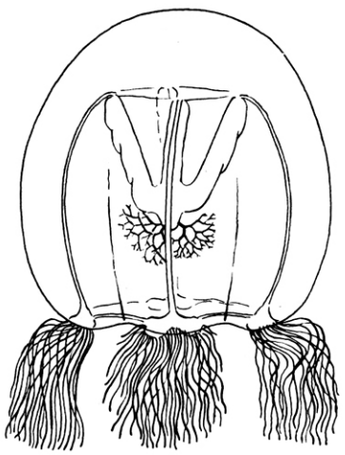


Fig. 85. *Bougainvillia macloviana* (from PL. SH.).

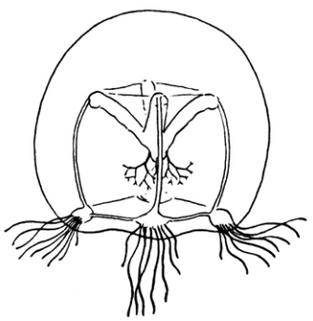


Fig. 86. *Bougainvillia pyramidata* (from PL. SH.).

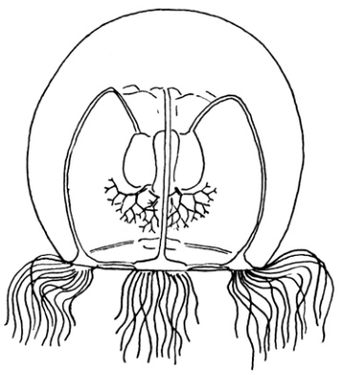


Fig. 87. *Bougainvillia superciliaris* (from PL. SH.).

Bougainvillia superciliaris (L. AGASSIZ 1849). 7—9 mm. high and wide, almost globular, walls very thick; stomach short, on broad base, cross-shaped in section, on well developed peduncle of about same width as stomach; gonads interradial, almost quadratic, on stomach walls only; oral tentacles with short, thick basal trunk, divided 4—5 (rarely 6—7) times, branches short; marginal bulbs crescent-shaped, less than half as wide as interradial spaces, each with 11—15 (up to 22) tentacles; ocelli large, round, black. Planulae developing on stomach walls.—Common in arctic waters: north of Russia, Spitzbergen, Iceland, West-Greenland; arctic Canada, Aleutian Islands; North Sea; North-America as far south as Woods Hole. (MAYER 1910 p. 162, Pl. 17 fig. 1, text-fig. 87, 88; RUSSELL 1953 p. 169, text-fig. 83 A, B, 84 A, B, 85 A—C).

Bougainvillia principis (STEENSTRUP 1850). 10 mm. high and wide, globular, gelatinous substance moderately thick; manubrium without a peduncle, short and broad, with deep interradial furrows; gonads adradial, swollen; oral tentacles short, divided 5—6 times, almost from base; marginal bulbs linear, wider than interradial spaces, each with 30—40 tentacles in a single row; ocelli black, linear.—North-western Europe; Murman Coast; Iceland; West-Greenland. (MAYER 1910 p. 160; RUSSELL 1953 p. 164, Pl. 8 fig. 4, text-fig. 76 A, B, 78 B, 79 B).

Bougainvillia platygaster (HAECKEL 1879). 12 mm. high and wide, with thick walls, flattened top and vertical sides; no peduncle; stomach quadrangular, very flat; oral tentacles short, divided 5—6 times immediately from base; gonads interradial; marginal bulbs triangular, each with 10—13 tentacles; ocelli crescent-shaped. Medusa-buds are produced either directly from stomach walls or from polypoid structures issuing from stomach walls and terminating in hydranths with mouth and tentacles (see above, p. 11).—Tropical Atlantic between Africa and South America; West Indies and Sargasso Sea; east coast of Africa. (MAYER 1910 p. 165; KRAMP 1957 p. 12, Pl. 3 fig. 1—6, first description of the asexual reproduction).

Bougainvillia britannica FORBES 1848. 12 mm. high, 10 mm. wide, walls very thick; no peduncle; stomach short, broad, cross-shaped in section; oral tentacles divided 4—6 times from a long undivided basal trunk; gonads adradial; marginal bulbs about half as wide as interradial spaces, each with up to 30 tentacles; ocelli black, as narrow transverse lines.—North-western Europe; southern Iceland; Gulf of Maine in North America; ? Black Sea. (MAYER 1910 p. 161, Pl. 17 fig. 8; RUSSELL 1953 p. 158, Pl. 8 fig. 2, 3, Pl. 9 fig. 1—3, text-fig. 75 A, B, 77 A, B, 78 A, 79 A).

Bougainvillia ramosa (VAN BENEDEN 1844). 2—3.5 mm. high and wide, semiglobular, jelly thick; stomach short; oral tentacles short, divided 1—2 times (rarely 3); gonads interradial, in female globular, in male

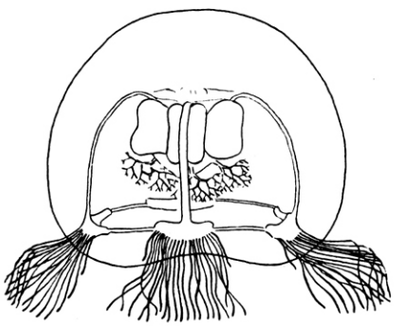


Fig. 88. *Bougainvillia principis* (from Pl. Sh.).

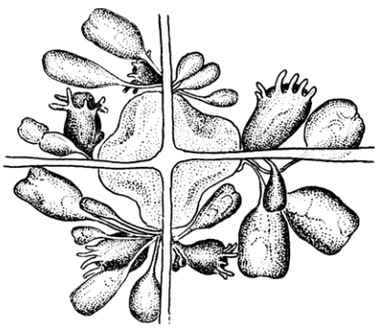


Fig. 89. *Bougainvillia platygaster*, aboral view of stomach with medusa buds and polypoid buds (after KRAMP, redrawn by P. W.).

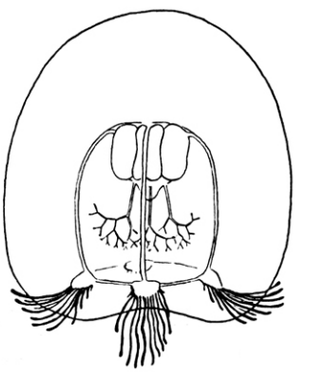


Fig. 90. *Bougainvillia britannica* (from PL. SH.).

prolonged along perradial sides of a low and broad peduncle; marginal bulbs small, each with 3—4 (rarely up to 7) long tentacles; ocelli black, round.—North-western Europe; Mediterranean; west coast of Africa; New England south of Cape Cod; the hydroid is also found on the south coast of Iceland. (HARTLAUB 1911 p. 183, fig. 162—167, as *B. ramosa*, fig. 138 as *B. triestina*; RUSSELL 1953 p. 153, Pl. 8 fig. 1, Pl. 9 fig. 4, 5, text-fig. 74 A—C. MAYER's synonyms are erroneous). Synonyms: *B. britannica* in part; *B. gibbsi* MAYER; *autumnalis* + *triestina* + *flavida* HARTLAUB.

Bougainvillia maniculata HAECKEL 1879. 1.5 mm. high and wide, almost spherical, with thin walls; manubrium flask-shaped with narrow base and a long, narrow throat projecting beyond velar opening; oral tentacles with long trunks, divided twice; gonads interradial; marginal bulbs small, globular, each with 4 short, finger-shaped tentacles; ocelli large.—Villefranche in Mediterranean. (MAYER 1910 p. 170, fig. 92; only seen by HAECKEL).

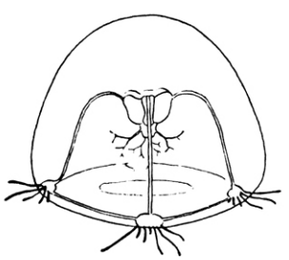


Fig. 91. *Bougainvillia ramosa* (from PL. SH.).

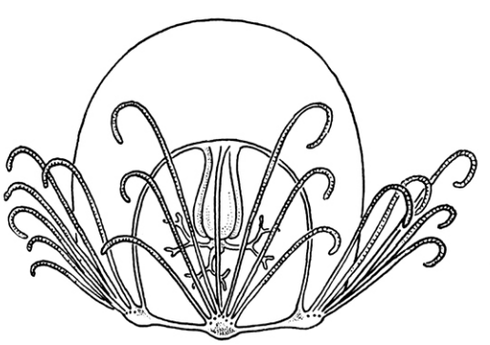


Fig. 92. *Bougainvillia carolinensis* (after MAYER, redrawn by P. W.).

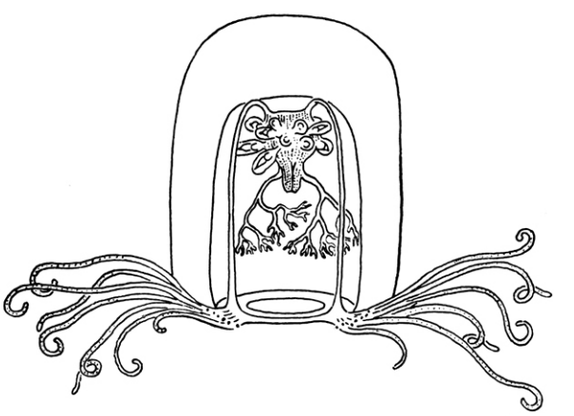


Fig. 93. *Bougainvillia niobe* (after MAYER, redrawn by P. W.).

Bougainvillia carolinensis (McCrady 1857). 4 mm. high and wide, dome-shaped, walls very thick; no peduncle; stomach long and narrow; oral tentacles with long trunks, divided twice; gonads in longitudinal, interradial, swollen regions; marginal bulbs small, bulbous, each with 7—9 slender, stiff tentacles; ocelli large, dark-brown or black.—North America from Woods Hole to Florida; Gulf of Guinea. (Mayer 1910 p. 165, Pl. 16 fig. 7—9, Pl. 17 fig. 7).

Bougainvillia niobe Mayer 1894. 7 mm. high, 5 mm. wide, with vertical sides and flatly rounded apex, walls thick; no peduncle; stomach wide, flask-shaped, cross-shaped in section, about half as long as bell cavity; oral tentacles with long trunks, divided 4 times; eight adradial gonads; medusa-buds developed

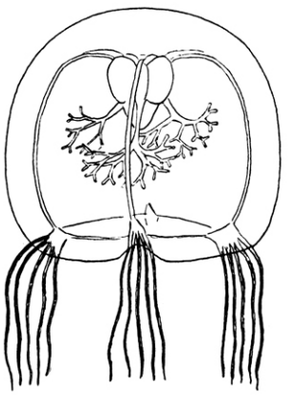


Fig. 94. *Bougainvillia nordgaardi* (from Pl. Sh.).

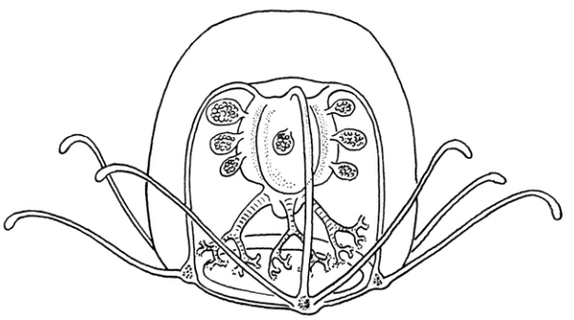


Fig. 95. *Bougainvillia frondosa* (after Mayer, redrawn by P. W.).

directly from stomach walls; marginal bulbs small, oval, each with about 8 tentacles; ocelli dark.—Western Atlantic off the southern parts of the east coast of North America; West-Indies. (Mayer 1910 p. 166, Pl. 18 figs. 1—3, text-fig. 90; see also the present paper p. 11).

Bougainvillia nordgaardi Browne 1903. 4—5 mm. high and wide, oval, walls not very thick; a peduncle may be indicated; stomach fairly small; oral tentacles divided 4—5 times, basal trunk short but distinct; four interradial gonads, well separated in the perradii; marginal bulbs small, globular, with 5—7 tentacles; no ocelli.—Norway and the waters north and west of Scotland; Vancouver on the west coast of North America. (Mayer 1910 p. 168, fig. 91; Kramp & Damas 1925 p. 256, fig. 8—12). Hydroid: *B. muscoides.*

Bougainvillia frondosa Mayer 1900. 2 mm. high, higher than wide, dome-like with vertical sides, jelly fairly thick; stomach short, thick, cruciform in section; flask-shaped, about half as long as bell cavity; oral tentacles with long basal trunks, divided 2—3 times; 8 adradial gonads; planulae develop on stomach walls; marginal bulbs small, each with two long tentacles; no ocelli.—Florida. (Mayer 1910 p. 171, Pl. 16 fig. 6).

Doubtful species of Bougainvillia.

Bougainvillia rugosa Clarke 1882. Hydroid with newly liberated medusa: somewhat pyriform; stomach short and thick; four short and unbranched oral tentacles; marginal bulbs with 3 tentacles, all of equal size; with ocelli.—Chesapeake Bay and Charleston Harbor on east coast of North America. (Mayer 1910 p. 171, Pl. 17 fig. 2).

Bougainvillia nigritella Forbes 1848. 3 mm., globular; oral tentacles divided twice; marginal bulbs with only one tentacle each.—Shetland Islands. (Hartlaub 1911 p. 169, fig. 152).

Bougainvillia simplex (Forbes & Goodsir 1853). Globular; oral tentacles branched twice; marginal bulbs four-lobed, with four ocelli, but with only one tentacle each.—Scotland. (Hartlaub 1911 p. 181, fig. 160).

Bougainvillia multicilia (HAECKEL 1879). 6 mm. high, 5 mm. wide, with thin walls; stomach globular to flask-shaped, with constricted base; no peduncle; oral tentacles simple, unbranched; gonads adradial; marginal bulbs kidney-shaped, each with 10—12 tentacles; ocelli dark-red.—Straits of Gibraltar. (MAYER 1910 p. 164).

Bougainvillia charcoti LE DANOIS 1913. 9 mm., globular, jelly very thick; no peduncle; stomach short, flatly everted, with four perradial, sac-like lobes; the four corners of the mouth (!) divided twice; marginal bulbs composed of 18 "elements", each with a red ocellus, no tentacles.—Hebrides. (LE DANOIS 1913 p. 15, fig. 1—3).

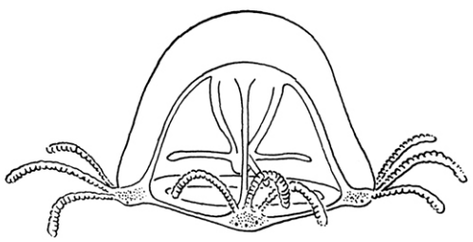


Fig. 96. *Bougainvillia rugosa* (after MAYER, redrawn by P. W.).

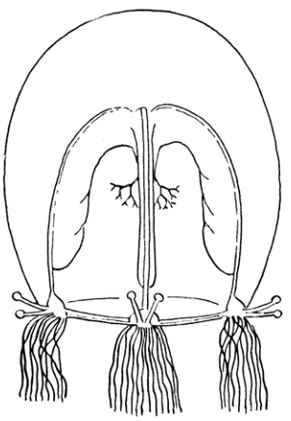


Fig. 97. *Nemopsis bachei* (from PL. SH.).

Nemopsis L. AGASSIZ 1849. Bougainvilliidae with four groups of marginal tentacles, in each group a median pair of club-shaped tentacles and on both sides a number of simple, filiform tentacles; with adaxial ocelli; with four perradial dichotomously branched oral tentacles; stomach with four radial lobes extending outwards along the radial canals; gonads on these lobes.—Type species: *N. bachei* L. AGASSIZ.

Three species have been described from the Atlantic area, but two of them are imperfectly known and may possibly be identical with *N. bachei.*

Nemopsis bachei L. AGASSIZ 1849. 11 mm. high, dome-shaped, with thick walls; stomach short, one-third as long as bell cavity; oral tentacles divided 5—7 times; gonads adradial, ribbon-like, with curtain-like folds, extending two-thirds or more towards bell margin; each marginal bulb cleft, with 14—18 tentacles; ocelli large, dark.—East coast of North America from Woods Hole to Florida; Zuiderzee in Holland; ? Scotland and Norway. (MAYER 1910 p. 173, Pl. 17 fig. 5, 6; HARTLAUB 1911 p. 194, fig. 172).

Nemopsis crucifera (FORBES & GOODSIR 1853). 4 mm. high and wide, globular; oral tentacles divided twice; marginal bulbs each with 6—8 tentacles, the median pair of club-shaped tentacles not observed.—West coast of Scotland. (HARTLAUB 1911 p. 195, fig. 173). Probably identical with *N. bachei.*

Nemopsis heteronema HAECKEL 1879. 12 mm. high, 10 mm. wide, globular; oral tentacles divided 6—8 times; gonads extending to bell margin; marginal bulbs each with 10 tentacles; the ocelli are said to be abaxial.—Sognefjord in Norway. (HARTLAUB 1911 p. 197, fig. 174). Only seen by HAECKEL, probably identical with *N. bachei.*

Köllikerina KRAMP 1939. Bougainvilliidae with eight groups of marginal tentacles, all alike in structure; with four oral tentacles inserted above the mouth-rim and dichotomously branched; marginal tentacles with or without adaxial ocelli.—Type species: *K. fasciculata* (PÉRON & LESUEUR). Synonym: *Köllikeria* L. AGASSIZ 1862, preoccupied.

Key to the species of Köllikerina.

1. Stomach on a peduncle; marginal tentacles with adaxial ocelli ..... 2.
   No peduncle and no ocelli; gonads interradial ..... *maasi.*
2. Gonads perradial, horse-shoe-shaped; peduncle short and broad ..... *fasciculata.*
   Gonads interradial; peduncle elongated, slender ..... *elegans.*

Köllikerina fasciculata (PÉRON & LESUEUR 1809). 8 mm. high, 9 mm. wide, barrel-shaped with flatly rounded apex and thick walls; stomach on a short, broad peduncle; oral tentacles divided 7 times; four perradial,

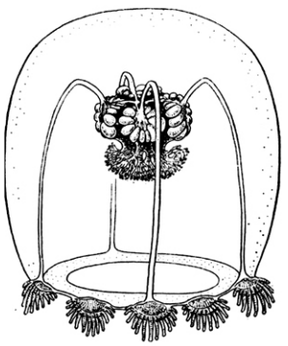


Fig. 98. *Köllikerina fasciculata* (after MAYER).

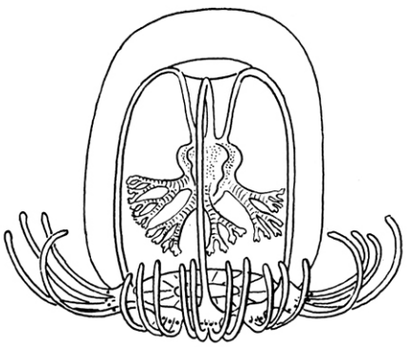


Fig. 99. *Köllikerina elegans* (after MAYER, redrawn by P. W.).

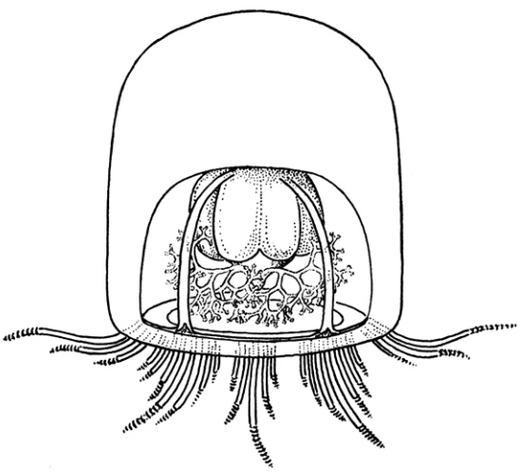


Fig. 100. *Köllikerina maasi* (after BROWNE, redrawn by P. W.).

horseshoe-shaped gonads with transverse furrows; eight marginal bulbs, each with 10—13 tentacles with adaxial ocelli.—Mediterranean and adjacent parts of the Atlantic Ocean; Black Sea. (MAYER 1910 p. 179, fig. 94, as *Rathkea fasciculata*).

Köllikerina elegans (MAYER 1900). 3—7 mm. high, dome-shaped with almost vertical sides, walls moderately thick; stomach pear-shaped, small, on a well developed, slender, conical peduncle; oral tentacles divided 3 times; gonads interradial; tentacles stiff, 4 in the perradial, 3 in the interradial groups, all with dark brown, adaxial ocellus.—Florida; Trivandrum Coast, India. (MAYER 1910 p. 181, Pl. 18 fig. 4, as *Rathkea elegans*).

Köllikerina maasi (BROWNE 1910). 10 mm. high, 9 mm. wide, walls very thick, particularly at apex; no gastric peduncle; stomach fairly large, cross-shaped; oral tentacles divided 7—8 times; gonads covering nearly the whole interradial walls of the stomach, separated perradially; 8 marginal groups of 7 tentacles each; no ocelli.—Antarctic: McMurdo Sound; Gauss Station; Weddell Sea. (BROWNE 1910 p. 22, Pl. 4 fig. 1—5).

Doubtful genus and species.

Lizzella HAECKEL 1879. "Margelidae" with simple, unbranched oral arms and with eight groups of marginal tentacles, the four perradial and the four interradial groups with same number of tentacles.—Type species: *L. octella* HAECKEL, from Japan.

The systematical position of this genus is uncertain, and the two species may not belong to the same genus.

Lizzella hyalina (VAN BENEDEN 1866). 4 mm. high, 6 mm. wide, spherical or egg-shaped; stomach egg-shaped, on a short, conical peduncle; four simple oral tentacles; four interradial gonads, transversely folded; 8 marginal bulbs, each with 3—4 short tentacles.—Belgium and Normandy. (HARTLAUB 1911 p. 151, fig. 137). HAECKEL referred this medusa to his new genus *Lizzella*; it has only been seen by VAN BENEDEN.

Family **Pandeidae.**

Anthomedusae with umbrella with or without an apical projection; large stomach usually without a peduncle; mouth with four simple or crenulated lips; with four radial canals, rarely with centripetal canals; with simple or folded gonads on stomach walls; with hollow marginal tentacles with tapering, conical bulbs, often laterally compressed; tentacles without terminal nematocyst knob; with or without rudimentary tentacles, warts or tentaculae; with or without abaxial ocelli.

This is the largest of the families of Anthomedusae; it was formerly called Tiaridae, but since the generic name *Tiara* was found to be preoccupied, the family was named after the oldest valid genus *Pandea*. The modern division into genera is mainly due to HARTLAUB's revision in "Nordisches Plankton", 1913. For determination of genera and species a careful examination is necessary, and identification of young stages is particularly difficult.

Key to the genera.

1. With two simple and two bifurcated radial canals; tentacle bulbs develop into medusae ... *Niobia.*
   With four undivided radial canals ... 2.
2. With four interradial centripetal canals; the four perradial canals with lateral branches ... *Eutiara.*
   Without interradial centripetal canals ... 3.
3. With only two well developed tentacles when adult ... 4.
   With 4 or more well developed tentacles ... 6.
4. With a well developed, broad gastric peduncle ... *Stomotoca.*
   Without a peduncle ... 5.
5. Gonads four flat leaves extending on subumbrella ... *Codonorchis.*
   Gonads on stomach walls only ... *Amphinema.*
6. Tentacles with adaxial, stalked nematocyst knobs; radial canals with long lateral diverticula . *Zanclonia.*
   Tentacles without stalked nematocyst knobs; radial canals smooth or with short lateral diverticula 7.
7. With 4 or 8 large tentacles and several small, solid, cirrus-like marginal appendages ... 8.
   Without marginal cirri ... 9.
8. Each cirrus placed beside a small marginal wart with an abaxial ocellus; four interradial gonads, horseshoe-shaped, with diverging folds ... *Cirrhitiara.*
   No marginal warts beside the cirri; gonads smooth, no ocelli ... *Halitiara.*
9. Gonads smooth; mouth with 4 simple lips ... 10.
   Gonads folded or reticulate, or both; oral lips more or less folded or crenulated ... 13.
10. No mesenteries; 4 tentacles, no marginal rudiments ... 11.
    Mesenteries well developed ... 12.
11. With a large, globular nematocyst knob inside the base of each tentacle ... *Cnidotiara.*
    Without a globular knob at base of tentacles ... *Protiara.*
12. Stomach cross-shaped in section, more or less twisted; 4 tentacles, no rudiments ... *Paratiara.*
    Stomach not twisted; 2—8 or more well developed tentacles and a number of marginal warts or rudimentary tentacles; mesenteries very long ... *Merga.*
13. Gonads reticulate, with isolated interradial pits, with or without additional folds ... 14.
    Gonads without isolated interradial pits, folds only ... 16.
14. Gonads altogether reticulate, without surrounding folds ... *Pandea.*
    Gonads combined folds and pits ... 15.
15. Gonads in eight vertical, adradial series of transverse folds, interradial portion of stomach walls with isolated pits; no ocelli ... *Neoturris.*
    Gonads mainly in irregular, more or less vertical folds, surrounding a reticulate area; ocelli present *Catablema.*
16. Gonads interradial, horseshoe-shaped, with diverging folds connected by an interradial, transverse bridge ... 17.

Gonads more or less irregular folds, mainly vertical, without a transverse bridge; stomach very broad, cruciform, with perradial lobes closely connected with radial canals; large and small tentacles alternating ..... *Annatiara.*

17. With well developed mesenteries ..... *Leuckartiara.*
Without mesenteries ..... *Halitholus.*

Protiara HAECKEL 1879. Pandeidae with four well developed tentacles with hollow basal bulbs; with 4 or 8 longitudinal gonads on the interradial sides of the stomach, smooth; with four simple oral lips not folded nor crenulated; no mesenteries.—Type species: *P. tetranema* (PÉRON & LESUEUR 1809).

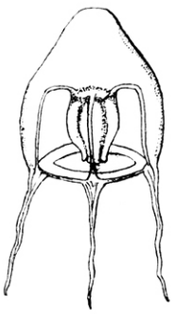


Fig. 101. *Protiara haeckeli* (after HARGITT).

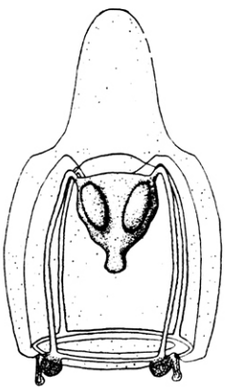


Fig. 102. *Cnidotiara gotoi* (after UCHIDA).

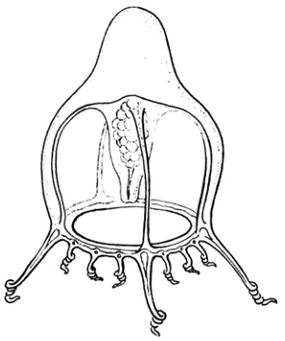


Fig. 103. *Halitiara formosa* (after MAYER, redrawn by P. W.).

The species belonging to *Protiara* are generally considered the most primitive of all Pandeidae. MAYER (1910 pp. 106, 107) erroneously referred *Halitiara formosa* FEWKES and *Plotocnide borealis* WAGNER to this genus.

Protiara haeckeli HARGITT 1902. 2—4 mm. high and about half as wide, somewhat oblong, with an extended apical projection; gastric portion of manubrium rather large, subquadrate in cross section; mouth simple with slightly everted lobes; gonads in rather prominent masses surrounding the stomach; four tentacles with rather prominent bulbs; no ocelli.—Vineyard Sound, Massachusetts in North America. (MAYER 1910 p. 106, as doubtful synonym of *Plotocnide borealis* WAGNER; HARTLAUB 1917 p. 251, fig. 207).

Protiara tetranema (PÉRON & LESUEUR 1809). 4 mm. high and wide, almost cubical, without apical projection; stomach likewise cubical, half as long as bell cavity; four cylindrical gonads (according to HAECKEL the gonads are situated on the perradial edges of the stomach!); four long tentacles, bulbs thickened; with ocelli.—Coasts of Holland and France. (MAYER 1910 p. 106, as *Protiara beroë* (SLABBER 1775); HARTLAUB 1913 p. 251, fig. 206).

Cnidotiara UCHIDA 1927. Pandeidae with 4 perradial, club-shaped tentacles; mouth without lips; with 8 simple, adradial gonads; with a globular nematocyst knob inside the base of each tentacle. No mesenteries.—Type species: *C. gotoi* UCHIDA.

Cnidotiara gotoi UCHIDA 1927. 8 mm. high, 4 mm. wide, rigid, with a solid apical process; manubrium broadly flask-shaped, without lips; 4 tentacles, very short, rounded at end, with ocelli; a large, round knob with nematocysts inside the base of each tentacle.—North Atlantic; Japan. (UCHIDA 1927 p. 204, fig. 33; se also the present paper, p. 12, Pl. I fig. 7—8).

Halitiara FEWKES 1882. Pandeidae with four straight radial canals; mouth a simple cruciform opening; gonads interradial, not folded; with four perradial tentacles and several intermediate, solid, cirrus-like tentacles.—Type species: *H. formosa* FEWKES.

Halitiara formosa FEWKES 1882. 3 mm. high, pyriform, with a solid apical projection; stomach pyriform, about half as long as bell cavity; mouth a simple, cruciform opening; gonads interradial; no mesenteries; four long, hollow, and 24—35 short, solid tentacles, tightly coiled, cirrus-like; no ocelli.—Florida and Bahamas; Fiji Islands; Japan; Philippines and Malayan Archipelago (not published); Madras in India. (MAYER 1910 p. 107, Pl. 6 fig. 4—6, Pl. 13 fig. 1, 2, as *Protiara formosa*).

Niobia MAYER 1900. Pandeidae (?) with four main radial canals, two of which bifurcate, so that 6 canals reach the ring canal; mouth with four simple lips; gonads interradial; no mesenteries; the marginal tentacles develop into medusae by a peculiar process.—Type species: *N. dendrotentaculata* MAYER.

The only species of this peculiar genus is provisionally referred to the Pandeidae.

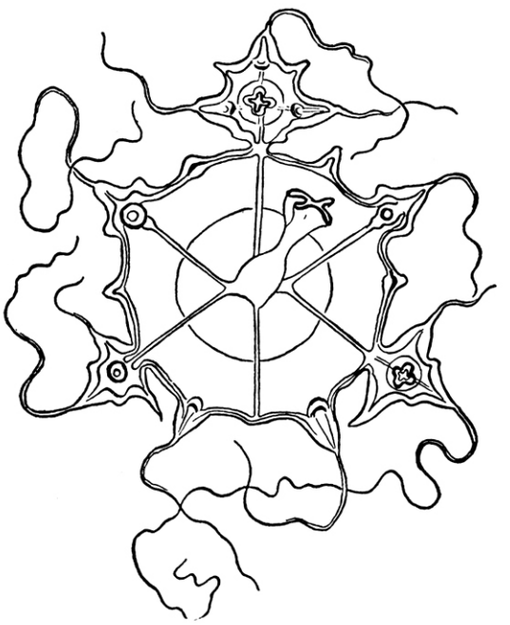


Fig. 104. *Niobia dendrotentaculata* (after MAYER, from BERRILL).

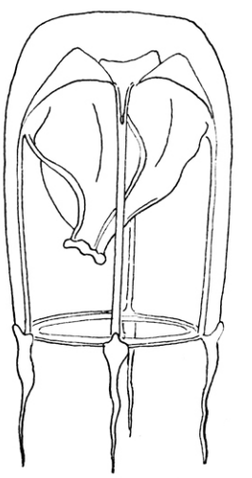


Fig. 105. *Paratiara digitalis* (from PL. SH.).

Niobia dendrotentaculata MAYER 1900. 4 mm. wide, flatter than a hemisphere; 12 marginal tentacles; each tentacle bulb is successively developed into a small medusa.—Tortugas, Florida; between Cape May and Chesapeake Bay; Trivandrum Coast, India.

Paratiara KRAMP & DAMAS 1925. Pandeidae with smooth interradial gonads; mouth with four simple lips; with well developed mesenteries; four marginal tentacles with abaxial spurs.—Type species: *P. digitalis* KRAMP & DAMAS.

Paratiara digitalis KRAMP & DAMAS 1925. 10 mm. high, 5 mm. wide; cylindrical, with thin walls and flat apex; stomach flask-shaped, two-thirds as long as bell cavity, cross-shaped in transverse section, twisted, the perradial edges all turned towards the same side; four simple lips; gonads smooth, interradial, completely covering stomach walls except in the perradii; mesenteries well developed; four perradial tentacles with conical basal bulbs, each with a well developed, ectodermal, abaxial spur; no ocelli.—Northern Norway; between Norway and Shetland Islands; south of Iceland; Sargasso Sea. (KRAMP & DAMAS 1925 p. 273, fig. 18—20; see also the present paper p. 12).

Merga HARTLAUB 1913. Pandeidae with perradial edges of stomach connected with radial canals by long mesenteries; with smooth or granulate gonads; with simple or faintly crenulated lips; with 4—8 or more long tentacles and as many or more rudimentary bulbs or tentaculae.—Type species: *M. violacea* (AGASSIZ & MAYER).—Synonyms: *Pandea* PÉRON & LESUEUR 1843, in part; *Mergintha* + *Tiarula* HARTLAUB 1913.

Key to the species of Merga.

1. Umbrella dome-like, without an apical projection ..... 2.
   Umbrella with a pointed apical projection ..... 3.
2. Gonads adradial; 8—12 long and 24—36 rudimentary tentacles ..... *violacea.*
   Gonads interradial; 4 long tentacles and 4 interradial tentaculae ..... *reesi.*
3. Gonads adradial; no apical chamber above stomach; 4—8 long tentacles and a few rudimentary bulbs *tergestina.*

Merga violacea (AGASSIZ & MAYER). Up to 11 mm. high and 7 mm wide, with thick walls and dome-like apex; manubrium about half as long as bell cavity, cross-shaped in transverse section; four slightly crenulated

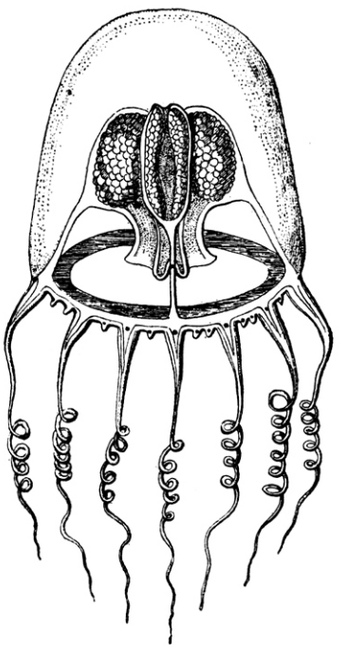


Fig. 106. *Merga violacea* (after MAYER, redrawn by P. W.).

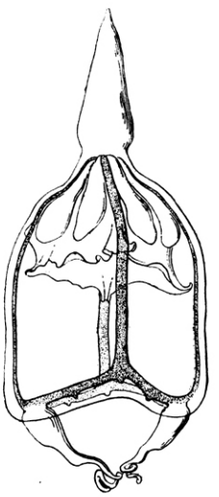


Fig. 107. *Merga tergestina* (after NEPPI & STIASNY).

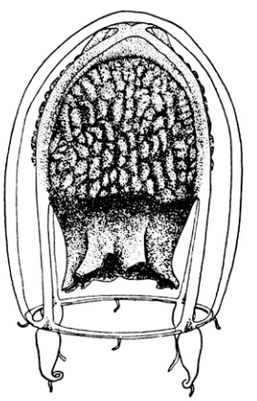


Fig. 108. *Merga reesi* (after RUSSELL).

lips; mesenteries very long; gonads adradial, smooth; 8—12 long tentacles and 24—36 rudimentary tentacles, all with ocelli.—Florida and Bahamas; Mediterranean Sea; India; north-eastern Australia; Fiji Islands; Pacific coast of Mexico. (MAYER 1910 pp. 119, 490, Pl. 11 fig. 7, Pl. 12 fig. 1; as *Pandea violacea*; HARTLAUB 1913 p. 249, fig. 204, as *Merga violacea,* p. 250, fig. 205, as *Mergintha lobianci* n. sp.).

Merga tergestina (NEPPI & STIASNY 1911). 7 mm high, 4 mm wide, with thin walls and a high, pointed apical projection; manubrium half to two-thirds as long as bell cavity; lips faintly crenulated; gonads adradial, smooth; mesenteries moderately long; 4—8 tentacles with ocelli and a few very small rudimentary bulbs without ocelli.—Adriatic Sea; Gulf of Guinea. (NEPPI & STIASNY 1913 p. 21, Pl. 1 fig. 10, as *Tiara tergestina*; HARTLAUB 1913 p. 253, fig. 209, as *Tiarula tergestina*).

Merga reesi RUSSELL 1956. 10 mm. high and wide, with fairly thin walls; no apical projection; stomach very large, almost as long as bell cavity, connected with the radial canals along almost whole length of perradial edges; gonads granulate, completely covering interradial walls of stomach; 4 perradial tentacles with large, conical basal bulbs and 4 interradial, tenon-like tentaculae. Stomach rich reddish brown.—Off the mouth of the English Channel, in deep water. (RUSSELL 1956*b* p. 493, fig. 1).

Amphinema HAECKEL 1879. Pandeidae with never more than two opposite, perradial tentacles; with marginal warts or tentaculae; no gastric peduncle; stomach with broad base, sessile; mouth with four simple lips; gonads adradial or interradial or extending along radial canals.—Type species: *A. dinema* (PÉRON & LESUEUR).

Key to the species of Amphinema.

1. Gonads folded, extending from adradial sides of stomach outwards along the radial canals; umbrella margin with tentaculae ..... *turrida.*
   Gonads on stomach only ..... 2.
2. Margin between tentacles with rudimentary warts ..... 3.
   Margin between tentacles with small, solid tentaculae ..... 4.
3. Tentacles and marginal warts with orange-red ocelli; gonads interradial ..... *australis.*
   Without ocelli; gonads adradial ..... *dinema.*
4. Umbrella with a large, solid apical projection; gonads adradial, folded ..... *rugosum.*
   Gonads interradial, smooth ..... 5.
5. Without apical projection ..... *krampi.*
   With a pointed apical projection ..... *rubra.*

Amphinema dinema (PÉRON & LESUEUR 1809). Up to 6 mm. high and 4 mm. wide, with large conical apical projection; stomach cross-like in section, flask-shaped, almost as long as bell cavity; four prominent, recurved lips. Gonads simple, adradial; 2 long tentacles with large, elongated conical basal bulbs; 14—24 small marginal warts; no ocelli.—Western Europe; North America from Cape Cod to Florida; Mediterranean; Gulf of Guinea; India; north-eastern Australia. (MAYER 1910 p. 109, Pl. 9 fig. 8—10, Pl. 10 fig. 1—4, as *Stomotoca dinema*; RUSSELL 1953 p. 180, Pl. 10 fig. 1, 2, 4, Pl. 11 fig. 1, 3, text-fig. 89). Synonyms: *A. apicatum* (MCCRADY 1857), *Tiarula coeca* HARTLAUB 1913.

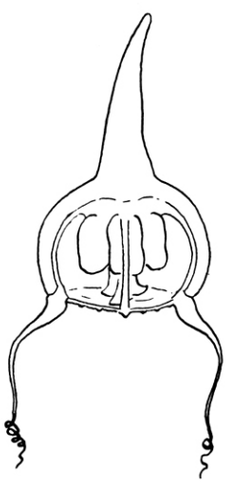


Fig. 109. *Amphinema dinema* (from PL. SH.).

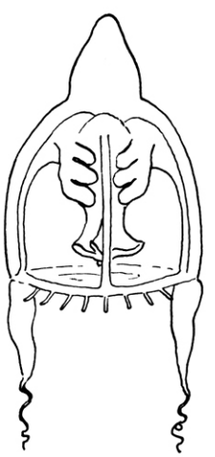


Fig. 110. *Amphinema rugosum* (from PL. SH.).

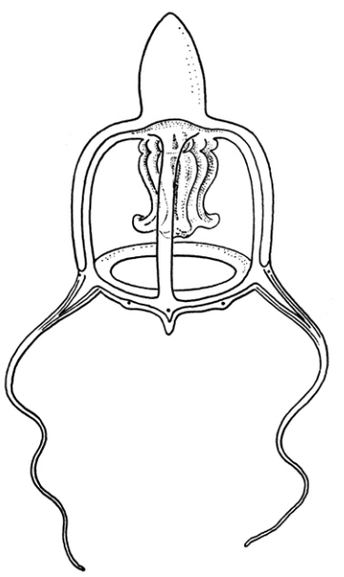


Fig. 111. *Amphinema australis* (after MAYER, redrawn by P. W.).

Amphinema rugosum (MAYER 1900). 5 mm. high, 3 mm. wide, with solid, elongated-conical or hemispherical apical projection; stomach cross-like in section, flask-shaped, almost as long as bell cavity; four prominent, recurved lips; gonads adradial, with 3—4 oblique folds; 2 long tentacles with large, elongated conical basal bulbs; 16—24 small, solid tentaculae; no ocelli.—North-western Europe; North America from Cape Cod to Florida; West-Indies; Adriatic Sea; Japan. (MAYER 1910 p. 112, Pl. 10 fig. 5, 6, Pl. 11 fig. 1, 2, as *Stomo-*

toca rugosa; HARTLAUB 1913 p. 258, fig. 214, 216, 217, as *A. dinema*; RUSSELL 1953 p. 183, Pl. 10 fig. 3, Pl. 11 fig. 2—4, text-fig. 90 A, B.).

Amphinema australis (MAYER 1900). 3 mm. high, 2.5 mm. wide, with well developed, sharp-pointed apical projection; manubrium urn-shaped, wide; four recurved lips; gonads interradial, smooth; 2 opposite tentacles, each with an orange-red, abaxial ocellus; 4—6 rudimentary marginal warts, one or two in each quadrant, with ocelli.—Florida and Bahamas; Pacific coast of Mexico. (MAYER 1910 p. 111, Pl. 11 fig. 5, 6, as *Stomotoca octaëdra*). This species is not identical with *Codonorchis octaëdrus* HAECKEL, see below.

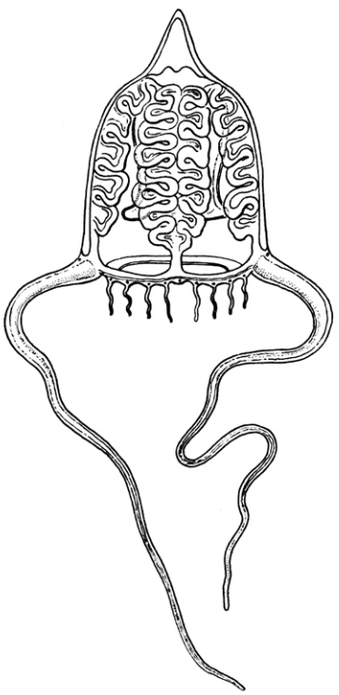


Fig. 112. *Amphinema turrida* (after MAYER, redrawn by P. W.).

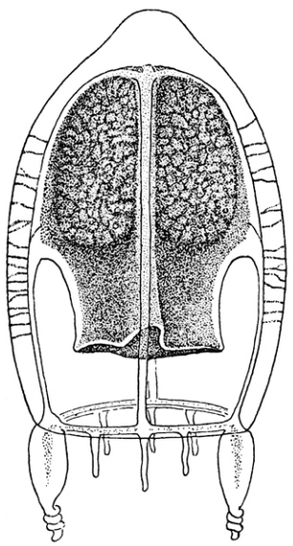


Fig. 113. *Amphinema krampi* (after RUSSELL).

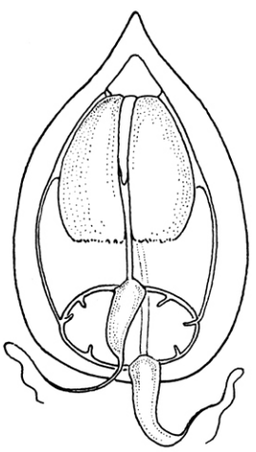


Fig. 114. *Amphinema rubra* (after KRAMP, redrawn by P. W.).

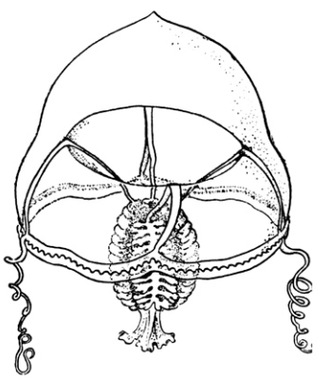


Fig. 115. *Stomotoca pterophylla* (after UCHIDA).

Amphinema turrida (MAYER 1900). 4—7 mm. high, somewhat higher than wide, with a conical, hollow apical projection; stomach pyriform, almost as long as bell cavity; four large, recurved, crinkled lips; gonads sac-like, folded, extending from adradial sides of stomach outwards along $^3/_4$ length of the radial canals; 2 long tentacles with elongated conical basal bulbs and 14 small, solid tentaculae, all with a red ocellus.—Florida and Bahamas; Pacific coast of Mexico; Torres Strait; Japan. (MAYER 1910 p. 116, Pl. 10 fig. 1, Pl. 22 fig. 1, as *Dissonema turrida*; MAYER 1915 p. 199, Pl. 1 fig. 1, as *Stomotoca turrida*).

Amphinema krampi RUSSELL 1956. 6 mm. high, 4 mm. wide, bell-shaped; no apical projection; stomach cross-like in section, $^2/_3$ as long as bell cavity, with long mesenteries; four simple lips; gonads four interradial, simple cushions; 2 tentacles with swollen, elongated basal bulbs; 8 marginal tentaculae; no ocelli. About 12 strands of cellular tissue from each radial canal to the exumbrella surface.—Off the mouth of the English Channel, deep water. (RUSSELL 1956*a* p. 371, fig. 1, 2 and 1958 p. 81, fig. 1—3).

Amphinema rubra (KRAMP 1957). 7 mm. high, 4.5 mm. wide, with fairly thick walls and a pointed apical projection; stomach large, barrel-shaped; mesenteries very long; mouth ?; gonads completely covering interradial walls of stomach; a broad conical apical chamber above stomach; 2 oposite tentacles with large, conical bulbs, ocelli not observed; 2 perradial and 4 interradial, tenon-like tentaculae. Stomach deep reddish-brown.—Antarctic, north of South Orkney Islands, in deep water. (KRAMP 1957 p. 14, Pl. 2 fig. 4).

Stomotoca L. AGASSIZ 1862. Pandeidae with 2 opposite, perradial tentacles and numerous marginal warts; stomach on broad peduncle, extending beyond bell cavity; gonads in eight adradial rows, well separated.—Type species: *S. atra* L. AGASSIZ.

Stomotoca pterophylla HAECKEL 1879. 10—12 mm. high, 20—30 mm. wide, conical, very thick at aboral pole, with a sharply-pointed apex; stomach large, swollen; mouth with four prominent, complexly crenulated lips; gonads complexly transversely folded; 2 very long opposite tentacles and 60—80 rudimentary marginal warts; no ocelli.—East coast of North America from Gulf of Maine to Florida; Bahamas; West-Indies; Sargasso Sea; Gulf of Guinea; Pacific coasts of Mexico, Panama, Colombia and Peru; Japan. (MAYER 1910 p. 113, Pl. 29 fig. 3—5, Pl. 30 fig. 7, as *S. pterophylla*; pp. 114, 490, fig. 61, as *S. divisa* MAAS).

Halitholus HARTLAUB 1913. Pandeidae with large, dome-like apical projection; manubrium cubical; gonads more or less horseshoe-shaped, folded; mouth-rim faintly crenulated; radial canals comparatively narrow, not or very slightly jagged; no mesenteries; 8 or more tentacles.—Type species *H. pauper* HARTLAUB.

Key to the species of Halitholus.

1. About 40 tentacles; no ocelli ..... *cirratus.*
   4—8 tentacles, with ocelli ..... 2.
2. Gonads with conspicuous horseshoe-fold; ocelli small ..... *pauper.*
   Horseshoe-fold of gonads faintly developed; ocelli large ..... *intermedius.*

Halitholus pauper HARTLAUB 1913. 10 mm. high, 9 mm. wide, with low, rounded apical projection; manubrium half as long as bell cavity; gonads with conspicuous horseshoe-fold; 4 large perradial and 4 small interradial tentacles, with small ocelli, and a few very small rudimentary bulbs.—Iceland, Greenland, and arctic Canada, Vancouver in western America; southern Kamchatka and northern Japan. (HARTLAUB 1913 p. 272, fig. 223, 224; KRAMP 1926 p. 71, Pl. 2 fig. 1—3).

Halitholus cirratus HARTLAUB 1913. 16 mm. high, 14 mm. wide, with large, globular apical projection; manubrium almost to velar level; about 40 tentacles; no ocelli.—Arctic, circumpolar; Baltic and Kattegat. (HARTLAUB 1913 p. 274, fig. 223, 224; KRAMP 1926 p. 74, Pl. 2 fig. 4).

Halitholus intermedius (BROWNE 1902). 9—10 mm. high, 7 mm. wide, with large, conical apical projection; manubrium $^1/_2$—$^2/_3$ as long as bell cavity; interradial horseshoe-fold merely indicated; 4 large perradial and

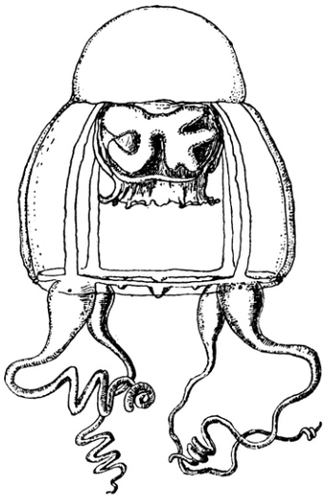


Fig. 116. *Halitholus pauper* (after HARTLAUB).

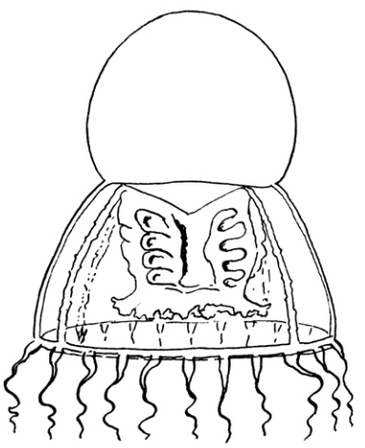


Fig. 117. *Halitholus cirratus* (from PL. SH.).

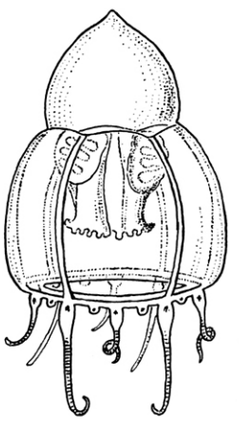


Fig. 118. *Halitholus intermedius* (after BROWNE & KRAMP, redrawn by P.W.).

4 smaller interradial tentacles and 8 adradial bulbs, all with conspicuous, red ocelli; also a variable number of minute marginal bulbs.—Falkland Islands; Cape of Good Hope. (BROWNE & KRAMP 1939 p. 288, Pl. 14 fig. 7, Pl. 16 fig. 1, 2).

Leuckartiara HARTLAUB 1913. Pandeidae usually with an apical projection of varying shape; with large stomach attached to radial canals by mesenteries; mouth with much folded or crenulated lips; gonads interradial, horseshoe-shaped with folds directed perradially; radial canals broad and ribbon-like, often with jagged edges; with numerous tentacles with elongated, laterally compressed basal bulbs; often with rudimentary tentacles.—Type species: *L. octona* (FLEMING). Synonyms: *Tiara* + *Turris* LESSON 1843, in part, both preoccupied.

Key to the species of Leuckartiara.

1. Mesenteries along whole length of stomach; no apical projection ..... *grimaldii.*
   Mesenteries along about half the length of the stomach; apical projection usually well developed 2.
2. Rudimentary tentacles club-shaped; 12—24 well developed tentacles with pronounced abaxial spurs; with ocelli ..... *octona.*
   No club-shaped rudimentary tentacles ..... 3.
3. About 40 tentacles with abaxial spurs; with ocelli ..... *nobilis.*
   100 or more densely crowded tentacles without abaxial spurs; without ocelli ..... *breviconis.*

Leuckartiara octona (FLEMING 1823). Up to 20 mm. high, higher than wide, with conical or spherical apical projection, lateral walls thin; manubrium broad, of varying length; gonads typical, on whole surface of stomach; mesenteries along about half the length of the stomach; radial canals with smooth or slightly jagged edges; tentacles 12—24, usually 16, each with a pronounced abaxial spur, and 16 or more rudiments which are club-shaped; tentacle bulbs and rudiments with red ocelli.—European coasts from Portugal to Lofoten in Norway; Iceland; North America from Labrador to Cape Cod; Mediterranean; west coast of Africa; Tristan du Cunha; India; Malayan Archipelago; north-estern Australia; Low Archipelago; China; Japan; Vancouver; Chile. (HARTLAUB 1913 p. 285, fig. 239—253; KRAMP 1926 p. 76, Pl. 2 fig. 5—7, text-fig. 35; RUSSELL 1953 p. 188, Pl. 11 fig. 5—6, Pl. 12 fig. 3, Pl. 31, text-fig. 91—96).

Leuckartiara nobilis HARTLAUB 1913. Up to 27 mm. high and 20 mm. wide, apical projection well developed; manubrium large, more than half as long as bell cavity; gonads typical, covering whole walls of stomach; mesenteries along half the length of the stomach; lips complexly folded; radial canals broad, with short lateral diverticula; about 40 tentacles of different size, well spaced, abaxial spurs faintly developed; no club-shaped marginal rudiments; ocelli dark red.—North-western Europe; north of the Azores; Newfoundland; Mediterranean; Vancouver on the west coast of North America. (HARTLAUB 1913 p. 308, fig. 257—260; KRAMP 1926 p. 83, Pl. 2 fig. 9, text-fig. 36 *a—e*; RUSSELL 1953 p. 195, Pl. 12 fig. 4, text-fig. 97).

Leuckartiara breviconis (MURBACH & SHEARER 1902). Up to 45 mm. high and 35 mm. wide, apical projection usually low and rounded; manubrium broad, more than half as long as bell cavity; gonads horseshoe-shaped with horizontal folds, usually only in upper half of stomach; radial canals jagged; 100 or more tentacles, densely crowded, fully developed alternating with smaller ones; bulbs laterally compressed, grasping border of umbrella, but without true spurs; no ocelli.—North-western Europe; Iceland; southern part of west coast of Greenland; Hudson Strait; Japan; Alaska; Vancouver. (HARTLAUB 1913 p. 304, fig. 254—256; KRAMP 1926 p. 80, Pl. 2 fig. 8; RUSSELL 1953 p. 198, Pl. 12 fig. 2, text-fig. 99—100). Some authors (HARTLAUB a. o.) have erroneously spelled the name brevicornis.

Leuckartiara grimaldii RANSON 1936, 16 mm high, 12 mm wide, thin walls, no apical projection; stomach very large, mesenteries along entire length ot stomach; gonads not observed; mouth folded; radial canals short, broad, slightly jagged; 24 tentacles and 32 small bulbs; ocelli not observed.—Azores. (RANSON 1936

p. 78, Pl. 1 fig. 7, 8). Described from a single badly preserved specimen and provisionally referred to *Leuckartiara*.

Leuckartiara abyssi (G. O. SARS 1874). Newly hatched medusa: globular, no apical projection; radial canals and ring canal fairly broad; 4 perradial tentacles, of which the two opposite are better developed than the two others. Hatched from the hydroid *Perigonimus abyssi* G. O. SARS.—Norway. (REES 1938 p. 19, fig. 6).

Cirrhitiara HARTLAUB 1913. Pandeidae with 4 or 8 large tentacles and a number of rudimentary marginal bulbs, each of which carries a lateral cirrus; all marginal bulbs with ocelli; gonads of Leuckartiara-type; long mesenteries.—Type species: *C. superba* (MAYER).

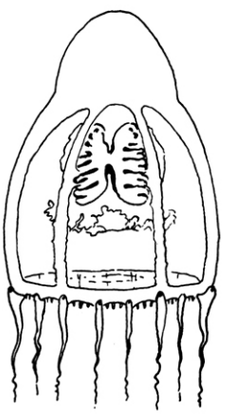


Fig.119. *Leuckartiara octona* (from PL. SH.).

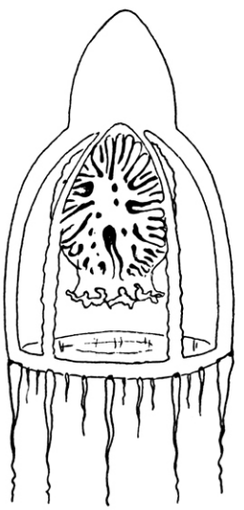


Fig. 120. *Leuckartiara nobilis* (from PL. SH.).

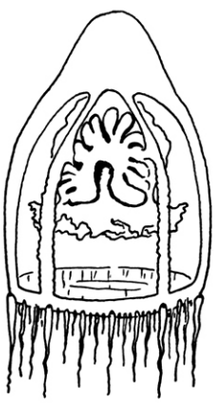


Fig. 121. *Leuckartiara breviconis* (from PL. SH.).

Cirrhitiara superba (MAYER 1900). 5—7 mm. high, with a well developed apical projection; manubrium wide, mouth with four recurved, folded lips; gonads interradial, horseshoe-shaped with diverging folds; four broad, flat, smooth-edged radial canals entering stomach by four wide, funnel-like openings; 4 long, hollow perradial tentacles with laterally compressed basal bulbs, and 12 small rudimentary bulbs, each with a small, solid cirrus on one side; occasionally 8 tentacles and 8 rudimentary bulbs; all marginal bulbs with an abaxial ocellus.—Florida and Bahamas; Brazil; north-eastern Australia. (MAYER 1910 p. 126, Pl. 27 fig. 8, Pl. 28 fig. 3, 4, as *Turris pileata* var. *superba*).

Annatiara RUSSELL 1940. Pandeidae with several tentacles of two sizes, regularly alternating; manubrium short and broad, cruciform, the four large lobes closely connected with the proximal half part or more of the four radial canals; gonads interradial, with several folds; mouth very broad, cruciform, with folded margin.—Type species: *A. affinis* (HARTLAUB). Synonym: *Tiaranna* HARTLAUB, in part.

Annatiara affinis (HARTLAUB 1913). 12 mm. high, 14—15 mm. wide, dome-shaped, no apical projection; manubrium very broad, cruciform, its four, perradial lobes along their entire length closely connected with the radial canals; mouth very wide, cruciform, with folded margin; gonads in irregular, vertical folds; about 32 primary tentacles with laterally compressed basal bulbs, alternating with minute tentacles; no ocelli.—Central and eastern Atlantic Ocean from N. W. of Scotland to the Cape of Good Hope, in deep water. (HARTLAUB 1913 p. 269, fig. 220, 221, as *Tiaranna affinis*; KRAMP 1920 p. 6, Pl. 1 fig. 1; KRAMP 1926 p. 68, Pl. 1 fig. 15—17).

Neoturris HARTLAUB 1913. Pandeidae with apical projection varying much in shape and size; manubrium large and wide, with well developed mesenteries; gonads in eight adradial series of transverse folds directed interradially, interradial portion of stomach with isolated pits of gonads; with 8 or more hollow tentacles with laterally compressed basal bulbs; without rudimentary tentacles or marginal warts.—Type species: *N. pileata* (FORSKÅL). Synonyms: *Tiara* + *Turris* LESSON 1843, in part, both preoccupied.

Neoturris pileata (FORSKÅL 1775). Up to 25 mm. wide and 40 mm. high, when the apical projection is well developed, but it is sometimes much reduced; manubrium large and broad, mouth with complexly

Fig. 122. *Cirrhitiara superba* (after MAYER, redrawn by P.W.).

Fig. 123. *Annatiara affinis* (from PL. SH.).

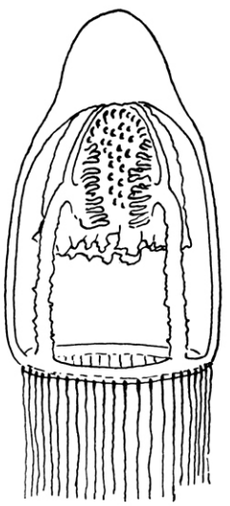


Fig. 124. *Neoturris pileata* (from PL. SH.).

folded and crenulated lips; gonads in numerous round pits on interradial sides of stomach between adradial series of transverse folds; mesenteries along proximal half part of the perradial edges of the stomach; radial canals broad, with short, sometimes branched lateral diverticula; ring canal smooth; numerous tentacles, usually 60—80, densely crowded, with laterally compressed, elongated basal bulbs without conspicuous abaxial spurs; no ocelli.—North-eastern Atlantic as far north as Iceland; Mediterranean; off the west coast of Africa as far south as 26° S.; a doubtful record from the Philippines. (HARTLAUB 1913 p. 326, fig. 270—281; RUSSELL 1953 p. 203, Pl. 12 fig. 1, text-fig. 104—106. Synonyms: *Turris digitalis* FORBES 1848, *Tiara pileata* HAECKEL 1879).

Catablema HAECKEL 1879. Pandeidae with large apical projection; stomach large, with broad base, with four short mesenteries; mouth with four large, crenulated lips; gonads broadly separated perradially, reticular, with irregular folds issuing from the perradial sides; radial canals broad, denticulated; with numerous tentacles; with abaxial ocelli.—Type species: *C. vesicarium* (A. AGASSIZ).

Catablema vesicarium (A. AGASSIZ 1862). Up to about 25 mm. wide and 30 mm. high, including the large, globular apical projection; gonads in irregular folds, oblique in lateral parts, almost perpendicular in middle part of each gonad, with densely reticulate surfaces; free portions of radial canals comparatively long; about 32 tentacles.—Arctic waters, in the western Atlantic penetrating as far south as Cape Cod; in the eastern Atlantic only as far as the north coast of Iceland and northern Norway; Aleutian Islands and Vancouver in northern Pacific. (MAYER 1910 p. 126, Pl. 12 fig. 2, 3, Pl. 13 fig. 7, as *Turris vesicaria*; HARTLAUB 1913 p. 315, fig. 263—267). Synonyms: *Catablema campanula* + *eurystoma* HAECKEL.

Catablema multicirrata KISHINOUYE 1910. Up to 35 mm. wide and 30 mm. high; with large apical projection; gonads predominantly in vertical folds, faintly reticulate; free portions of radial canals very broad and short; 100—155 tentacles.—West coast of Greenland; northern Pacific from Japan to Alaska. (BIGELOW 1913 p. 19, Pl. 1 fig. 4—7).

Pandea LESSON 1843. Pandeidae with or without apical projection; gonads reticulate, at first in the adradii and eventually encircling the stomach, forming complex network; lips wide and folded; long mesenteries; radial canals ribbon-like; with more than 8 tentacles.—Type species: *P. conica* (QUOY & GAIMARD).

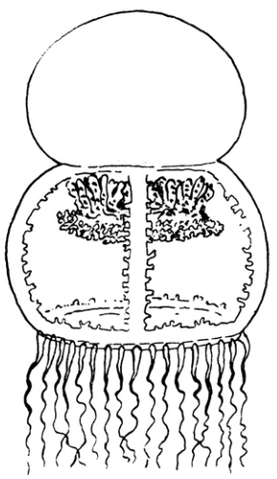


Fig. 125. *Catablema vesicarium* (from PL. SH.).

Fig. 126. *Catablema multicirrata* (after BIGELOW, from HARTLAUB).

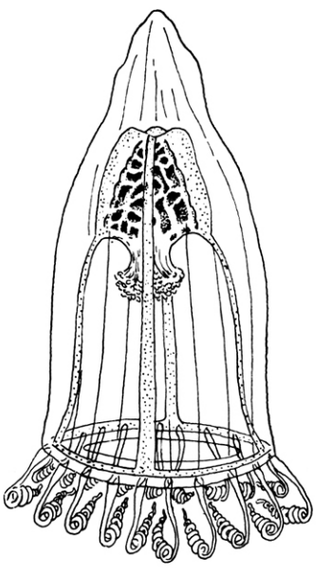


Fig. 127. *Pandea conica* (from PL. SH.).

Pandea conica (QUOY & GAIMARD 1827). Up to 21 mm. high and 10 mm. wide, with a conical apex terminating with a peculiar patch of thickened ectoderm; exumbrella with longitudinal ribs and ridges, manubrium about half as long as bell cavity, with short mouth tube and folded lips; radial canals smooth, mesenteries long; 16—24 tentacles with laterally compressed basal bulbs, each with an abaxial ocellus.—Mediterranean; Atlantic Ocean from Bermuda to South Africa and Patagonia; Philippines; southern Japan. (MAYER 1910 p. 118, fig. 63; HARTLAUB 1913 p. 338, fig. 286, 287).

Pandea rubra BIGELOW 1913. Up to 75 mm. high and wide, with fairly thin walls, no apical projection; manubrium wide, half as long as bell cavity; mouth cruciform, very complexly folded; gonads close network on entire interradial areas; radial canals jagged; up to 24 tentacles with large conical bulbs, not laterally compressed. Subumbrella, manubrium, velum and tentacles deep brownish red.—Distribution scattered: west of British Isles; Bermuda; south of Africa; Weddell Sea; Sea of Okhotsk and Kamchatka; north-eastern Pacific; in deep water. (BIGELOW 1913 p. 14, Pl. 2 fig. 1—7; RUSSELL 1953 p. 211, fig. 111, 112).

Eutiara BIGELOW 1918. Pandeidae with blind centripetal canals alternating with the radial canals; with well developed mesenteies; with complex gonads fundamentally of the "Neoturris" type.—Type species: *E. mayeri* BIGELOW.

Eutiara mayeri BIGELOW 1918. 18 mm. high, 14 mm. wide, dome-shaped, with thin walls, no apical projection; exumbrella with 8 radial ribs (hollow canals) from tentacle bulbs upward; manubrium more than half as long as bell cavity, connected with radial canals in almost whole length; gonads 8 adradial series of folds; radial canals broad, with more or less branched lateral diverticula; four interradial centripetal

canals with wavy margins; 8 tentacles and many small marginal knobs.—Near Chesapeake Bay on east coast of North America; West Indies. (BIGELOW 1918 p. 374, Pl. 1 fig. 1—5, Pl. 3 fig. 6; see also the present paper, p. 14).

Zanclonia HARTLAUB 1913. Pandeidae with long transversal diverticula on both sides of the four radial canals; with several tentacles provided with numerous stalked nematocyst knobs on their adaxial side.—Type species: *Z. weldoni* (BROWNE).

Zanclonia weldoni (BROWNE 1910). Up to 36 mm. high, bell-shaped, with thick walls and a rounded apex; stomach large, about half as long as bell cavity; mouth large with folded lips; four broad radial

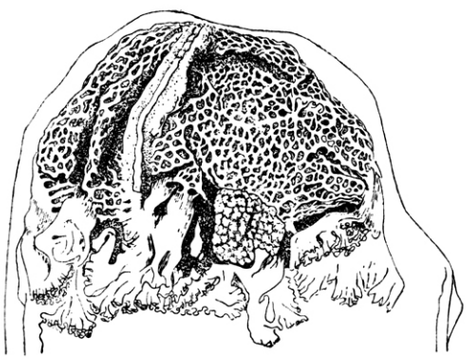


Fig. 128. *Pandea rubra*, manubrium (after BIGELOW, from HARTLAUB).

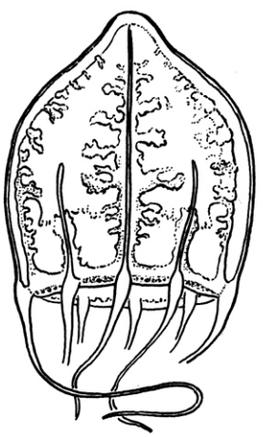


Fig. 129. *Eutiara mayeri* (after BIGELOW, redrawn by P. W.).

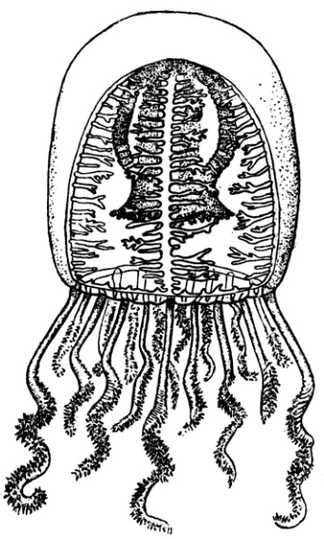


Fig. 130. *Zanclonia weldoni* (after BROWNE, from HARTLAUB).

canals, each with about 20 pairs of long diverticula at right angles to radial canals; gonads in 8 longitudinal rows of transverse folds; about 24—32 long tentacles, each with an adaxial series of filaments with nematocysts.—Antartic, circumpolar. (BROWNE 1910 p. 13, Pl. 1 fig. 1—5, as *Catablema weldoni*; HARTLAUB 1913 p. 313, fig. 261, 262, as *Zanclonia weldoni*).

Codonorchis HAECKEL 1879. Pandeidae with two opposite, perradial tentacles; without gastric peduncle and without mesenteries; gonads four flat, interradial lappets extending from the sides of the stomach outwards upon the subumbrella.—Type species, *C. octaedrus* HAECKEL.

Codonorchis octaedrus HAECKEL 1879. 2.5 mm. wide, 4 mm. high, with a high, cylindrical apical projection; bell margin with two very long, opposite tentacles and 10 rudimentary marginal bulbs, with ocelli.—Croisic, Atlantic coast of France. (HARTLAUB 1913 p. 265). MAYER 1910 p. 111 erroneously identified this species with his *Stomotoca australis*. The species has not been observed since it was described by HAECKEL, and it must be regarded as a doubtful species belonging to a doubtful genus.

Family **Calycopsidae.**

Anthomedusae without apical projection; without gastric peduncle; mouth with four simple or crenulated lips; with simple or folded gonads on stomach walls; with 4 simple or branched radial canals; with or without centripetal canals; with hollow marginal tentacles without basal swellings and each terminating in a large nematocyst cluster which, however, is frequently lost in preserved specimens.

Key to the genera.

1. With centripetal canals, blind or joining base of stomach ..... 2.
   Without centripetal canals ..... 3.
2. All tentacles hollow, nematocysts only in the terminal knob ..... *Calycopsis.*
   Two kinds of tentacles: large, hollow, with rings of nematocysts and a terminal knob, and small, solid, without terminal knob ..... *Eumedusa.*
3. Radial canals simple, unbranched, gonads smooth ..... *Heterotiara.*
   Radial canals branched; gonads folded ..... 4.
4. Radial canals bifurcated (some few additional branches may occur as abnormalities) .. *Bythotiara.*
   Radial canals branching repeatedly at various levels ..... *Sibogita.*

Heterotiara MAAS 1905. Calycopsidae with 4 simple radial canals; without centripetal canals; gonads purely interradial, without transverse folds; without secondary tentacles.—Type species: *H. anonyma* MAAS.

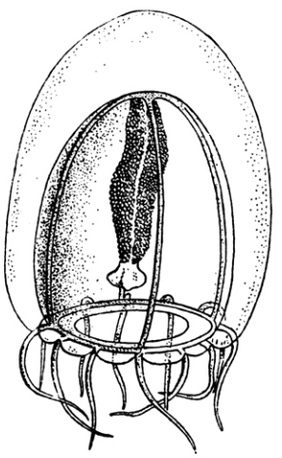


Fig. 131. *Heterotiara anonyma* (after BIGELOW, from HARTLAUB).

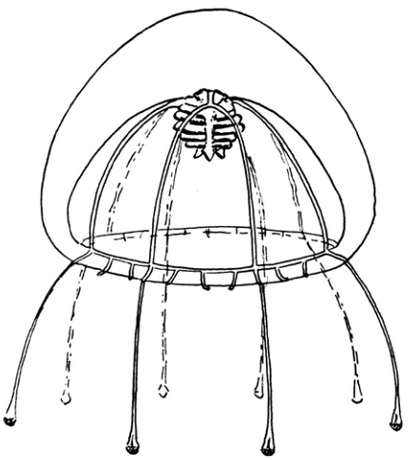


Fig. 132. *Bythotiara murrayi* (from PL. SH.).

Heterotiara anonyma MAAS 1905. Up to 22 mm. high and 20 mm. wide; with thick walls; 8—12 tentacles.—Bermudas and Bahamas; West Indies; west of the Azores; South Africa; Indian Ocean; Malayan Archipelago; northern Pacific; Peru. (BIGELOW 1909 *a* p. 216, Pl. 41 fig. 12, 13; MAYER 1910 pp. 107, 489).

Bythotiara GÜNTHER 1903. Calycopsidae with 4 bifurcate (or simple) radial canals; without centripetal canals; gonads interradial, with transverse furrows.—Type species: *B. murrayi* GÜNTHER. (A species in the Indian sector of the Antarctic Ocean has four simple, unbranched radial canals).

Bythotiara murrayi GÜNTHER 1903. About 20 mm. wide and high, with thick walls; stomach small, four interradial gonads with transverse furrows; radial canals generally four, bifurcate (but additional branching may occur); long tentacles as many as ends of radial canals; some small secondary tentacles and minute dwarf tentacles.—Mediterranean and eastern Atlantic from about 33° S. to $60^1/_2$° N., in deep water. (MAYER 1910 p. 185, fig. 97, 98; RUSSELL 1953 p. 215, Pl. 13 fig. 1, text-fig. 113 A, B, 114 A, B, 115, 116).

Calycopsis FEWKES 1882. Calycopsidae with primarily four unbranched radial canals and with four or more centripetal canals arising from the ring canal, blind or joining the cruciform base of the stomach; gonads transversely folded, frequently forming eight adradial rows of deep transverse furrows; basal portion of tentacles adnate to umbrella margin; all tentacles hollow, nematocysts only in the terminal knob.—Type species: *C. typa* FEWKES.—A revision of the species belonging to this genus is given in the present paper, pp. 18—26.

Key to the species of Calycopsis.

1. Umbrella with a funnel-shaped apical depression; 3—4 centripetal canals in each quadrant; 16—30 tentacles ..... *typa.*
   Umbrella without an apical depression ..... 2.
2. With only 4 perradial tentacles; one interradial centripetal canal in each quadrant ..... *krampi.*
   With 8 or more tentacles ..... 3.
3. Gonads in pockets; one interradial centripetal canal in each quadrant; 8—16 tentacles *borchgrevinki.*
   Gonads in exterior folds ..... 4.
4. Marginal lobes between tentacles with well-marked exumbral papillae; 2 centripetal canals in each quadrant; 8—12 tentacles ..... *papillata.*
   Marginal lobes without well-marked papillae ..... 5.
5. Gonads in few, irregular transverse folds; one centripetal canal in each quadrant; 8 tentacles, all alike ..... *simplex.*
   Gonads in eight adradial rows of deep transverse folds; more than 8 tentacles ..... 6.
6. Numerous centripetal canals, 7 or more in each quadrant, most of them joining base of stomach or upper part of neighbouring canals; 16—32 tentacles ..... *chuni.*
   One or two centripetal canals in each quadrant ..... 7.
7. One centripetal canal in each quadrant, blind; 8 long and several small tentacles ..... *bigelowi.*
   One or two centripetal canals in each quadrant, joining base of stomach; about 50 long tentacles *gara.*

Calycopsis simplex KRAMP & DAMAS 1925. 8 mm. high and wide, globular; gonads in few transverse folds; 4 blind, interradial centripetal canals; 8 tentacles, all alike.—Norway, in deep water. (KRAMP & DAMAS 1925 p. 282, fig. 23—25).

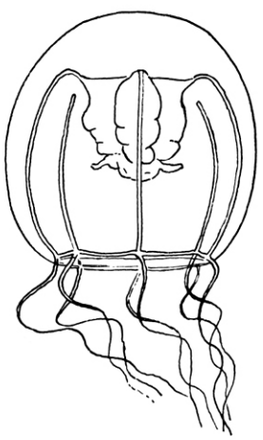


Fig. 133. *Calycopsis simplex* (from PL. SH.).

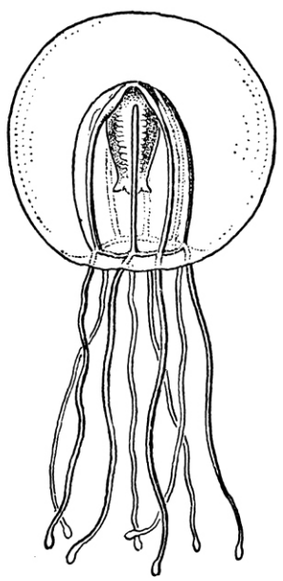


Fig. 134. *Calycopsis borchgrevinki* (after VANHÖFFEN, redrawn by P. W.).

Calycopsis borchgrevinki (BROWNE 1910). 20 mm. high, 15—18 mm. wide; gonads in pockets, embedded in the walls of the stomach; 4 interradial centripetal canals, blind or joining base of stomach; 8—16 tentacles.—Antarctic and subantarctic, circumpolar. (BROWNE 1910 p. 17, Pl. 2 fig. 1—5; VANHÖFFEN 1911 p. 215, Pl. 22 fig. 7, text-fig. 10 *a*, *b*).

Calycopsis krampi PETERSEN 1957. 5 mm. high, 3 mm. wide, jelly very thick; manubrium large; gonads slightly folded; 4 interradial centripetal canals; 4 perradial tentacles, the base of each tentacle with a pro-

minent projection on the adaxial side pointing inwards into the bell cavity.—Outside the mouth of the English Channel. (PETERSEN 1957 p. 31, fig. 2).

Calycopsis bigelowi VANHÖFFEN 1911. 16 mm. high and wide; jelly thick; gonads with about 10 transverse folds in each of the adradial rows; 4 interradial centripetal canals, blind; 8 long and numerous, up to 40, small tentacles, all tentacles structurally alike.—West of the Cape of Good Hope; Gulf of Aden; in deep water. (VANHÖFFEN 1911 p. 218, text-fig. 12).

Calycopsis gara PETERSEN 1957. 11 mm. high, 9 mm. wide, jelly fairly thick; gonads with 15—16 transverse folds in each row; one interradial or two adradial centripetal canals in each quadrant, all joining base of stomach; about 50 long tentacles.—Central part of northern Atlantic. (PETERSEN 1957, p. 29 fig. 1).

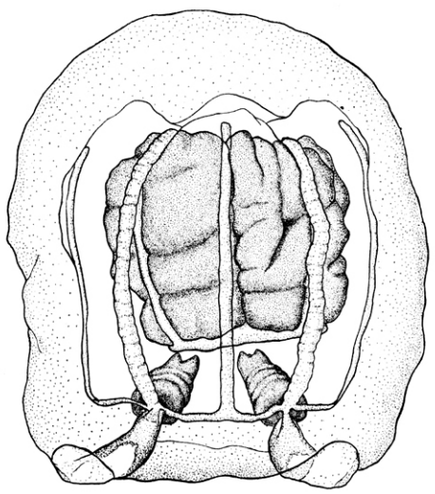


Fig. 135. *Calycopsis krampi* (after PETERSEN).

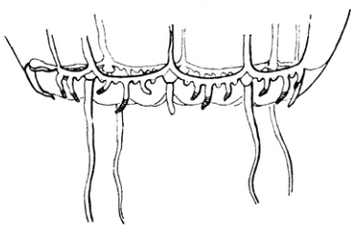


Fig. 136. *Calycopsis bigelowi*, bell margin (after VANHÖFFEN, from HARTLAUB).

Calycopsis papillata BIGELOW 1918. 27—33 mm. high, 26 mm. wide, jelly very thick and rigid; each of the marginal lobes between the tentacles with a group of prominent gelatinous papillae; 8 centripetal canals, usually adradial in position, blind or joining base of stomach; 8—12 tentacles, all alike.—Florida; West Indies; west coast of Africa; ? western part of Indian Ocean. (BIGELOW 1918 p. 378, Pl. 2 fig. 1—7, Pl. 3 fig. 1; KRAMP 1955 p. 252, Pl. 1 fig. 2, 3).

Calycopsis typa FEWKES 1882. Up to 37 mm. high and 40 mm. wide, jelly not very thick; a deep funnel-shaped depression in the apical jelly; stomach large, broad, mouth with large, folded lips; gonads with numerous transverse folds in each row; 12—16 centripetal canals, blind or joining base of stomach; 16 long tentacles and up to 16 small ones.—New England south of Cape Cod; Cape Verde on west coast of Africa. (BIGELOW 1909 *b* p. 206, Pl. fig. 1—8, as *Sibogita nuarchus*; BIGELOW 1913 p. 21, as *Calycopsis typa*).

Calycopsis chuni VANHÖFFEN 1911. Up to 38 mm. high and 30 mm. wide, jelly thick and rigid; manubrium about half as long as bell cavity, lips fairly short, crenulated; gonads with 19—32 transverse folds in each row; 28—56 centripetal canals, most of them communicating either directly with the base of the stomach or with neighbouring canals close by the stomach; 16—32 tentacles.—West, south and east coast of Africa; West Indies. (VANHÖFFEN 1911 p. 214, pl. 22 fig. 6, as *Calycopsis typa*, p. 217, Pl. 22 fig. 8, as *C. chuni*; HARTLAUB 1913 p. 360, as *C. valdiviae*; see also the present paper p. 23.

Sibogita MAAS 1905. Calycopsidae with primarily four radial canals which branch repeatedly at various levels; without centripetal canals; gonads transversely folded.—Type species: *S. geometrica* MAAS. Synonym: *Calycopsis*, in part.

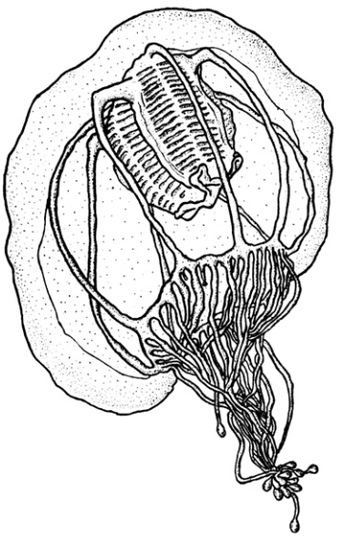
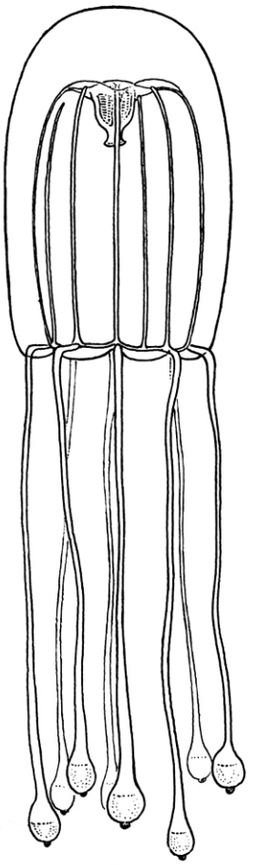


Fig. 137. *Calycopsis gara* (after PETERSEN).

b



a

Fig. 138. *Calycopsis papillata*; *a*, medusa (after KRAMP, redrawn by P. W.); *b*, part of bell margin showing gelatinous warts (after BIGELOW, redrawn by P. W.).

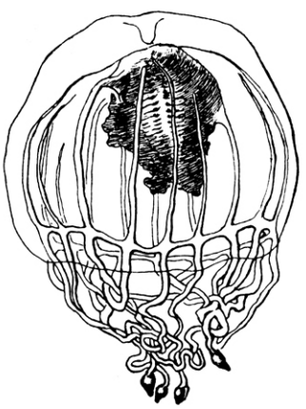


Fig. 139. *Calycopsis typa* (after BIGELOW, from HARTLAUB).

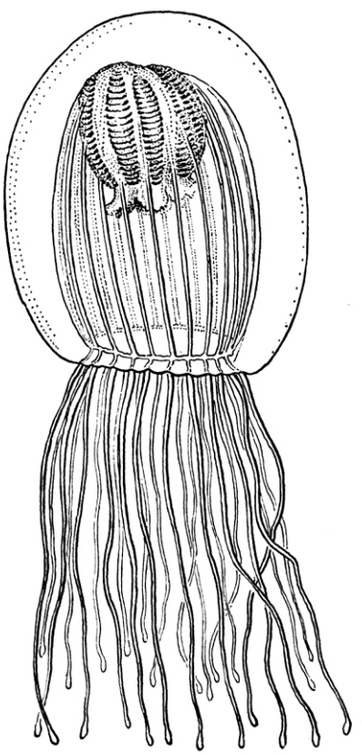


Fig. 140. *Calycopsis chuni* (after VANHÖFFEN, redrawn by P. W.).

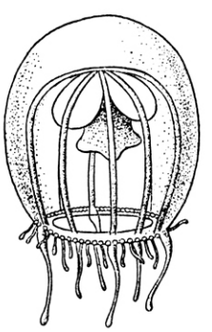


Fig. 141. *Eumedusa birulai* (after LINKO, from JASCHNOW).

Sibogita geometrica MAAS, var. *occidentalis* KRAMP. About 30 mm. high and up to 40 mm. wide, jelly fairly thick; manubrium very small; mouth with four small, simple lips; gonads in 8 adradial rows, about 6 transverse folds in each row; radial canals repeatedly dichotomously branched at various levels, 34—43 canals joining the ring canal; about 30 large tentacles alternating with as many small ones, each flanked by a pair of minute wart-like protuberances.—Azores; Bay of Biscay. (Described in the present paper, p. 28, Pl. I fig. 11, 12, Pl. II fig. 2, 3).

The typical form occurs in the Malayan Archipelago and at the Philippines.

Eumedusa BIGELOW 1920. Calycopsidae with primarily 4 unbranched radial canals and with 4 (or more?) centripetal canals arising from the ring canal; gonads folded; with two kinds of tentacles, large hollow tentacles with rings of nematocysts and a terminal knob, and small solid tentacles without a terminal knob.—Type species: *E. birulai* (Linko).

Eumedusa birulai (LINKO 1913). Up to 13 mm. high and 10 mm. wide; gonads irregularly folded; 4 interradial centripetal canals joining base of stomach in adult specimens; 8 or 16 long tentacles, hollow, with a terminal knob of nematocysts; numerous small, solid tentacles without terminal knob.—Arctic, Kara Sea to Alaska. (BIGELOW 1920 p. 7, Pl. 1 fig. 4, 5, Pl. 2 fig. 1, 2, as *Eumedusa similis*; JASCHNOV 1939 pp. 110, 113, as *Calycopsis birulai*).

Family **Russelliidae.**

Anthomedusae with unbranched oral tentacles without terminal clusters of nematocysts, situated above the mouth opening; mouth with simple perradial lips; with groups of hollow, marginal tentacles without basal swellings, partly sunk into narrow fissures of the umbrella margin; with adaxial ocelli.

Russellia KRAMP 1957. Russelliidae with an apical projection; with cruciform stomach mounted upon a peduncle; with four pointed oral tentacles; with eight smooth, adradial gonads; with four simple radial canals; with eight groups of marginal tentacles, each group with one large and two small tentacles, the basal part of the large tentacle sunk into a deep furrow of the umbrella margin; with an adaxial ocellus at the base of the free portion of the tentacle.—Type species: *R. mirabilis* KRAMP.

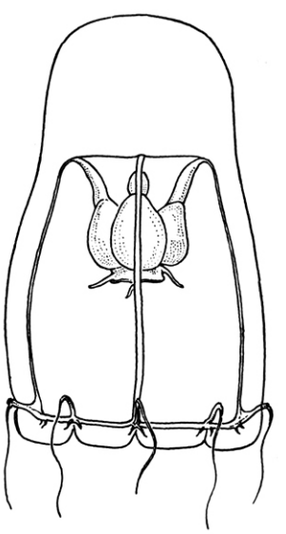


Fig. 142. *Russellia mirabilis* (after KRAMP, redrawn by P.W.).

Russellia mirabilis KRAMP 1957. 9 mm. wide, 15 mm. high including the large apical projection; stomach cruciform, about half as long as the height of the bell cavity, mounted upon a short, broad peduncle; gonads eight adradial, smooth, occupying entire length of stomach; mouth quadrangular, with very short perradial lips; four perradial oral tentacles inserted above the mouth, finger-shaped, pointed, with scattered nematocysts along entire length; four perradial and four interradial, hollow tentacles, their basal part deeply sunk into a narrow fissure between two prominent lobes of the umbrella margin, each with an adaxial red ocellus, and each flanked by a pair of small tentacles of similar structure.—Graham Land and near South Georgia in the Antarctic; West Indies; partly in deep water. (KRAMP 1957 p. 24, Pl. 4 fig. 1—6; see also the present paper p. 30).

Family **Tiarannidae.**

Anthomedusae without apical projection and without gastric peduncle; with large, cruciform stomach; mouth with simple or folded lips; with four radial canals; with folded gonads on the walls of the stomach and its perradial lobes; with numerous hollow marginal tentacles with conical basal bulbs; with marginal hollow, spindle-shaped cordylus-like structures with nematocysts at distal end; without ocelli.

The cordylus-like structures are particularly characteristic of the Tiarannidae, which forms an intermediate family between the Pandeidae in the Anthomedusae and the Laodiceidae in the Leptomedusae.

Key to the genera.

Gonads connected in the interradii of the stomach ..... *Tiaranna.*
Gonads separated in the interradii ..... *Chromatonema.*

Tiaranna HARTLAUB 1913. Tiarannidae in which the gonads are lateral folds on both sides of the perradial stomach lobes and connected in the interradii.—Type species: *T. rotunda* (QUOY & GAIMARD).

Tiaranna rotunda (QUOY & GAIMARD 1827). About 20 mm. wide, somewhat less in height; jelly thick, apex evenly rounded; manubrium broad, cruciform, perradial edges of stomach in their entire length connected with subumbrella; mouth with four large, slightly crenulated lips; gonads in regular transverse folds on interradial walls of stomach extending outwards along the perradii; 16—28 tentacles with conical bulbs; between successive tentacles 2—3 minute spindle-shaped cordylus-like appendages with distal bundle of nematocysts.—Northern Atlantic to Davis Strait and west coast of Norway; North Sea; Straits of Gibraltar; Gulf of Guinea; off Patagonia; near the Antarctic Continent south of Australia; mainly in deep water. (HARTLAUB 1913 p. 266, fig. 218, 219, as *Tiaranna rotunda*; 1917 p. 411, fig. 341—343, as *Rotundula brochi*; KRAMP 1920 p. 6, Pl. 1 fig. 2—4; RUSSELL 1953 p. 219, text-fig. 117—119).

Two unrecognizable species from British waters, *Oceania globulosa* FORBES 1848 and *Oceania ducalis* FORBES & GOODSIR 1853, were referred to *Tiaranna* by HARTLAUB 1913 p. 270 and 1917 p. 362. *Tiaranna affinis* HARTLAUB 1913 belongs to the Pandeidae and is mentioned above as *Annatiara affinis.*

Chromatonema FEWKES 1882. Tiarannidae in which the gonads are eight series of sac-like invaginations from the surface of the perradial stomach lobes, and separated in the interradii.—Type species: *C. rubrum* FEWKES.

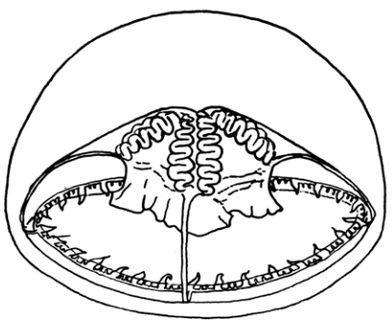


Fig. 143. *Tiaranna rotunda* (from PL. SH.).

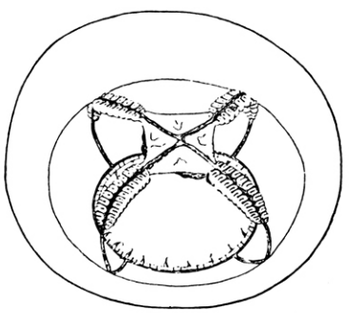


Fig. 144. *Chromatonema rubrum* (from PL. SH.).

Chromatonema rubrum FEWKES 1882. Up to 27 mm. wide and 22 mm. high; jelly thick, apex evenly rounded; manubrium broad, quadrangular, with four perradial lobes extending for half or two-thirds the distance towards bell margin; mouth with four short, slightly crenulated lips; 10—16 sac-like gonads on each side of each stomach lobe, hanging down into cavity of stomach lobe; 20—24 tentacles with conical bulbs; between successive tentacles two, rarely one, minute cordylus-like appendages with distal bundle of nematocysts.—Northern Atlantic to Davis Strait and south coast of Iceland; Azores; Bermuda; South Africa; Atlantic and Indian sectors of the Antarctic Ocean; in deep water. (KRAMP 1919 p. 7, Pl. 1 fig. 1—8, text-fig. 3, 4 *a*; 1947 p. 52, Pl. 6 fig. 7; RUSSELL 1953 p. 223, text-fig. 120, 121).

II. Order **Leptomedusae.**

Hydromedusae with umbrella usually hemispherical or flattened; with gonads on radial canals; marginal sense organs, when present, in form of cordyli or marginal vesicles of ectodermal origin; occasionally with ocelli.

Key to the families of Leptomedusae.

1. With no marginal sense organs ..... 2.
   With marginal sense organs, either cordyli or marginal vesicles ..... 3.
2. Base of stomach broad, attached over its whole surface; with 8 simple radial canals *Melicertidae.*
   Base of stomach narrow; radial canals either branched or, if simple, irregularly arranged *Dipleurosomidae.*
3. With marginal cordyli ..... *Laodiceidae.*
   With marginal vesicles; without cordyli ..... 4.
4. Marginal vesicles open ..... *Mitrocomidae.*
   Marginal vesicles closed ..... 5.
5. With a distinct gastric peduncle ..... 6.
   Without a distinct gastric peduncle ..... 7.
6. With numerous marginal vesicles; gonads restricted to umbrellar portion of radial canals; tentacle bulbs usually with excretory pores ..... *Eirenidae.*
   Marginal vesicles usually 8; if more, the gonads extend from bell-margin down along the peduncle almost to the stomach; no excretory pores ..... *Eutimidae.*
7. Stomach very broad; with many radial canals; tentacle bulbs with excretory pores ... *Aequoreidae.*
   Stomach narrow; with (normally) 4 or 8 radial canals ..... 8.
8. Tentacle bulbs with excretory pores; 4—8 radial canals ..... *Phialuciidae.*
   Without excretory pores; 4 radial canals ..... 9.
9. Tentacle bulbs with lateral cirri ..... *Lovenellidae.*
   Without cirri ..... 10.
10. Gonads divided into two lateral parts separated by a median groove; 8 marginal vesicles.. *Phialellidae.*
    Gonads completely surrounding radial canals; 8 or more marginal vesicles..... *Campanulariidae.*

Family **Dipleurosomidae.**

Leptomedusae with 3, 4 or more radial canals, either branched or, if simple, irregularly arranged; with hollow marginal tentacles; without marginal or lateral cirri; without any kind of marginal sense organs. Hydroid, where known, *Cuspidella*-like.

Key to the genera.

1. Radial canals regularly branched, all branches reaching ring canal ..... 2.
   Radial canals irregularly arranged, simple or irregularly branched..... *Dipleurosoma.*
2. With 8 main radial canals bifurcating once; gonads adjacent to stomach ..... *Netocertoides.*
   With 4 main radial canals, branched ..... 3.
3. The four main canals not continued perradially to ring canal, but each divided into two canals with lateral branches; gonads adjacent to stomach..... *Dichotomia.*
   The four main canals continued perradially to ring canal giving rise to lateral branches; gonads on distal parts of the canals ..... 4.
4. Each of the four radial canals with one pair of simple, unbranched lateral branches .... *Cannota.*
   Main canals as well as lateral branches repeatedly branched ..... *Cuvieria.*

Dipleurosoma BOECK 1866. Dipleurosomidae with three or more main radial canals, some or all of which branch irregularly (not regularly and dichotomously) and join the ring canal; gonads on proximal parts of the radial canals adjacent to stomach; with numerous tentacles; ocelli may be present.—Type species: *D. typicum* BOECK.

Among the species mentioned by MAYER (1910) *D. collapsa* should possibly be referred to *Orchistoma* (Laodiceidae), and *D. brooksi* is a *Toxorchis* (Laodiceidae). *D. gemmifera* THIEL (1938) has marginal vesicles and belongs to the Eucopida.

Key to the species of Dipleurosoma.

12—16 well developed and about 35 rudimentary tentacles, each basal bulb flanked by club-shaped appendages ..... *ochracea.*
About 100 tentacles without club-shaped appendages ..... *typicum.*

Dipleurosoma typicum BOECK 1866. 8—12 mm. wide, flatter than a hemisphere; stomach very variable in shape; 5—18 main radial canals, simple or irregularly branching, narrow; 1—12 gonads, most frequently 5, on proximal parts of radial canals; more than 100 tentacles, each with an adaxial ocellus.—North-western Europe; Newfoundland. (MAYER 1910 p. 224; RUSSELL 1953 p. 251, text-fig. 143—146). Synonyms: *D. stuvitzii* BOECK 1866, *hemisphaericum* (ALLMAN 1873), *irregulare* HAECKEL 1879. *D. amphitectum* HAECKEL 1879 may be an abnormal specimen of *D. typicum*, but RUSSELL (p. 256) is inclined to retain it provisionally, because its radial canals branch between the gonads and the bell margin; it was found in Sognefjord, Norway.

Dipleurosoma ochracea MAYER 1910. 8 mm. wide, flatter than a hemisphere, thin; stomach flat, mouth with 6 or more lips; about 6—9 radial canals, irregular, partly branched; gonads not observed; 12—16 well developed and about 35 rudimentary tentacles, with hollow, conical bulbs, each bulb flanked by a pair of large club-shaped appendages and with one sausage-shaped diverticulum above each bulb; ocelli not observed.—Florida. (MAYER 1910 p. 226, Pl. 29 fig. 1, 2).

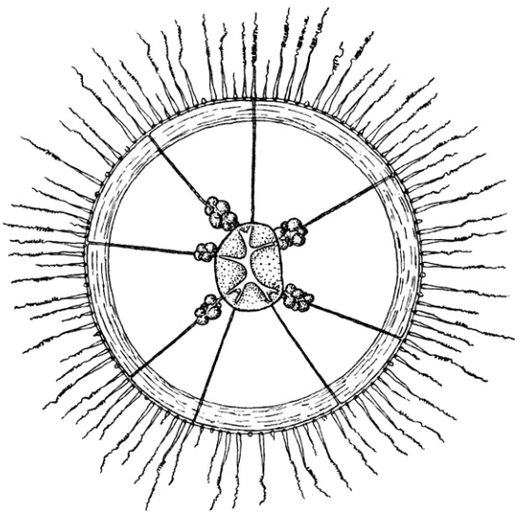


Fig. 145. *Dipleurosoma typicum* (after KRAMP).

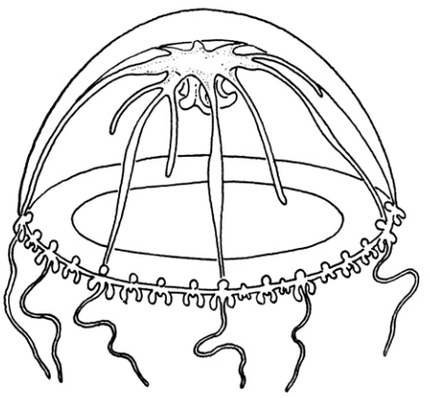


Fig. 146. *Dipleurosoma ochracea* (after MAYER, redrawn by P. W.).

Dipleurosoma collapsa (MAYER 1900). 7 mm. high and wide, apex dome-shaped, side walls vertical; stomach on a large and prominent peduncle; mouth with 8 slightly crenated lips; 16 radial canals in four groups of four each; gonads in proximal parts of radial canals; 16 well developed and 112 rudimentary tentacles, all with endodermal pigment spots.—Florida and Bahamas. (MAYER 1910 p. 226, Pl. 27 fig. 1—3 and 7). This is probably not a *Dipleurosoma*; it resembles some species of *Orchistoma* among the Laodiceidae, and if the "rudimentary tentacles" turn out to be cordyli, it should be transferred to that family.

Netocertoides MAYER 1900. Dipleurosomidae with 8 main radial canals bifurcating once; gonads on main radial canals adjacent to stomach.—Type species: *N. brachiatum* MAYER.

Netocertoides brachiatum MAYER 1900. 4—5 mm. high, higher than wide; stomach broad and disk-like, mouth with four simple lips; 8 main radial canals bifurcated once; 16 long, hollow tentacles opposite the 16 canals, 16—25 small tentacles.—Bahamas and Florida. (MAYER 1910 p. 229, Pl. 27 fig. 4—6).

Dichotomia BROOKS 1903. Dipleurosomidae with 4 main radial canals bifurcating into two diverging branches, each of which gives rise to lateral branches all reaching ring canal; gonads adjacent to stomach extending outwards along the canals and their branches.—Type species: *D. cannoides* BROOKS.

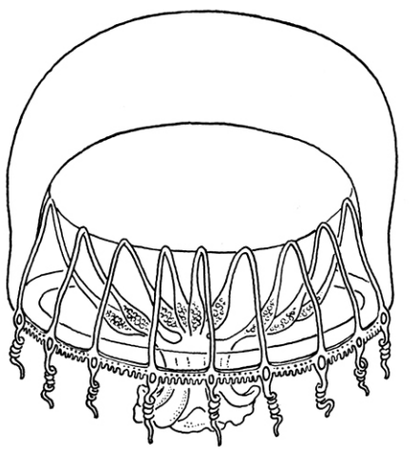


Fig. 147. *Dipleurosoma collapsa* (after MAYER, redrawn by P. W.).

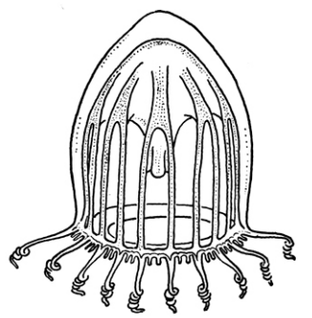


Fig. 148. *Netocertoides brachiatum* (after MAYER, redrawn by P. W.).

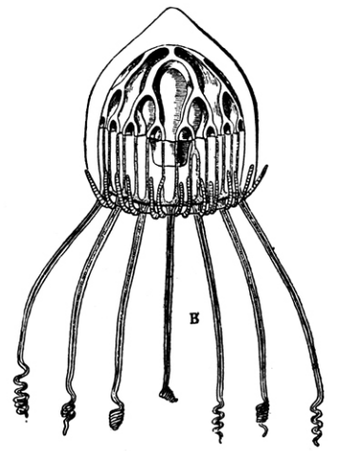


Fig. 149. *Dichotomia cannoides* (after BROOKS, from MAYER).

Dichotomia cannoides BROOKS 1903. 8 mm. high, 6 mm. wide, with conical apex; the four main radial canals arise in pairs from the ends of a short transverse canal; they are divided near the base of the stomach into two widely diverging branches, each giving rise to lateral branches, so that about 32 canals join the ring canal; gonads on the canals and their branches; up to 50 tentacles of different sizes, densely crowded.—Bahamas; West Indies. (MAYER 1910 p. 223, text-fig. 116; see also the present paper p. 32).

Cannota HAECKEL 1879. Dipleurosomidae with 4 radial canals, each giving rise to two simple, unbranched lateral branches which join the ring canal on either side of the main canal; 12 gonads on the distal part of the four main canals and side branches.—Type species: *C. dodecantha* HAECKEL.

Cannota dodecantha HAECKEL 1879. 4 mm. high and wide, flatly conical; stomach cubic, mouth with four small, folded lips; in the middle of each of the four radial canals one pair of lateral branches issuing at right angles and joining the ring canal at equal distances from the main canal; 12 spindle-shaped gonads in the distal parts of the canals; 12 long tentacles.—Gulf of Guinea. (HAECKEL 1879 p. 151). MAYER, 1910 p. 221, erroneously identified this species with *Staurodiscus nigricans* AGASSIZ & MAYER 1899 from the Fiji Islands.

Cuvieria PÉRON 1807. Dipleurosomidae with 4 main radial canals which branch repeatedly, all branches joining ring canal; gonads on terminal branches of canals.—Type species: *C. carisochroma* PÉRON. Synonym: *Berenice* ESCHSCHOLTZ 1829.

Cuveria carisochroma PÉRON 1807. 20—50 mm. wide, flatter than a hemisphere; stomach small, mouth with four short lips; in the middle of each of the four radial canals one pair of lateral branches; these as well as the main canal are further profusely branched in their distal portions, 50—60 or more canals joining

ring canal; gonads on the terminal branches of all the canals; 50—100 or more long tentacles.—Equatorial Atlantic; Cape Verde Islands. (MAYER 1910 p. 222, text-fig. 114). Synonyms: *Berenice rosea* ESCHSCHOLTZ 1829, *Berenice capillata* HAECKEL 1879.

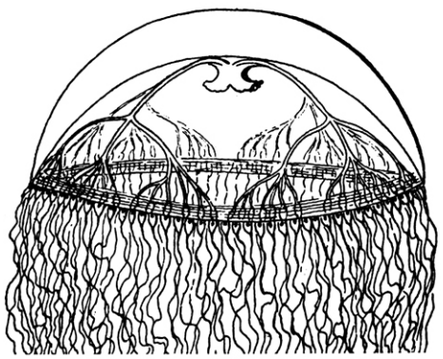


Fig. 150. *Cuvieria carisochroma* (after HAECKEL, from MAYER).

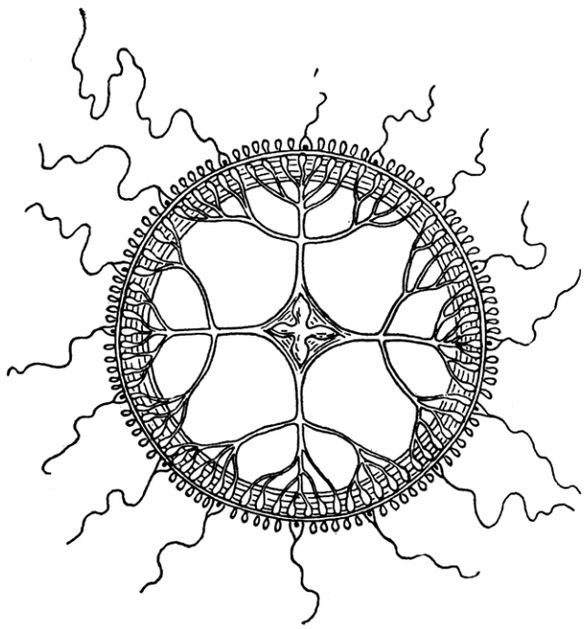


Fig. 151. *Cuvieria huxleyi* (after HAECKEL, from MAYER).

Cuvieria huxleyi (HAECKEL 1879). 16 mm. wide, 4 mm. high; stomach small, four short lips; about 70 terminal branches of radial canals; gonads on these terminal branches; 16 long tentacles with ocelli; 80—100 marginal "clubs".—Azores. (MAYER 1910 p. 222, text-fig. 115). If the small marginal appendages between the long tentacles really are "clubs", this species might be transferred to *Toxorchis* (Laodiceidae); if they are only the basal bulbs of broken tentacles, the species may remain in *Cuvieria* and may even be identical with *C. carisochroma*.

Family **Melicertidae.**

Leptomedusae with base of stomach attached over its whole surface; with 8 simple radial canals; with gonads on radial canals separated from stomach; with hollow marginal tentacles; without marginal cirri; without any kind of marginal sense organs.

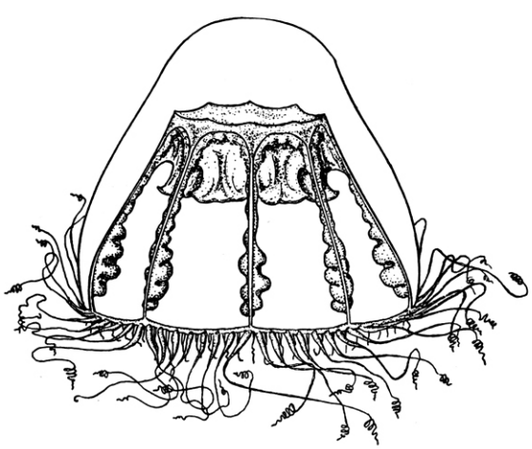


Fig. 152. *Melicertum octocostatum* (after KRAMP).

Melicertum L. AGASSIZ. With the characters of the family.—Type species: *M. octocostatum* (M. SARS). Synonym: *Melicertidium* HAECKEL 1879.

Melicertum octocostatum (M. SARS 1835). 10—14 mm. high and wide, conical to pyriform with thick, solid apex and thinner sides; in each octant 3—7 fine lines of nematocysts on subumbrella; stomach short and broad, octagonal, mouth with 8 small lips; 8 sinuous, linear gonads on radial canals almost to bell margin; about 64—72 large tentacles alternating with as many small ones; no ocelli.—North-western Europe from English Channel to Murman Coast; Iceland; North America from Woods Hole to Halifax; west coast of Greenland; northern Japan; ? Vancouver on Pacific coast of North America

(*M. georgicum* A. AGASSIZ). (MAYER 1910 p. 207, Pl. 23 fig. 4, 5, Pl. 24 fig. 5, as *M. campanula*, p. 208 as *M. octocostatum*; RUSSELL 1953 p. 245, Pl. 13 fig. 2—4, text-fig. 138—142). Synonym: *M. campanula* L. AGASSIZ 1862. RUSSELL (1953) is inclined to keep the two species separate, because their hydroids are different, providing the description of the hydroid given by AGASSIZ is correct.

Melicertum panocto (HAECKEL 1879) is a doubtful species, distinguished by having only 8 long tentacles with very large, globular bulbs with ocelli; it may possibly be a mutilated specimen of *Melicertissa clavigera* (Laodiceidae) having lost its cordyli.—Azores. (MAYER 1910 p. 209).

Family **Laodiceidae.**

Leptomedusae with marginal cordyli; without marginal vesicles.

Key to the genera.

1. With 6 or more radial canals ..... 2.
   With 4 radial canals ..... 4.
2. Radial canals simple, unbranched ..... 3.
   Some or all of the radial canals branched, all branches joining ring canal ..... *Toxorchis.*
3. With 8 radial canals ..... *Melicertissa.*
   With more than 8 radial canals ..... *Orchistoma.*
4. Radial canals open grooves forming large cruciform mouth ..... *Staurophora.*
   Radial canals closed ..... 5.
5. Radial canals with one or a few pairs of blindly ending lateral branches ..... *Staurodiscus.*
   Radial canals simple or with short lateral diverticula ..... 6.
6. Some or all tentacle bulbs with adaxial ocelli ..... *Laodicea.*
   No ocelli ..... *Ptychogena.*

Laodicea LESSON 1843. Laodiceidae with four simple radial canals; with simple wavy gonads; with or without marginal cirri; with adaxial ocelli. Type species: *L. undulata* (FORBES & GOODSIR).

Key to the valid species.

Stomach with large perradial lobes; about 50 tentacles without basal spurs; 3—4 cordyli between tentacles ..... *pulchra.*
Stomach with short perradial lobes; 2—300 or more tentacles with abaxial basal spurs; one cordylus between tentacles ..... *undulata.*

Laodicea undulata (FORBES & GOODSIR). Up to 37 mm. wide, usually much smaller; flatter than a hemisphere; stomach quadratic, short, with four crenulated lips; 4 long, sinuous gonads along the radial canals, contiguous with stomach; up to 400—600 tentacles, basal bulbs faintly developed, young tentacles with abaxial endodermal spur; adaxial ocellus usually on each 3—5' tentacle; spiral cirri, usually one between successive tentacles; cordyli distinctly club-shaped, without nematocysts, usually one between successive tentacles.—Eastern Atlantic and adjacent waters from Iceland and northern Norway to South Africa; western Atlantic from Nova Scotia to Tierra del Fuego; Mediterranean. (MAYER 1910 p. 201, Pl. 21 fig. 4, 5, Pl. 22 fig. 2—6, Pl. 23 fig. 1—3, text-fig. 104, 105, as *Laodicea cruciata*; KRAMP 1919 p. 16, Pl. 2 fig. 1—8; RUSSELL 1953 p. 230, Pl. 14 fig. 1—3, text-fig. 123—131).

Laodicea pulchra BROWNE 1902. 25 mm. wide, 15 mm. high; stomach large, with four large perradial lobes extending more than half-way to bell margin; four large, slightly folded lips; gonads from near centre of stomach almost to ring canal, with numerous lateral folds; about 50 tentacles without basal spur; no cirri;

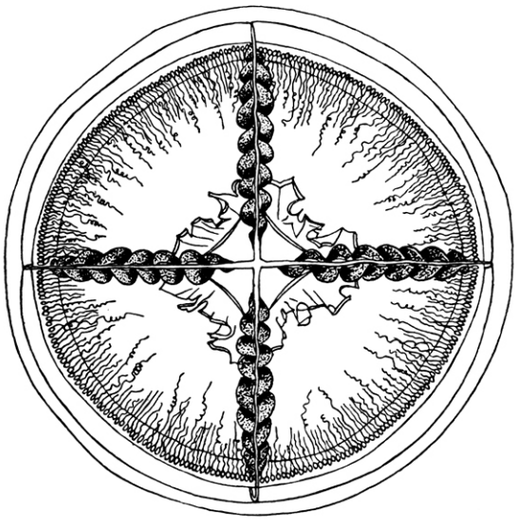


Fig. 153. *Laodicea undulata* (after KRAMP).

cordyli 3—4 between successive tentacles, with nematocysts; adaxial ocelli on each tentacle bulb and cordylus. —Falkland Islands and adjacent waters; Kerguelen Island. (BROWNE & KRAMP 1939 p. 291, Pl. 16 fig. 3—5; KRAMP 1957 p. 27, Pl. 4 fig. 7).

Doubtful species.

Laodicea ocellata BABNIK 1948. 3.5 mm. wide, globular, thin; lips short, not undulated; thick, club-shaped gonads along proximal parts of radial canals; 7—14 tentacles and 10—18 rudimentary bulbs; very large black ocelli on all bulbs.—Adriatic Sea. (BABNIK 1948 pp. 23, 69, 72, fig. 4, 5).

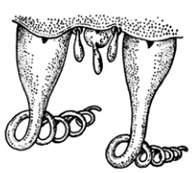


Fig. 154. *Laodicea pulchra*, part of bell margin with tentacles and cordyli (after BROWNE & KRAMP, redrawn by P. W.).

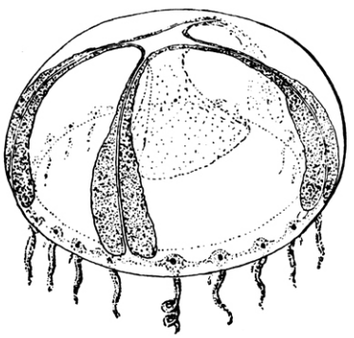


Fig. 155. *Laodicea ocellata* (after BABNIK).

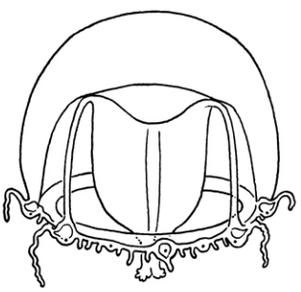


Fig. 156. *Laodicea neptuna* (after MAYER, redrawn by P. W.).

Laodicea chapmani GÜNTHER 1903. 17 mm. wide, 12 mm. high; gonads somewhat nearer stomach than bell margin, not touching the sides of the stomach; 32 tentacles; ocelli only on the four perradial tentacles; cirri and cordyli not observed.—West of Ireland. (MAYER 1910 p. 206).

Laodicea neptuna MAYER 1900. 2.5 mm. wide, a little higher than a hemisphere; stomach long and wide, lips surrounded by four prominent clusters of nematocysts; gonads on upper portions of radial canals, adjacent to stomach; 8 short tentacles with large bulbs and 8 rudimentary bulbs; 16 ocelli on the marginal bulbs; numerous nematocyst-bearing cirri; no cordyli.—Florida. (MAYER 1910 p. 206, Pl. 26 fig. 1—3). This is probably not a *Laodicea*.

Ptychogena A. AGASSIZ 1865. Laodiceidae with four radial canals giving rise to lateral diverticula, in which the gonads are placed; stomach with funnel-shaped perradial lobes; without cirri; without ocelli.— Type species: *P. lactea* A. AGASSIZ.

Key to the species of Ptychogena.

1. Radial canals with 20—30 lamellar lateral diverticula on either side, attached to subumbrella .. *lactea.*
   Lateral diverticula not attached to subumbrella ..... 2.
2. Lateral diverticula 10—15 on either side of radial canals, complexly folded ..... *antarctica.*
   Lateral diverticula simple ..... 3.
3. 6—7 lateral diverticula on either side of radial canals ..... *crocea.*
   2—3 lateral diverticula on either side of radial canals ..... *hyperborea.*

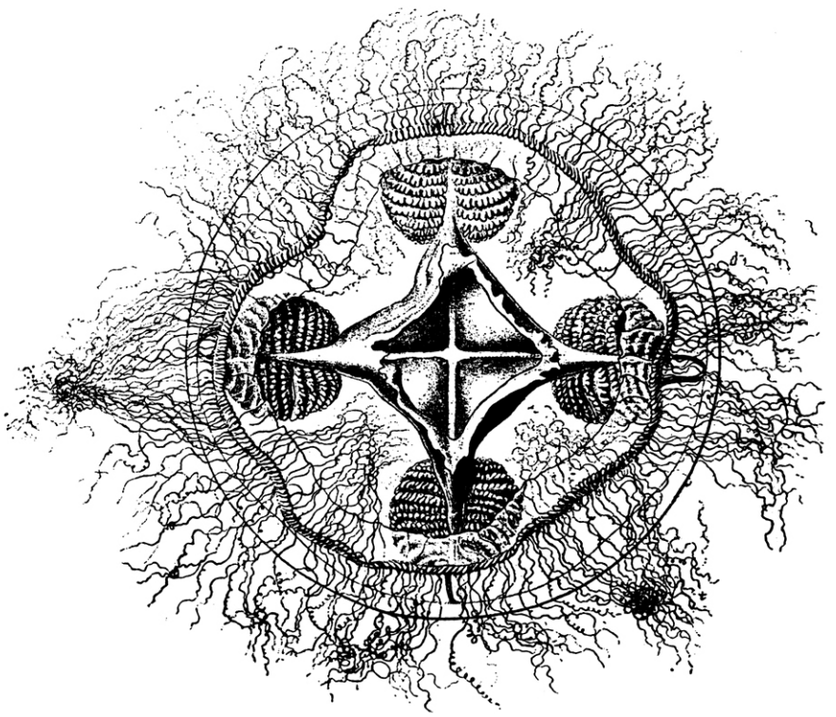


Fig. 157. *Ptychogena lactea* (after HAECKEL, from MAYER).

Ptychogena lactea A. AGASSIZ 1865. Up to 90 mm. wide and 30 mm. high, jelly very thick; stomach short, quadratic, mouth rim slightly crenulated; radial canals with 20—30 lamelliform lateral diverticula on either side, along their entire length attached to subumbrella; 300—500 tentacles and as many club-shaped cordyli without nematocysts.—Arctic circumpolar, occasionally penetrating as far south as Cape Cod in the western Atlantic and northern Japan in the western Pacific. (MAYER 1910 p. 215, fig. 109; KRAMP 1919 p. 31, Pl. 3 fig. 1—6, text-fig. 5). Synonym: *P. pinnulata* HAECKEL 1879.

Ptychogena antarctica BROWNE 1907. 60—100 mm. wide, slightly convex, jelly very thick; stomach wide, with funnel-shaped perradial lobes almost to terminal portions of the gonads; gonads along nearly whole length of radial canals, in 10—15 lateral folds on either side, each of them further divided into 2—5 lamellar folds, not attached to subumbrella; about 300 tentacles and as many cordyli with some few nematocysts.— Antarctic: South Orkney Islands; Gauss Station; Cape Adare and McMurdo Sound. (BROWNE 1910 p. 29, Pl. 2 fig. 6—9; KRAMP 1957 p. 28, Pl. 5 fig. 8).

Ptychogena crocea KRAMP & DAMAS 1925. 25 mm. wide and high, jelly moderately thick; stomach large, cruciform, mouth rim slightly folded; proximal $^1/_2$—$^2/_3$ of radial canals high and laterally compressed with

gonads in 6—7 lateral, free lamellae on either side; about 64 tentacles; 2—4 cordyli between successive tentacles, with nematocysts. Stomach and gonads with a characteristic saffron colour.—West coast of Norway. (KRAMP & DAMAS 1925 p. 290, Pl. 1 fig. 1—7).

Ptychogena hyperborea KRAMP 1942. 15 mm. wide, 8 mm. high, jelly very thick; stomach broad, quadrangular, mouth somewhat folded; stomach with four large, perradial lobes; gonads in 2—3 pairs of lateral folds on proximal half of radial canals above lobes of stomach; about 80 tentacles and probably as many cordyli. Stomach with a deep reddish brown colour.—Smith Sound between Greenland and Ellesmere Land, in deep water. (KRAMP 1942 p. 55, fig. 18).

Doubtful species: *Ptychogena aurea* VANHÖFFEN 1912 is probably *Chromatonema rubrum* (Tiarannidae). *Ptychogena longigona* MAAS 1893 in the northern Atlantic was probably a large specimen of *Laodicea undulata*.

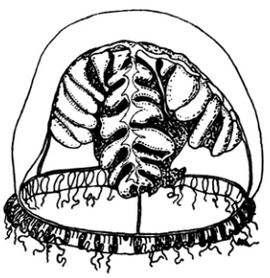


Fig. 158. *Ptychogena crocea* (after KRAMP & DAMAS).

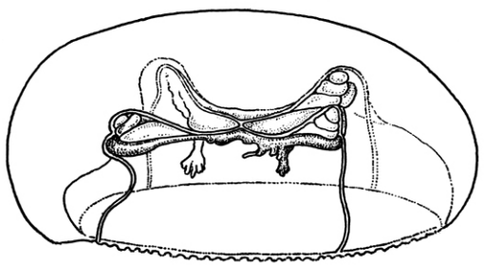


Fig. 159. *Ptychogena hyperborea* (after KRAMP, redrawn by P. W.).

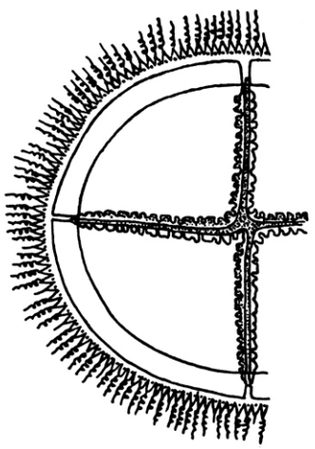


Fig. 160. *Staurophora mertensi* (after MAYER).

Staurophora BRANDT 1838. Laodiceidae with four radial canals which for the greater part of their length are open grooves forming a large, cruciform mouth; gonads in branched diverticula from the lateral walls of the cruciform stomach; with ocelli; without cirri.—Type species: *S. mertensi* BRANDT.

Staurophora mertensi BRANDT 1838. 100—200 mm. wide, flatter than a hemisphere; up to 4400 short tentacles, all with adaxial ocellus, alternating with club-shaped cordyli without nematocysts.—Bipolar. Arctic-boreal, circumpolar, southwards to the North Sea and to Cape Cod on the American coast; in the Pacific as far south as northern Japan and the south coast of Alaska; Falkland Islands and South Orkney Islands in southern Atlantic. (MAYER 1910 p. 291, Pl. 26 fig. 4—9; RUSSELL 1953 p. 239, text-fig. 132—137). Synonyms: *Staurophora laciniata* L. AGASSIZ 1849; *Staurostoma arctica* HAECKEL 1879; *Staurophora falklandica* BROWNE 1907.

Melicertissa HAECKEL 1879. Laodiceidae with 8 simple radial canals; with adaxial ocelli; with or without marginal cirri.—Type species: *M. clavigera* HAECKEL.

Key to the species of Melicertissa.

1. With 8 tentacles and 24 cordyli ..... *clavigera.*
   With more than 8 tentacles ..... 2.
2. With 16 tentacles and 16 cordyli ..... *mayeri.*
   With 24 tentacles and about 100 cordyli ..... *adriatica.*

Melicertissa clavigera HAECKEL 1879. 10 mm. wide, flatter than a hemisphere, moderately thin walls; stomach flat, mouth with 8 short lips; 8 straight, narrow radial canals; gonads somewhat sinuous, on middle halves of radial canals; 8 tentacles; 24 cordyli; no cirri.—Canary Islands; Indian Ocean. (MAYER 1910 p. 210, text-fig. 106).

Melicertissa mayeri n. sp. 7. mm. wide, similar to *M. clavigera* but with 16 tentacles and 16 cordyli.—Florida. (MAYER 1910 p. 210, Pl. 24 fig. 2, 3, as *M. clavigera*).

Fig. 161. *Melicertissa clavigera* (after HAECKEL, from MAYER).

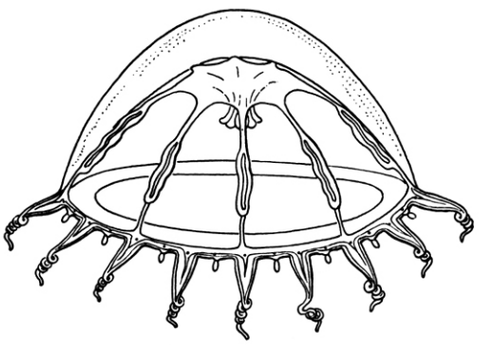


Fig. 162. *Melicertissa mayeri* n. sp. (after MAYER, redrawn by P. W.).

Melicertissa adriatica NEPPI 1915. 46 mm. wide, flatter than a hemisphere, jelly fairly thick; stomach short, bell-shaped, mouth with 8 short, crenulated lips; gonads linear, along whole length of radial canals; 8 perradial and between them 16 other tentacles, all alike; 3—5 cordyli between successive tentacles, each with a black ocellus and even more cirri.—Adriatic Sea. (NEPPI 1915 p. 2).

Orchistoma HAECKEL 1879. Laodiceidae with more than 8 simple radial canals which arise separately from the periphery of the stomach; the whole dorsal wall of the stomach attached to subumbrella; without marginal cirri; with or without ocelli; with (or without?) a gastric peduncle.—Type species: *O. pileus* (LESSON).

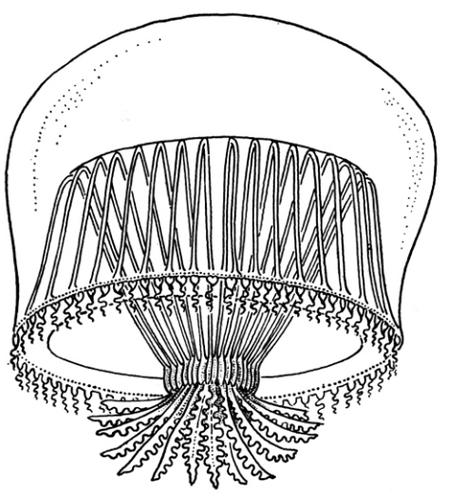


Fig. 163. *Orchistoma pileus* (after MAYER, redrawn by P. W.).

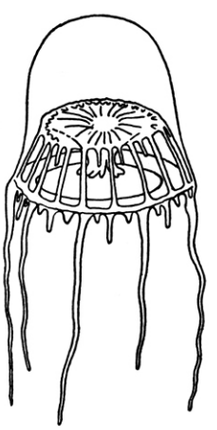


Fig. 164. *Orchistoma tentaculata* (after HARGITT).

Orchistoma pileus (LESSON 1843). 30—40 mm. wide, flat-topped with vertical sides, apical jelly very thick; stomach wide and shallow, on a wide and large peduncle; mouth with 32 long, complexly crenulated lips; 32 radial canals; 32 short, swollen gonads on the radial canals near stomach; 64 short tentacles with well developed bulbs; about 100 slender cordyli with nematocysts; about 400 adaxial ocelli.—Bahamas; Florida; West Indies; ? West-Africa. (MAYER 1910 p. 211, Pl. 25 fig. 1—4).

Orchistoma agariciforme KELLER 1884. Similar to *O. pileus*, except that there are only 7 lips instead of 32; 19 or more radial canals.—Naples in Mediterranean. (MAYER 1910 p. 212).

The following two species are provisionally referred to *Orchistoma*; they have no gastric peduncle, cordyli and gonads are not observed.

Orchistoma tentaculata MAYER 1900. 6 mm. high, higher than wide, apical jelly very thick, sides thin; no peduncle; stomach very broad and flat; mouth with 8 lips; up to 32 radial canals, some of which may end blindly; 32 or more tentacles of unequal length.—Newport, North America; Bermudas. (MAYER 1910 p. 212, Pl. 24 fig. 1; see also the present paper, p. 34).

Orchistoma graeffei NEPPI & STIASNY 1911. 4 mm. wide, highly vaulted, apical jelly very thick; stomach quite flat, mouth with 8 simple lips; 8 fully developed radial canals and in each octant about 12 young, blindly ending canals; 8 tentacles with large, pear-shaped bulbs; 2—3 rudimentary bulbs between successive tentacles.—Adriatic Sea. (NEPPI & STIASNY 1913 p. 39).

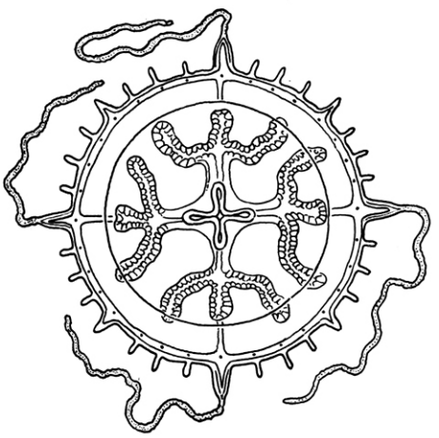


Fig. 165. *Staurodiscus tetrastaurus* (after MAYER, redrawn by P. W.).

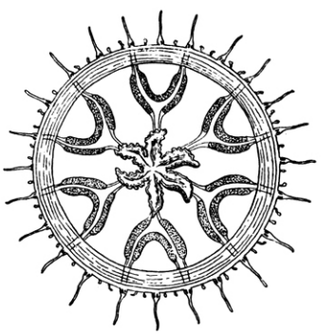


Fig. 166. *Toxorchis arcuatus* (after HAECKEL, from MAYER).

Staurodiscus HAECKEL 1879. Laodiceidae with four radial canals, each giving rise to one or more pairs of side branches which end blindly; gonads on main canals and branches; with adaxial ocelli; without marginal cirri.—Type species: *S. tetrastaurus* HAECKEL.

Staurodiscus tetrastaurus HAECKEL 1879. 4.5 mm. wide and about half as high; stomach small, cruciform, mouth with four prominent lips; 4 radial canals, each with two opposite, blind lateral branches; gonads on side branches and distal parts of radial canals; 8 tentacles; 16—24 cordyli with nematocysts; 32 ocelli.—Canary Islands; Florida; Indian Ocean. (MAYER 1910 p. 214, Pl. 22 fig. 7, 8, Pl. 25 fig. 5, Pl. 26 fig. 10, 11).

Staurodiscus heterosceles HAECKEL 1879. 6—8 mm. wide; radial canals with two side branches not opposite each other; 12 club-shaped gonads on main canals and branches; 8—32, usually 16, tentacles; 40—80 cordyli.—Canary Islands. (MAYER 1910 p. 214). This species is probably identical with *S. tetrastaurus*.

Toxorchis HAECKEL 1879. Laodiceidae with 6 or more main radial canals, some or all branching one or more times, all branches reaching ring canal; gonads on outermost branches; numerous tentacles and cordyli; cirri may be present.—Type species: *T. arcuatus* HAECKEL. Synonyms: *Cuvieria* PÉRON 1807, in part; *Berenice* OKEN 1815, in part; *Cladocanna* HAECKEL 1879.

Key to the species of Toxorchis.

1. With 6 main radial canals, bifurcated once ..... *arcuatus.*
   With 8 main radial canals ..... 2.

2. All or most of the radial canals bifurcated once ..... 3.
   Four canals unbranched, four with two lateral branches ..... *brooksi.*
3. With about 32 tentacles ..... *kellneri.*
   With about 300 tentacles ..... *polynema.*

Toxorchis arcuatus HAECKEL 1879. 6 mm. wide, flat to hemispherical; stomach small and flat, mouth with 6 crinkled, lanceolate lips; 6 wide main radial canals which fork at their middle points; gonads on the forked ends of the radial canals; 24 long tentacles, each with an ocellus; numerous cordyli and cirri.—Canary Islands. (MAYER 1910 p. 288, fig. 119).

Toxorchis kellneri MAYER 1910. 15 mm. wide, almost hemispherical, moderately thin walls; stomach shallow; 8 lanceolate, folded lips; 8 wide radial canals, most of them bifurcated near stomach; gonads

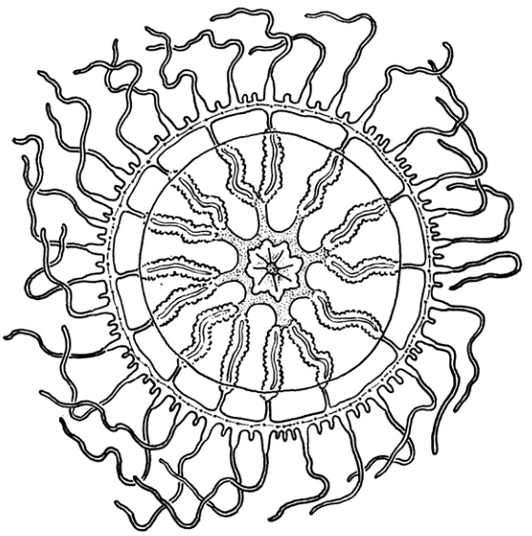


Fig. 167. *Toxorchis kellneri* (after MAYER, redrawn by P. W.).

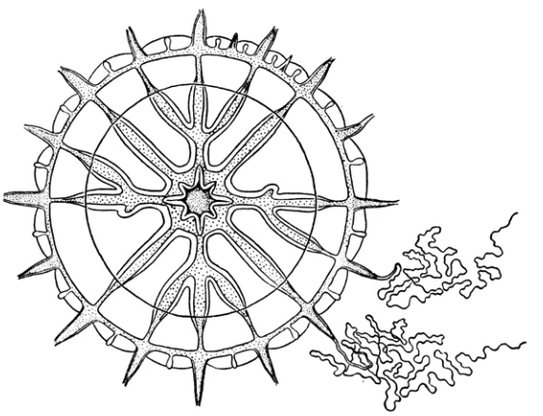


Fig. 168 a. *Toxorchis brooksi* (after MAYER).

extending outwards from bifurcation; about 32 tentacles; about 50 cordyli; no cirri; ocelli at base of each tentacle and cordylus.—Florida and Gulf of Maine. (MAYER 1910 p. 229, Pl. 28 fig. 1—2).

Toxorchis brooksi (MAYER 1910). Size? Flatter than a hemisphere; stomach short, small; 4 long and 4 short lips; 8 radial canals, four of them with two lateral branches; gonads extending outwards from stomach; 16 tentacles; no ocelli observed.—Bahamas. (MAYER 1910 p. 227, fig. 118a, as *Dipleurosoma brooksi*). The species was described from drawings by W. K. BROOKS; cordyli are not mentioned in the description, but it appears from the drawing that club-shaped bodies are present on the bell margin alternating with the tentacles. I provisionally refer this species to *Toxorchis.*

Toxorchis polynema KRAMP. 17 mm. wide, flat; stomach broad and flat, mouth with broad and crenulated lips; four groups of radial canals, each bifurcating twice inside the cruciform base of the stomach, 16 (4×4) canals leaving the stomach, all running to the ring canal; gonads along proximal $^3/_5$—$^2/_3$ of the radial canals; about 300 tentacles and as many cordyli.—West Africa. (Described in the present paper, p. 34, Pl. I fig. 13, Pl. II fig. 4.)

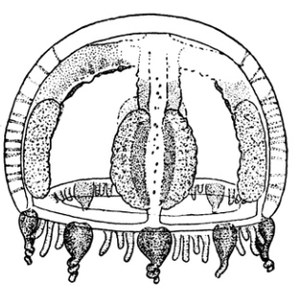


Fig. 168 b. *Krampella dubia* (after RUSSELL).

The following species which has recently been described, may possibly belong to the Laodiceidae:

Krampella dubia RUSSELL 1957. 3 mm. wide, hemispherical, stomach damaged; four broad radial canals, connected with the exumbrella surface by several fine strands of tissue running through the jelly; gonads

along almost whole length of radial canals, widely separated longitudinally; 4 perradial and 4 interradial tentacles with swollen conical basal bulbs; 3—4 small cirrus-like tentacles between successive large tentacles; cordyli, ocelli and marginal vesicles cannot be seen.—Bay of Biscay (RUSSELL 1957 p. 445, fig. 1, 2). The species represents a new genus, *Krampella*, of problematical systematic position.

Family **Mitrocomidae.**

Leptomedusae with open marginal vesicles; with base of stomach attached to subumbrella along edges of radial furrows; with gonads on radial canals separated from stomach; with hollow marginal tentacles; with or without marginal cirri.

Key to the genera.

1. With 4 radial canals, each bent like an S ..... *Cyclocanna.*
   Radial canals straight ..... 2.
2. With a large black ocellus at the base of each marginal vesicle ..... 3.
   Without ocelli ..... 5.
3. With only one kind of tentacles; 8 marginal vesicles ..... *Tiaropsis.*
   With two kinds of tentacles ..... 4.
4. With 4 radial canals ..... *Tiaropsidium.*
   With 8 radial canals ..... *Octogonade.*
5. With about 12—16 radial canals ..... *Halopsis.*
   With 4 radial canals ..... 6.
6. Without marginal cirri; 8 marginal vesicles ..... *Cosmetirella.*
   With marginal cirri ..... 7.
7. Cirri flexile, with nematocysts throughout their length; 8 marginal vesicles ..... *Cosmetira.*
   Cirri spiral, with terminal cluster of nematocysts ..... 8.
8. With 8—16 marginal vesicles ..... *Mitrocomella.*
   With numerous marginal vesicles ..... *Mitrocoma.*

Mitrocomella HAECKEL 1879. Mitrocomidae with 4 radial canals; with 8, 12 or 16 marginal vesicles without ocelli; with marginal cirri which coil spirally.—Type species: *M. polydiademata* (ROMANES).

Key to the species of Mitrocomella.

1. With 8 marginal vesicles ..... 2.
   With 16 marginal vesicles ..... *polydiademata.*
2. With about 16 tentacles; gonads short, swollen ..... *brownei.*
   With 32—72 tentacles; gonads elongated ..... *frigida.*

Mitrocomella brownei (KRAMP 1930). 4—7 mm. wide; gonads oval, swollen, near distal ends of radial canals; up to 24 tentacles, usually 16; 6—8 cirri between successive tentacles; 8 marginal vesicles, each with 5—7 concretions.—British coasts; Villefranche in Mediterranean. (KRAMP 1932 p. 341, fig. 9, 37; RUSSELL 1953 p. 261, Pl. 15 fig. 4, text-fig. 150—155).

Mitrocomella frigida (BROWNE 1910). 13—17 mm. wide; gonads along greater part of radial canals; 32—72 tentacles; about 8 cirri between successive tentacles; 8 marginal vesicles.—Antarctic: South Georgia; Gauss Station; McMurdo Sound; west of the Cape of Good Hope. (KRAMP 1932 p. 345, Pl. 10 fig. 5, 6, text-fig. 23). Synonym: *Cosmetira frigida* BROWNE 1910.

Mitrocomella polydiademata (ROMANES 1876). 12—30 mm. wide; gonads linear, somewhat sinuous, along $^2/_3$—$^4/_5$ of radial canals; tentacles 36—48, in American specimens up to 64; 5—9 cirri between successive tentacles; 16 marginal vesicles, each with 15—20 concretions.—North-western Europe; Barents Sea and Kara Sea; west coast of Greenland; Gulf of Maine in North America. (MAYER 1910 p. 290, as *Mitrocoma polydiademata*; KRAMP 1932 p. 346, Pl. 10 fig. 3, 4, text-fig. 3, 5, 11, 18, 29, 30, 40; RUSSELL 1953 p. 257, text-fig. 147—149). Synonyms: *Mitrocomella fulva* BROWNE 1903; *Mitrocoma cruciata* BIGELOW 1915 ff.

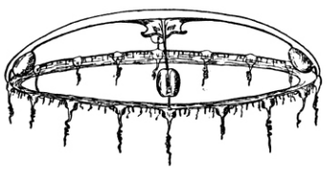


Fig. 169. *Mitrocomella brownei* (after KRAMP).

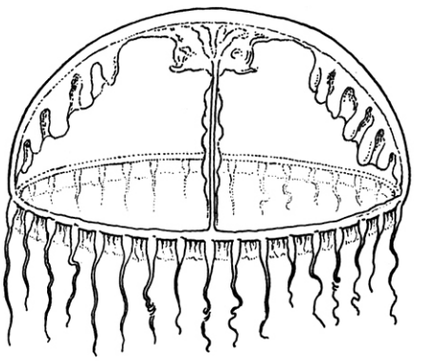


Fig. 170. *Mitrocomella frigida* (after KRAMP, redrawn by P. W.).

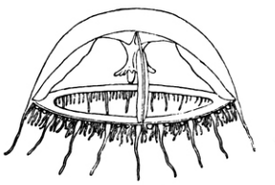


Fig. 171. *Mitrocomella polydiademata* (after BROWNE, from KRAMP).

Mitrocomella cruciata (A. AGASSIZ 1865). 40—50 mm. wide; about 100 tentacles; one cirrus between successive tentacles; 12 marginal vesicles.—Massachusetts Bay, America. (KRAMP 1932 p. 343, text-fig. 39). This is a doubtful species, not observed since it was described by AGASSIZ as *Halopsis cruciata*; all other specimens from America belong to *M. polydiademata*.

Mitrocoma HAECKEL 1864. Mitrocomidae with 4 radial canals; with numerous marginal vesicles without ocelli; with marginal cirri which coil spirally.—Type species: *M. annae* HAECKEL 1864.

Mitrocoma annae HAECKEL 1864. 30—40 mm. wide; gonads linear, sinuous, along distal $^1/_2$—$^3/_4$ of radial canals; 60—100 tentacles; 3—8 cirri between successive tentacles; 60—100 marginal vesicles, each with about 20 concretions in two rows.—Mediterranean. (MAYER 1910 p. 287, fig. 152; KRAMP 1932 p. 350, fig. 21, 31, 42).

Doubtful species: *Mitrocoma minervae* HAECKEL 1879. Size? 120—160 tentacles; one cirrus between successive tentacles; 120—160 marginal vesicles, each with 8—12 concretions.—South Africa. (KRAMP 1932 p. 352).

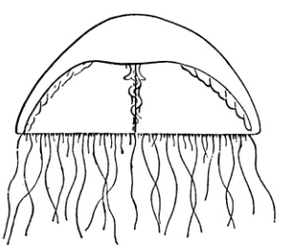


Fig. 172. *Mitricomella cruciata* (after AGASSIZ, from MAYER).

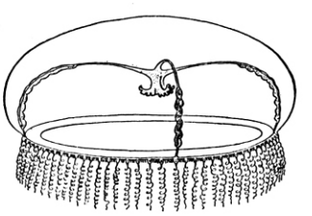


Fig. 173. *Mitrocoma annae* (after MAYER, from KRAMP).

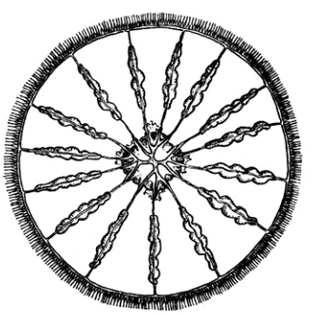


Fig. 174. *Halopsis ocellata* (after KRAMP).

Halopsis A. AGASSIZ 1863. Mitrocomidae with more than 8 radial canals; with numerous marginal vesicles without ocelli; with marginal cirri which coil spirally.—Type species: *H. ocellata* A. AGASSIZ 1863.

Halopsis ocellata A. AGASSIZ 1863. 50—65 mm wide, about four times as wide as high; stomach broad and flat, mouth with four fairly short lips; 12—16 radial canals in four groups; gonads linear, sinuous, along

about $^2/_3$ of radial canals; up to 450 tentacles; one spiral cirrus between successive tentacles; about 80 marginal vesicles with many concretions.—Bipolar: north-western Europe; Iceland; Greenland; New England; Falkland Islands. (MAYER 1910 p. 323, fig. 183, 184; KRAMP 1932 p. 353, fig. 6, 12, 19, 28, 32, 43; RUSSELL 1953 p. 273, Pl. 14 fig. 4, text-fig. 162—166).

Cosmetira FORBES 1848. Mitrocomidae with 4 radial canals; with 8 marginal vesicles without ocelli; with flexile cirri provided with nematocysts throughout their length, usually straight, exceptionally, in young specimens, spirally coiled.—Type species: *C. pilosella* FORBES 1848.

Cosmetira pilosella FORBES 1848. 20—48 mm. wide, usually hemispherical; stomach small; four pointed, somewhat folded lips; gonads linear, narrow, slightly sinuous, along middle $^1/_2$—$^2/_3$ of radial canals; 64—100 tentacles; 6—10 cirri between successive tentacles, older cirri extending well up surface of exumbrella; 8 marginal vesicles, each with 12 or more concretions.—North-western Europe. (MAYER 1910 p. 261, fig. 134*a*,

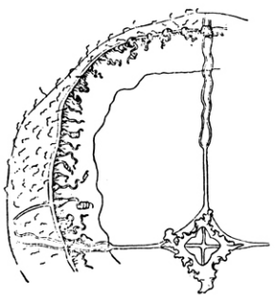


Fig. 175. *Cosmetira pilosella* (after HARTLAUB).

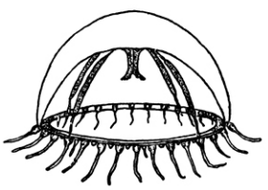


Fig. 176. *Cosmetirella davisi* (after BROWNE, from KRAMP).

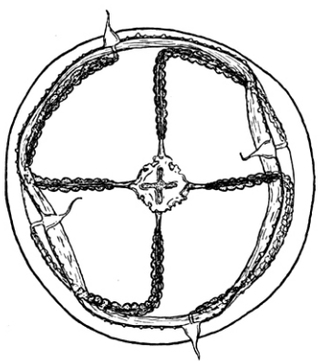


Fig. 177. *Cyclocanna welshi* (after KRAMP).

as *C. pilosella*; p. 289, fig. 156 as *Mitrocoma megalota*; KRAMP 1932 p. 356, fig. 7, 8, 10, 13, 16, 17, 25, 26, 27, 44, as *C. pilosella*; p. 358, fig. 45, as *C. megalotis*; RUSSELL 1953 p. 266, Pl. 15 fig. 1—3, text-fig. 156—161). Synonym: *Cosmetira megalotis* (MAAS 1893).

Cosmetirella BROWNE 1910. Mitrocomidae with 4 radial canals; with 8 marginal vesicles without ocelli; without marginal cirri.—Type species: *C. davisi* (BROWNE).

Cosmetirella davisi (BROWNE 1902). Up to 60 mm. wide, larger in subantarctic than in antarctic waters; almost hemispherical; stomach small; lips somewhat folded; gonads linear, sinuous, along $^1/_2$—$^2/_3$ of radial canals; number of tentacles very variable, up to 180; normally 8 marginal vesicles with several concretions.—Antarctic and subantarctic, circumpolar; South Africa. (MAYER 1910 p. 259, as *Tiaropsis davisii*; KRAMP 1932 p. 359, fig. 4, 34, 46; BROWNE & KRAMP 1939 p. 293, Pl. 17 fig. 1; KRAMP 1957 p. 31). Synonyms: *C. simplex* BROWNE 1910, *C. kerguelensis* VANHÖFFEN 1912.

Cyclocanna BIGELOW 1918. Mitrocomidae with 4 radial canals each bent like an S; with 8 marginal vesicles without ocelli; with two kinds of tentacles; without marginal cirri.—Type species: *C. welshi* BIGELOW.

Cyclocanna welshi BIGELOW 1918. 44—68 mm. wide, watchglass-shaped; stomach quadrangular, about as long as broad, with four short lips; 4 radial canals, in their distal part following the ring canal, which they join in the next perradius; 4 long tentacles and about 80 rudimentary tentacles.—West coast of Norway near Bergen; the Skagerrak; off Chesapeake Bay in North America. (BIGELOW 1918 p. 383, Pl. 3 fig. 2—5; KRAMP 1933 p. 571, fig. 35).

Tiaropsis L. AGASSIZ 1849. Mitrocomidae with 4 radial canals; with 8 marginal vesicles each with a basal ocellus; with only one kind of tentacles; without marginal cirri.—Type species: *T. multicirrata* (M. SARS).

Tiaropsis multicirrata (M. SARS 1835). About 20 mm. wide, flatter than a hemisphere; stomach fairly small, mouth with four lips fairly long and broad, much folded and crenated; a broad, flat gastric peduncle; gonads somewhat sinuous, along middle $^1/_2$—$^2/_3$ of radial canals, from base of peduncle outwards; about 300 tentacles, fairly short, with broad, swollen bulbs; 8 marginal vesicles, each with about 12 concretions and with a black ocellus at the base.—North-western Europe from English Channel to Barents Sea; Iceland; an isolated record off the Mauretanian coast, see above, p. 35; north of Russia and Siberia; west coast of Greenland; American coast north of Cape Cod, occasionally as far south as Woods Hole; north-eastern Pacific.

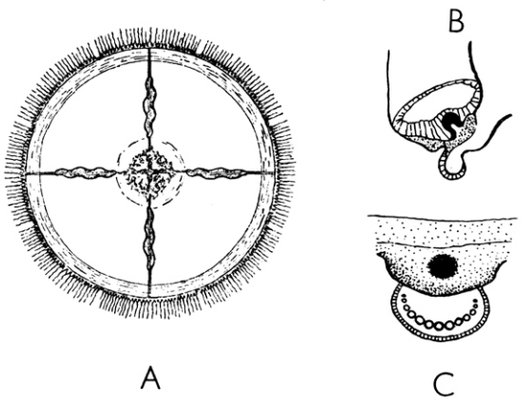


Fig. 178. *Tiaropsis multicirrata*; A, oral view of medusa, B and C, marginal vesicle with ocellus (after KRAMP).

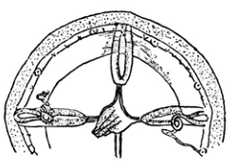


Fig. 179. *Tiaropsidium mediterraneum* (after METCHNIKOFF, from KRAMP).

(MAYER 1910 p. 258, Pl. 31 fig. 11, Pl. 32 fig. 8, 9, as *T. diademata*; p. 259 as *T. multicirrata*; KRAMP 1932 p. 364, fig. 14, 15, 20, 35, 48; RUSSELL 1953 p. 278, Pl. 17 fig. 1, text-fig. 167—171). Synonyms: *Tiaropsis diademata* L. AGASSIZ 1849; *Thaumantias eschscholtzii* HAECKEL 1879.

Tiaropsidium TORREY 1909. Mitrocomidae with 4 radial canals; with 8, 16 or 48 marginal vesicles, each with an ocellus; with two kinds of tentacles; without marginal cirri.—Type species: *T. kelseyi* TORREY.

Tiaropsidium mediterraneum (METSCHNIKOFF 1886). 7 mm. wide, 5 mm. high, globular; stomach short, fairly broad, 4 short, simple lips; gonads elongated, along distal $^2/_3$ of radial canals; two opposite perradial, long tentacles and two small perradial bulbs; in each quadrant 5 rudimentary tentacles; 8 marginal vesicles, each with 20 or more concretions and a basal ocellus.—Messina in the Mediterranean Sea. (MAYER 1910 p. 260, as *Tiaropsis mediterranea*; KRAMP 1932 p. 367, fig. 49).

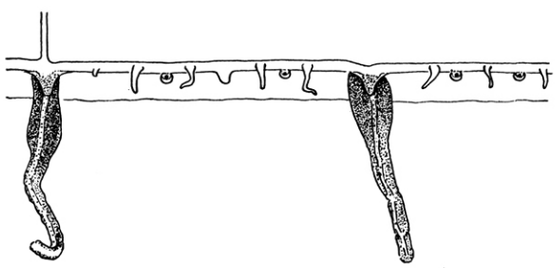


Fig. 180. *Tiaropsidium atlanticum* (after RUSSELL).

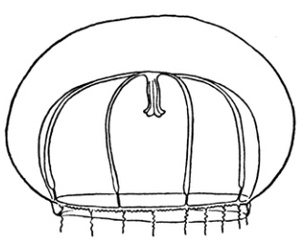


Fig. 181. *Octogonade mediterranea* (after ZOJA, from MAYER).

Tiaropsidium atlanticum RUSSELL 1956. 60 mm. wide, flatter than a hemisphere; stomach small, four short, broad, slightly folded lips; gonads linear, along middle $^3/_4$ of radial canals; probably 24 large and 72 small tentacles; probably about 48 marginal vesicles, each with 12—20 concretions and a black ocellus.—Off the mouth of the English Channel, in deep water. (RUSSELL 1956 *b* p. 496 fig. 2, 3).

Octogonade ZOJA 1896. Mitrocomidae with 8 radial canals; with numerous marginal vesicles, each with an ocellus; with two kinds of tentacles; without marginal cirri.—Type species: *O. mediterranea* ZOJA.

Octogonade mediterranea ZOJA 1896. 60—70 mm. wide, globular; stomach small, tubular, octagonal, 8 small but distinct lips; gonads along almost entire length of radial canals; 16 long and 150—160 small rudimentary tentacles; 50—60 marginal vesicles, each with 12—20 concretions and a basal ocellus.—Messina and Adriatic Sea. (KRAMP 1932 p. 373, fig. 52).

Superfamily **Eucopida.**

Leptomedusae with closed marginal vesicles; without a distinct gastric peduncle; without excretory pores.

This group comprises the families Campanulariidae, Phialellidae and Lovenellidae, besides a few genera with doubtful affinities: *Blackfordia* and *Eugymnanthea.*

Family **Campanulariidae.**

Leptomedusae with small stomach; with (normally) 4 radial canals; without peduncle; with gonads completely surrounding radial canals and separated from stomach; without marginal or lateral cirri; with closed marginal vesicles; without ocelli; without excretory pores.—Hydroids, where known, *Campanularia*-like.

Key to the genera.

1. Reduced medusae without manubrium and without tentacles ..... *Agastra.*
   Well-developed medusae ..... 2.
2. Tentacles solid; 8 marginal vesicles ..... *Obelia.*
   Tentacles hollow; with numerous marginal vesicles when adult ..... *Phialidium.*

Agastra HARTLAUB 1897. Campanulariidae without manubrium and without marginal tentacles; with four simple, unbranched radial canals; with four sac-like gonads; with 8 adradial marginal vesicles. Hydroid: *Orthopyxis.*—Type species: *A. mira* HARTLAUB.

Key to the species of Agastra.

Gonads in irregular lobes ..... *mira.*
Gonads not lobular ..... *rubra.*

Agastra mira HARTLAUB 1897. About 1 mm. high and wide, bell-shaped; exumbrella with scattered nematocysts; no tentacles, but four minute pigmented bulbs; gonads in lateral, irregular lobes along middle half of radial canals.—North Sea and southern British coasts. (MAYER 1910 p. 234; RUSSELL 1953 p. 303, Pl. 19 fig. 1, text-fig. 186—188).

Agastra rubra BEHNER 1914. 1 mm. high, 0.8 mm. wide; exumbrella with scattered nematocysts; no tentacles but four minute bulbs; gonads along middle half of radial canals in broad, band-like dilatations, not in irregular lobes.—Naples in Mediterranean. (BEHNER 1914 p. 393, Pl. 7 fig. 6, text-fig. 8—10).

Obelia PÉRON & LESUEUR 1809. Campanulariidae with reduced velum; with solid marginal tentacles; with 8 marginal vesicles.

The medusae belonging to this genus are derived from several different species of Hydroids but the medusae cannot be specifically distinguished.

Obelia spp. Up to 6 mm. wide, flat, jelly thin; velum rudimentary; stomach short, with quadrangular base; mouth with four short simple lips; gonads round, sac-like, on middle of radial canals; numerous short, solid tentacles, somewhat stiff, with axial core of single row of endoderm cells; each tentacle with small basal swelling and a short prolongation of endoderm into mesogloea of umbrella margin; 8 adradial marginal vesicles, each situated on under side of basal bulb of marginal tentacle, each with one concretion.—The *Obelia*-medusae have a world-wide distribution in coastal waters except in high-arctic and antarctic seas. (MAYER 1910 pp. 238—257, Pl. 30 fig. 1—6, Pl. 31 fig. 6—8, text-fig. 124—134, under several different names; RUSSELL 1953 p. 287, Pl. 18 fig. 1, 2, Pl. 19 fig. 2, text-fig. 182—185).

Phialidium LEUCKART 1856. Campanulariidae with normal velum; with hollow marginal tentacles; with numerous marginal vesicles.—Type species: *P. hemisphaericum* (L.). Synonyms: *Clytia* LAMOUROUX 1812

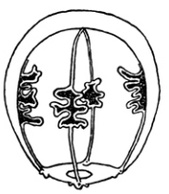


Fig. 182. *Agastra mira* (after BROWNE, from KRAMP).

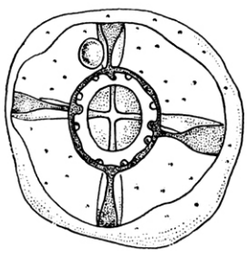


Fig. 183. *Agastra rubra* (after BEHNER, redrawn by P. W.).

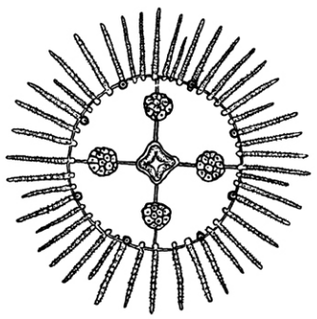


Fig. 184. *Obelia* sp. (after KRAMP).

sensu MAYER 1910; *Thaumantias* ESCHSCHOLTZ 1829, in part; *Eucope* GEGENBAUR 1856, in part. Moreover specimens with five radial canals have been referred to a separate genus, *Pseudoclytia* MAYER 1900. Among the three species of *Gastroblasta* KELLER 1883 only one (*G. timida* KELLER, from the Red Sea) must provisionally be retained as belonging to a separate genus; the two others are abnormal specimens of *Phialidium* with more than one manubrium.

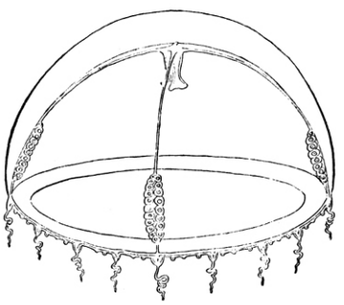
The numerous species of *Phialidium* need a revision. In the papers by VANHÖFFEN the name *Phialidium phosphoricum* (PÉRON & LESUEUR) is used for all species of *Phialidium* with marginal vesicles in same number as tentacles; all records under that name must, therefore, be regarded as obsolete.

Key to the species of Phialidium.

1. Subumbrella iridescent; 16 large and 16 small tentacles ..... *iridescens.*
   Subumbrella not iridescent ..... 2.
2. Marginal vesicles about twice as numerous as tentacles ..... 3.
   Marginal vesicles in about same number as tentacles + rudimentary bulbs ..... 6.
3. Gonads small, in middle portion of radial canals; blastostyles carrying medusa buds issue from gonads ..... *mccradyi.*
   No blastostyles on gonads ..... 4.
4. Gonads thick, along almost entire length of radial canals; 16 tentacles ..... *discoidum.*
   Gonads oval or linear, nearer to margin than to stomach; 16—32 or more tentacles ..... 5.
5. In European and West-African waters ..... *hemisphaericum.*
   In American waters ..... *languidum.*
6. Gonads along almost entire length of radial canals; about 200 tentacles ..... *islandicum.*
   Gonads less than $^3/_4$ as long as radial canals; less than 100 tentacles ..... 7.
7. Fully developed tentacles alternating with rudimentary bulbs ..... 8.
   Tentacles all alike, apart from few young bulbs ..... 10.

8. Gonads near margin; 32 tentacles + 32 bulbs; umbrella globular ..... *globosum.*
   Gonads near base of stomach; 16 tentacles + 16 bulbs ..... 9.
9. Umbrella about as high as wide, with a lens-shaped apical projection ..... *singularis.*
   Umbrella twice as high as wide, apex very thick but not separated from lateral walls by a constriction ..... *gelatinosum.*
10. With 60—85 tentacles; gonads linear, in distal portion of radial canals ..... *simplex.*
    With about 16 tentacles; gonads oval ..... 11.
11. Gonads in distal portion of radial canals ..... *folleatum.*
    Gonads in middle portion of radial canals ..... *bicophorum.*

Phialidium noliformis, P. brunescens, "Pseudoclytia" pentata, and *"Gastroblasta" ovalis,* see below.



(Fig. 185. *Phialidium hemisphaericum* (after MAYER).

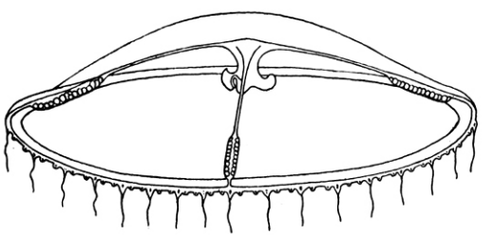


Fig. 186. *Phialidium languidum* (after MAYER, from KRAMP).

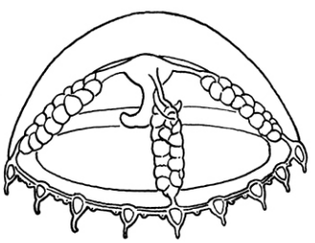


Fig. 187. *Phialidium discoidum* (after MAYER, redrawn by P. W.).

Phialidium hemisphaericum (L.). Up to 20 mm. wide, nearly hemispherical, jelly fairly thin; stomach small, mouth with four short, simple lips; gonads oval or linear, $^1/_2$ to $^3/_4$ as long as radial canals, somewhat nearer margin than stomach; 16 or 30—58 tentacles with globular bulbs; 1—3, usually 2 marginal vesicles between successive tentacles, each with one concretion. Medusae reared in spring or early summer usually attains maturity at a small size with oval gonads and about 16 tentacles, whereas medusae reared at a later season may continue growth and attain larger size, elongated, linear gonads and 32 or more tentacles.—European coasts from Lofoten in Norway to Portugal; Iceland; Mediterranean; west coast of Africa; India; Australia. (MAYER 1910 p. 266, fig. 140—144; KRAMP 1919 p. 91, Pl. 4 fig. 14, Pl. 5 fig. 3, text-fig. 16, 17; RUSSELL 1953 p. 285, Pl. 16 fig. 1, Pl. 17 fig. 6, text-fig. 172—179). Synonyms: *Phialidium buskianum* GOSSE 1853, *P. variabile* HAECKEL 1879 in part, *P. temporarium* BROWNE 1896, and many others.

Gastroblasta raffaelei LANG 1886, with up to 20 radial and centripetal canals, up to 9 complete and 7 rudimentary stomachs, and 26 well developed and 17 rudimentary tentacles, is probably an abnormal form of *Phialidium hemisphaericum.*—Naples. (MAYER 1910 p. 280).—It is also possible that *Pseudoclytia pentata* forma *hexaradiata* THIEL 1938, from South Africa, belongs to this species.

Phialidium languidum (A. AGASSIZ 1862). This medusa may hardly be distinguished from *P. hemisphaericum,* faintly differing from the European species in colours and in the gonads usually being somewhat shorter; their hydroids, however, seem to be different.—East coast of North America from Gulf of Maine to Florida. (MAYER 1910 p. 269, Pl. 33 fig. 4—8, Pl. 34 fig. 5).

Phialidium discoidum (MAYER 1900). 4 mm. wide, almost hemispherical; stomach small, urn-shaped, with bulging sides, mouth with four recurved slightly folded lips; gonads on greater part of radial canals, thick, cylindrical, female with very large eggs; 16 very short tentacles with large basal bulbs; usually three marginal vesicles between successive tentacles.—Florida; Brazil (records from Pacific waters are probably erroneous). (MAYER 1910 p. 272, Pl. 33 fig. 9—11; KRAMP 1957 p. 33).

Phialidium mccradyi (Brooks 1888). 15 mm. wide, about twice as broad as high; stomach short and stout, mouth with four recurved lips; gonads small, on middle part of radial canals; by asexual budding hydroid blastostyles may be developed from the gonads, each blastostyle is included in a gonotheca and gives rise to medusa buds; 16—24 tentacles with conical basal bulbs; 1—2 marginal vesicles between successive tentacles, each with one concretion.—Bahamas; Florida. (Mayer 1910 p. 271, Pl. 34 fig. 2, 3, Pl. 35 fig. 1—3).

Phialidium simplex Browne 1902. Up to 22 mm. wide and 10 mm. high, watchglass-shaped; stomach short, mouth with four large, fimbriated lips; gonads along distal $^1/_2$—$^3/_4$ of radial canals, linear, slightly

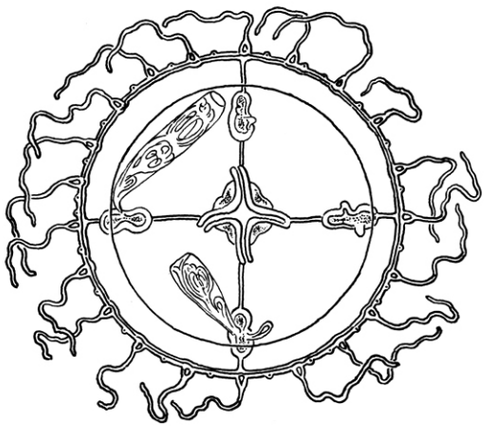


Fig. 188. *Phialidium mccradyi* (after Mayer, redrawn by P. W.).

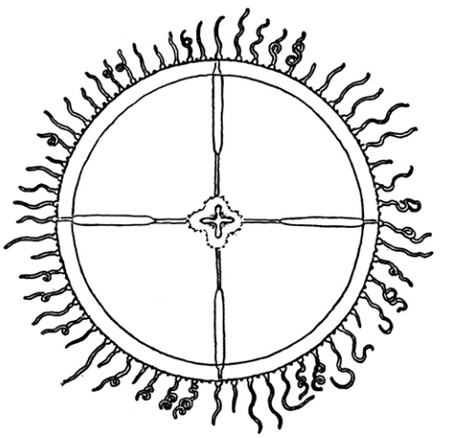


Fig. 189. *Phialidium simplex* (after Browne & Kramp, redrawn by P. W.).

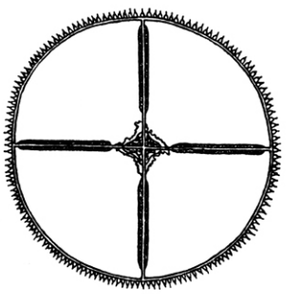


Fig. 190. *Phialidium islandicum* (after Kramp).

folded; 60—85 tentacles with globular bulbs and some few young bulbs; one marginal vesicle between successive tentacles. Specimens are seen with 3 and with 6 radial canals.—Falkland Islands; southern Brazil; north-eastern Australia. (Browne & Kramp 1939 p. 299, Pl. 17 fig. 5—9; Kramp 1953 p. 272).

Phialidium islandicum Kramp 1919. 35—40 mm. wide, watchglass-shaped, jelly thin; stomach very small, cruciform; mouth with four pointed, crenulated lips; gonads linear along almost entire length of radial canals; about 200 tentacles with swollen basal bulbs; marginal vesicles alternating with tentacles.—North-western Europe; Iceland. (Kramp 1919 p. 95, Pl. 4 fig. 11—13, Pl. 5 fig. 1, 2; Russell 1953 p. 294, text-fig. 180, 181).

Phialidium folleatum (McCrady 1857). 5 mm. wide, hemispherical or somewhat flatter, jelly thin; stomach small, mouth with four short, slightly recurved lips; gonads oval, in distal portion of radial canals; 16 (rarely more) tentacles with tapering basal bulbs; marginal vesicles alternating with tentacles, each with one concretion.—Woods Hole to Florida. (Mayer 1910 p. 264, Pl. 31 fig. 9, 10, Pl. 33 fig. 1—3, as *Clytia folleata*).

Phialidium bicophorum (L. Agassiz 1862). 5.5 mm. wide, two to three times as broad as high; stomach small, short; four small, simple lips; gonads spindle-shaped, in middle $^1/_4$ of radial canals; 16 tentacles; marginal vesicles alternating with tentacles.—New England coast. Other records of this species are uncertain. (Mayer 1910 p. 262, as *Clytia volubilis*, in part).

Phialidium globosum[1]) (Mayer 1900). 14 mm. wide, globular, jelly very thick; stomach very short, mouth with four prominent lips; gonads linear, wavy, along distal half part of radial canals; 32 large tentacles alternating with as many rudimentary ones; 64 marginal vesicles, each with 3—5 concretions.—Florida. (Mayer 1910 p. 272, Pl. 34 fig. 4).

[1]) In the explanation of fig. 4 in Mayer, 1910, the name is written *globulosum*.

Phialidium gelatinosum (MAYER 1900). 3.3 mm. wide, 7 mm. high, upper half part of umbrella very thick; stomach long and slender, four prominent lips; gonads linear, along proximal $^1/_3$—$^2/_5$ of radial canals; 16 well developed and 16 rudimentary tentacles alternating with 32 marginal vesicles, each with 3—5 concretions.—Florida. (MAYER 1910 p. 272, Pl. 34 fig. 1).

Phialidium singularis (MAYER 1900). 2 mm. wide, sides quite straight and sloping, near apex a sharp constriction above which is a lens-shaped, apical projection; stomach quadrangular, four simple lips; gonads

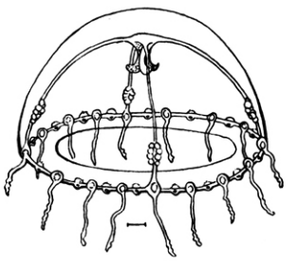


Fig. 191. *Phialidium folleatum* (after MAYER, from KRAMP).

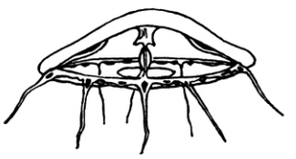


Fig. 192. *Phialidium bicophorum* (after AGASSIZ, from KRAMP).

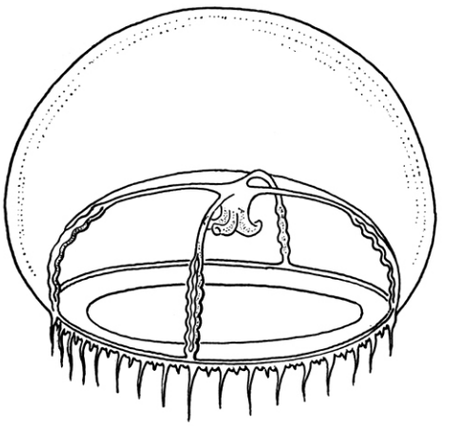


Fig. 193. *Phialidium globosum* (after MAYER, redrawn by P. W.).

short, near base of stomach; 16 well developed and 16 rudimentary tentacles alternating with 32 marginal vesicles, each with one concretion.—Rhode Island in New England. (MAYER 1910 p. 273, Pl. 35 fig. 9, 10).

Phialidium iridescens MAAS 1906. 4—5 mm. wide, somewhat globular, jelly fairly thick, subumbrella iridescent; stomach wide, quadrangular, mouth with four small, complexly folded lips; gonads spindle-shaped, along middle portion of radial canals; 16 well developed tentacles with broad, conical bases, and

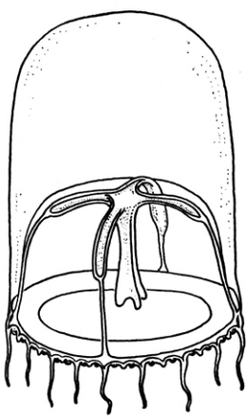


Fig. 194. *Phialidium gelatinosum* (after MAYER, redrawn by P. W.).

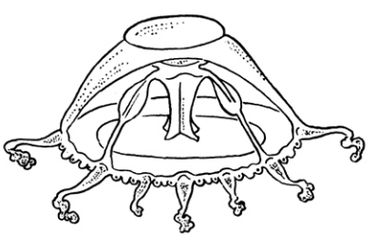


Fig. 195. *Phialidium singularis* (after MAYER, redrawn by P. W.).

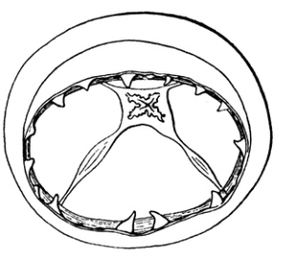


Fig. 196. *Phialidium iridescens* (after MAAS, from MAYER).

16 small tentacles, large and small not regularly alternating; number and structure of marginal vesicles unknown.—Antarctic Seas. (MAYER 1910 p. 273, fig. 147). Provisionally referred to *Phialidium*.

Phialidium brunescens (BIGELOW 1904). 2 mm. wide, 0.7 mm. high, manubrium very short and broad; gonads large, thick and prominent, proximal; about 30 short, thick tentacles, a prominent, brown pigment

spot at base of each tentacle; 32—40 marginal vesicles.—Maldive Islands; recorded by THIEL (1938) from off the coast of Brazil. (MAYER 1910 p. 274, fig. 148).

Phialidium noliformis (McCRADY 1859). Newly hatched medusa: Bell-shaped, as high as wide, numerous nematocysts on exumbrella; stomach small, spherical, with narrow mouth-tube, no lips; no trace of gonads; 4 perradial tentacles and 4 minute interradial bulbs; 8 marginal vesicles.—Mediterranean coast of France; Brazil. The hydroid, *Campanularia noliformis*, has a circumglobal distribution in warm seas. (PICARD 1949 pp. 184—190, fig. 1, 2). The newly hatched medusa differs from corresponding stages of *P. hemisphaericum* by complete absence of gonads.

Phialidum ovalis (MAYER 1900). Abnormal medusa: 2.4 × 4 mm. wide; a single, straight canal along major axis of bell; up to four stomachs along the canal; two small gonads near ends of canal; 20—25 short tentacles;

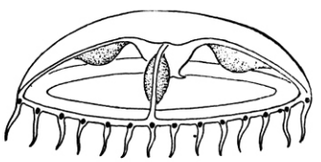


Fig. 197. *Phialidium brunescens* (after BIGELOW, from MAYER).

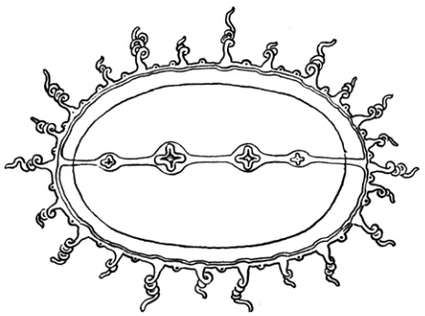


Fig. 198. *Phialidium ovalis* (after MAYER, redrawn by P. W.).

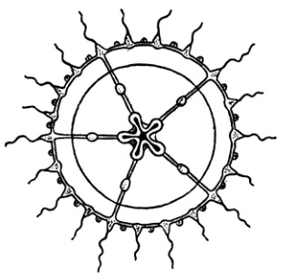


Fig. 199. *"Pseudoclytia pentata"* (after MAYER).

marginal vesicles slightly more numerous than tentacles, each with one concretion.—Florida; Brazil. (MAYER 1910 p. 281, Pl. 35 fig. 7, 8 as *Gastroblasta ovalis*). This is evidently an abnormal form of *Phialidium*, but it cannot be referred to any known species of this genus.

"Pseudoclytia pentata" MAYER 1900. 8—13 mm. wide, flatter than a hemisphere; stomach flask-shaped, five simple, recurved lips; gonads short, oval, in middle parts of five radial canals, 72° apart; 20 tentacles alternating with 20 marginal vesicles, each with one concretion.—Florida. (MAYER 1910 p. 278, Pl. 35 fig. 4—6, Pl. 36 fig. 7, text-fig. 150 A). This is likewise an abnormal form of *Phialidium*, similar to *P. folleatum* except in position of the gonads. The six-radiate specimen from South-Africa, described by THIEL, 1938, probably belongs to *P. hemisphaericum*.

Family **Phialellidae.**

Leptomedusae with small stomach; with 4 radial canals; with gonads divided into two lateral parts separated by a median groove; without marginal or lateral cirri; with 8 closed marginal vesicles each with two or more concretions; without ocelli; without excretory pores.—Hydroids, where known, *Campanulina*-like.

Phialella BROWNE 1902. With the characters of the family.—Type species: *P. falklandica* BROWNE. Synonyms: *Thaumantias* ESCHSCHOLTZ 1829, in part; *Eucope* GEGENBAUR 1856, in part.

Key to the species of Phialella.

1. With 4 perradial tentacles, no interradial bulbs (young medusa) ..... *parvigastra.*
   With several tentacles (youngest stage with four interradial bulbs) ..... 2.
2. Gonads in wavy folds along greater part of radial canals; about 60 tentacles ..... *falklandica.*
   Gonads oval, in distal third of radial canals; 16—32 tentacles ..... *quadrata.*

Phialella quadrata (FORBES 1848). Up to 13 mm. wide, hemispherical, with thick walls; stomach short, quadratic, with small base; four short, slightly folded lips; gonads on distal third of radial canals, elongated oval, with median groove; 16—32 tentacles with small, globular bulbs; 8 marginal vesicles with 2—4 or more concretions.—North-western Europe; Gulf of Guinea; New Zealand. (MAYER 1910 p. 235, as *Eucope globosa*; RUSSELL 1953 p. 315, Pl. 16 fig. 4—6, Pl. 17 fig. 5, text-fig. 196—200). Synonyms: *Thaumantias* spp. FORBES 1848; *Th. cymbaloides* VAN BENEDEN 1866; *Phialidium cymbaloideum* BROWNE 1896.

Phialella falklandica BROWNE 1902. Up to 17 mm. wide, semiglobular, with thick walls; stomach short, quadratic, four lips with fimbriated margin; gonads along greater part of radial canals, hanging down in wavy folds; about 60 tentacles with globular bulbs; 8 marginal vesicles on broad, cushion-like bulbs, each

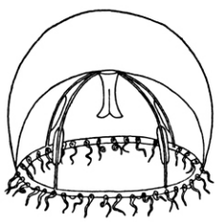


Fig. 200. *Phialella quadrata* (after BROWNE, from KRAMP).

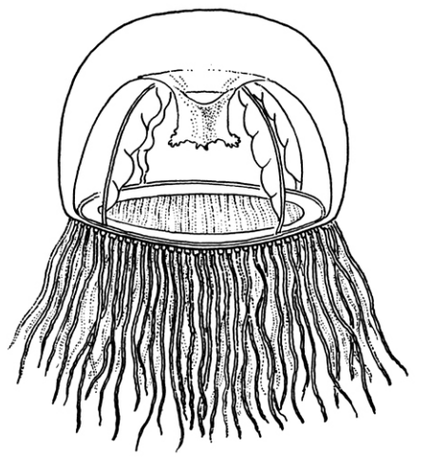


Fig. 201. *Phialella falklandica* (after BROWNE & KRAMP, redrawn by P. W.).

with 2 or more concretions.—Subantarctic: Falkland Islands; southern Patagonia; southern part of west coast of South America; Auckland and Campbell Islands.—(MAYER 1910 p. 237, as *Eucope falklandica*; BROWNE & KRAMP 1939 p. 296, Pl. 17 fig. 2—4, Pl. 19 fig. 3—5, text-fig. 1).

Phialella parvigastra (MAYER 1900). 1 mm. high, half-egg-shaped; stomach very small, four simple lips; gonads swollen-linear, near middle point of radial canals; 4 small tentacles; 8 marginal vesicles, each with one concretion (young medusa).—Florida. (MAYER 1910 p. 238, Pl. 31 fig. 5, as *Eucope parvigastra*).

Family **Lovenellidae.**

Leptomedusae with small stomach; with 4 simple radial canals; without peduncle; with gonads on radial canals separated from stomach; with lateral cirri; without marginal cirri; with closed marginal vesicles; without ocelli; without excretory pores.—Hydroid, where known, *Lovenella*-like.

Key to the genera.

With fixed number of marginal vesicles, 8 or 12 ..... *Eucheilota.*
With indefinite number of marginal vesicles, 16 or more ..... *Lovenella.*

Lovenella HINCKS 1868. Lovenellidae with 16 or more marginal vesicles. Hydroid *Lovenella*.—Type species: *L. clausa* HINCKS. Synonyms: *Eucheilota* MCCRADY 1859, in part; *Mitrocoma* HAECKEL 1864, in part; *Phialium* HAECKEL 1879.

Key to the species of Lovenella.

1. With gonads in distal part of radial canals; cirri at base of well-developed tentacles only..... 2.
   With swollen gonads near stomach; cirri also on rudimentary bulbs between tentacles.. *bermudensis.*
2. With 8—16 tentacles, each with 3—4 pairs of lateral cirri; several marginal warts without cirri.. *cirrata.*
   With 16—24 tentacles, each with 1—3 pairs of lateral cirri; no rudimentary marginal warts... *clausa.*

Lovenella clausa HINCKS 1871. 5—9 mm. wide, hemispherical, jelly moderately thick; stomach short and small; four small simple lips; gonads oval, longitudinally divided, very close to ring canal; 16—24 tentacles with large conical bulbs; 1—3 lateral, spiral cirri on either side of each tentacle base; 16—23 marginal vesicles, each with one concretion.—Southern England and Ireland. (RUSSELL 1953 p. 307, Pl. 16 fig. 2, Pl. 18 fig. 3, 4, text-fig. 189—192). Synonym: *Eucheilota hartlaubi* RUSSELL 1936.

Lovenella cirrata (HAECKEL 1879). Up to 16 mm. wide, almost hemispherical; stomach short, urn-shaped; four simple lips; gonads spindle-shaped, on distal half of radial canals; 8—16 tentacles with large bulbs,

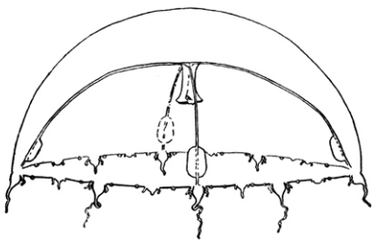


Fig. 202. *Lovenella clausa* (after RUSSELL).

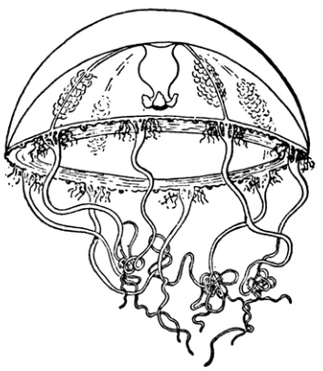


Fig. 203. *Lovenella cirrata* (after HARTLAUB, from MAYER).

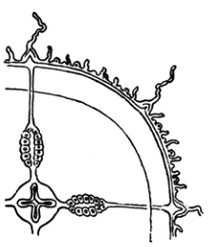


Fig. 204. *Lovenella bermudensis* (after MAYER, redrawn by P.W.).

each flanked by 3—4 pairs of spiral cirri; usually 3 rudimentary marginal warts between successive tentacles; about 16 marginal vesicles, each with about three concretions.—Mediterranean; west coast of Africa; off the mouth of the Amazon river. (MAYER 1910 p. 288, text-fig. 153, 154, as *Mitrocoma cirrata*; KRAMP 1953 p. 254, as *Eucheilota cirrata*). Synonyms: *Mitrocomium cirratum* HAECKEL 1879; *Euchilota multicirrata* THIEL 1938.

Lovenella bermudensis (FEWKES 1883). 6 mm. wide, somewhat higher than a hemisphere; stomach short, wide; four slightly recurved lips; gonads swollen, near stomach; 8 tentacles, each with one pair of lateral cirri; between successive tentacles up to 6 rudimentary marginal warts some of which carry one lateral cirrus; about 32 marginal vesicles, each with one concretion.—Bermudas; Florida. (MAYER 1910 p. 282, Pl. 37 fig. 4, Pl. 38, fig. 2, 3, as *Eucheilota bermudensis*).

Eucheilota MCCRADY 1859. Lovenellidae with fixed number of maginal vesicles, usually 8 or 12. Hydroids unknown.—Type species: *E. ventricularis* MCCRADY.

Key to the species of Eucheilota.

1. With about 12 marginal vesicles ..... 6.
   With 8 marginal vesicles ..... 2.
2. Stomach with four interradial black spots; 16—30 tentacles ..... *maculata.*
   Stomach without black spots ..... 3.

3. Tentacle bulbs with two pairs of lateral cirri; 16 tentacles ..... *flevensis.*
   Tentacle bulbs with one pair of lateral cirri ..... 4.
4. With 16 tentacles with cirri; about 40 rudimentary marginal bulbs, 16 of which have cirri. . *ventricularis.*
   With 4 tentacles and 4 or more rudimentary bulbs, some of which have cirri ..... 5.
5. With medusa buds on gonads ..... *paradoxica.*
   No medusa buds (young medusa) ..... *maasi.*
6. With 12 marginal vesicles; 4 tentacles ..... *duodecimalis.*
   With up to 14 marginal vesicles; 17—19 tentacles ..... *comata.*

Eucheilota ventricularis McCrady 1859. 10 mm. wide, hemispherical; stomach short; four prominent lips; gonads linear, along middle $^1/_3$ or distal $^2/_3$ of radial canals; 16 tentacles and 16 rudimentary bulbs, all

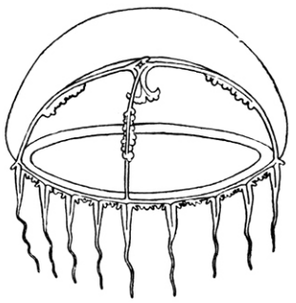


Fig. 205. *Eucheilota ventricularis* (after Mayer, from Kramp).

Fig. 206. *Eucheilota maculata*, stomach and bell margin (after Kramp).

with one pair of lateral cirri; also about 24 minute knobs without cirri; 8 marginal vesicles, each with about 8 concretions.—East coast of North America from Vineyard Sound to Florida; southern part of west coast of Greenland; West Africa. Records from Red Sea and Indian Ocean by Vanhöffen, 1911, are doubtful. (Mayer 1910 p. 282, Pl. 37 fig. 5, Pl. 38 fig. 1).

Eucheilota maculata Hartlaub 1894. Up to 13 mm. wide and 10 mm. high; stomach small, with four large, interradial black spots; four well developed lips; gonads linear, along distal $^2/_3$ of radial canals; 16—20 (up to 30) long tentacles with one pair of spiral, lateral cirri; 1—3 rudimentary bulbs between successive tentacles, with cirri; 8 marginal vesicles, each with 5—10 concretions.—North-western Europe. (Mayer 1910 p. 285; Russell 1953 p. 311, text-fig. 193—195).

Eucheilota flevensis van Kampen 1922. Size ?; 16 tentacles, each with two pairs of lateral cirri; 8 marginal vesicles; no black spots on stomach.—Only found in the Zuiderzee in Holland, from where it has now disappeared. (van Kampen 1922 p. 212, fig. 1, 2).

Eucheilota paradoxica Mayer 1900. 4 mm. wide, higher than a hemisphere; stomach small, flask-shaped; gonads swollen, in middle part of radial canals; medusa buds are developed on gonads; 4 large tentacles with one pair of lateral cirri and 4 interradial rudimentary bulbs flanked by cirri; 8 marginal vesicles, each with one concretion.—Florida; Bahamas; Japan. (Mayer 1910 p. 285, Pl. 37 fig. 3—3″).

Eucheilota maasi Neppi & Stiasny 1911. 3—5 mm. wide, 3 mm. high, jelly thick; stomach cylindrical, half as long as bell cavity; small (immature) gonads on middle part of radial canals; 4 tentacles with thick, round bulbs with one pair of lateral cirri, and a number of rudimentary bulbs, some of which have cirri; 8 marginal vesicles, each with one concretion.—Adriatic Sea. (Neppi & Stiasny 1913 p. 46, Pl. 3 fig. 32, 33).

Eucheilota duodecimalis A. Agassiz 1862. 2.5 mm. wide, higher than a hemisphere, manubrium very short; gonads along distal half of radial canals; 4 tentacles with one pair of lateral cirri; 12 marginal vesicles,

each with one concretion.—East coast of North America from Florida to Cape Cod; Pacific coast of Mexico. (MAYER 1910 p. 283, Pl. 36 fig. 6, Pl. 37 fig. 1, 2, text-fig. 151).

Eucheilota comata (BIGELOW 1909). 6—12 mm. wide, somewhat higher than a hemisphere, thick; stomach short, flask-shaped, sometimes with a low peduncle; gonads linear from middle $^1/_3$ to near distal end of radial canals; 17 tentacles and 23 rudimentary bulbs (in Pacific specimens) or 19 tentacles and 62 rudimentary bulbs (in West Indian specimens), each flanked by 1—3 pairs of lateral cirri; 7—14 large marginal vesicles, number not increasing with age.—Pacific coast of Mexico; West Indies. (BIGELOW 1909 *a* p. 158, Pl. 5 fig. 6, 7, Pl. 6 fig. 9, Pl. 37 fig. 9, 10, 12; as *Phialucium comata*). MAYER (1910 p. 276) was inclined to refer this species to the genus *Phialopsis*, but since the number of marginal vesicles does not increase with age, it may better be placed in the genus *Eucheilota*.

Fig. 207. *Eucheilota paradoxica* (after MAYER, redrawn by P. W.).

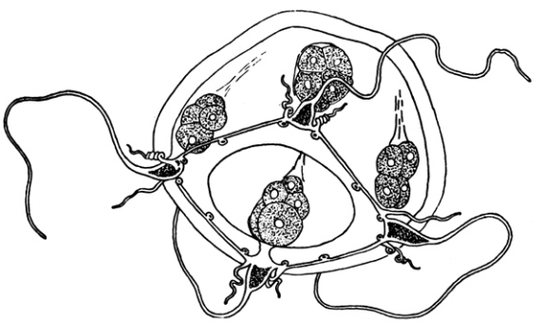


Fig. 208. *Eucheilota duodecimalis* (after MAYER).

Eucopida incertae sedis.

Eugymnanthea PALOMBI 1935.—Type species: *E. inequilina* PALOMBI.

Eugymnanthea inequilina PALOMBI 1935. 0.55 mm. high and wide; without manubrium and tentacles; 4 simple unbranched radial canals; four large, sac-like, oval gonads on radial canals, not lobular; 8 adradial marginal vesicles. Medusa reared from an athecate hydroid living on mantle, food and gills of the lamellibranch *Tapes decussatus*.—Naples. (PALOMBI 1935 pp. 159—168, Pl. 2, text-fig. 1—8).

Blackfordia MAYER 1910. Eucopida with 4 radial canals; without gastric peduncle; with gonads completely surrounding radial canals; with numerous hollow marginal tentacles; the endodermal cores of the tentacles extend inwards from the bell margin into the gelatinous substance of the bell; with numerous closed marginal vesicles; without permanently rudimentary tentacles; without marginal or lateral cirri.—Type species: *B. manhattensis* MAYER.

Key to the species.

With 2—3 marginal vesicles between successive tentacles ..... *manhattensis.*
With one marginal vesicle between successive tentacles ..... *virginica.*

Blackfordia manhattensis MAYER 1910. 10 mm. wide, higher than a hemisphere, with rounded apex; stomach narrow, half as long as bell cavity; four long, slender, frilled lips; gonads on middle part of radial canals, elongated, undulated; 70—80 tentacles, with finger-shaped endodermal diverticula into bell margin;

2—3 marginal vesicles between successive tentacles, each with 2—5 concretions; no black pigment at base of marginal vesicles.—New Jersey on Atlantic coast of North America. (MAYER 1910 p. 277, Pl. 36 fig. 2—2‴).

Blackfordia virginica MAYER 1910. 14 mm. wide, higher than a hemisphere, with rounded apex; stomach narrow, half as long as bell cavity; four long, recurved, fluted lips; gonads linear, from corners of stomach extending along somewhat more than half the length of radial canals; about 80 long tentacles with finger-shaped or broadly oval diverticula into bell margin; one (rarely two) marginal vesicles between successive tentacles, each with 2—3 concretions. According to the original description black pigment granules are present at the base of the marginal vesicles, but examination of specimens from all three localities has revealed no such pigment.—Indigenous in the Mandra swamps on the Bulgarian coast of the Black Sea; originally recorded from Chesapeake Bay on the American coast and recently found in the Ganges estuary near Calcutta

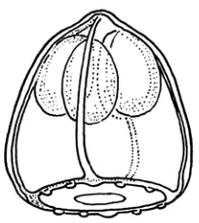


Fig. 209. *Eugymnathea inequilina* (after PALOMBI, redrawn by P. W.).

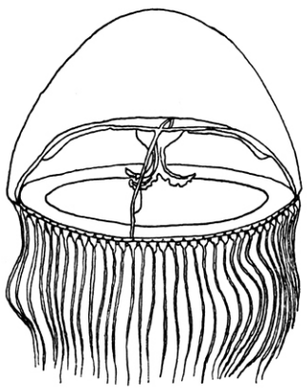


Fig. 210. *Blackfordia virginica* (after MAYER, from THIEL).

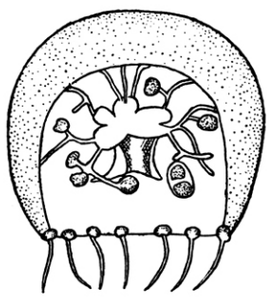


Fig. 211. "*Dipleurosoma gemmifera*" (after THIEL).

in India. The occurrence in America and India is presumably due to transportation with ships. (MAYER 1910 p. 277, Pl. 36 fig. 3—5, Pl. 37 fig. 6; KRAMP, Indian Medusae, in press).

Future examination of *B. manhattensis* may possibly show that the two species are identical.

"*Dipleurosoma gemmifera*" THIEL 1938.

2 mm. high, 3 mm. wide; stomach fairly short, branching into 5 lobes, each lobe giving rise to 1—3 radial canals which sometimes branch dichotomously, 13 canals extending to the ring canal, the others ending blindly in medusa buds; about 13 fairly short tentacles with globular bulbs; one closed lithocyst between successive tentacles (!).—Gulf of Guinea. (THIEL 1938 p. 324, fig. 5—7).

Family **Phialuciidae.**

Leptomedusae with small stomach; with 4—8 radial canals; without gastric peduncle; with gonads completely surrounding radial canals and separated from stomach; with excretory papillae on adaxial side of marginal bulbs; without marginal or lateral cirri; with closed marginal vesicles.

Phialucium MAAS 1905.

Phialuciidae with normally 4 radial canals.—Type species: *P. carolinae* (MAYER). Discussion in KRAMP 1953 pp. 273 ff.

Phialucium carolinae (MAYER 1900). 14—20 mm. wide, not quite hemispherical, jelly fairly thick; stomach flask-shaped, simple lips; usually 4 but sometimes up to 8 radial canals; gonads linear, along distal half

of radial canals; 16—36 well-developed tentacles; between successive tentacles usually 3 rudimentary bulbs, the middle one the largest, and 4 marginal vesicles, each with 2 concretions.—Florida and South Carolina; India; Malayan Archipelago; North-east Australia; Philippines; southern China. (MAYER 1910, p. 275, Pl. 36 fig. 1′, 1″; BIGELOW 1919 p. 293—295, Pl. 41 fig. 8; KRAMP 1953 p. 276, text-fig. 2, 3). Synonyms: *Octocanna polynema*, MAAS 1905; *Phialidium heptactis*, VANHÖFFEN 1911; *Phialidium phosphoricum* f. *polynema* VANHÖFFEN 1912 *a*; *Phialucium mbenga*, BIGELOW 1919; *P. m.* var. *polynema* BIGELOW 1919; probably also *Pseudoclytia longleyi* BURKENROAD 1931. Specimens of *Phialucium virens* (BIGELOW 1904) MAAS 1905 belong partly to *P. carolinae*, partly to *P. mbenga*.

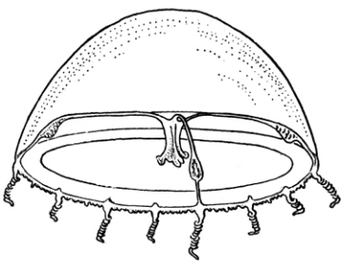


Fig. 212. *Phialucium carolinae* (after MAYER, redrawn by P. W.)

It is mainly in the Indo-West-Pacific region that specimens with more than four radial canals occur; the variation is discussed in KRAMP 1953.

Octophialucium KRAMP 1955. Phialuciidae with normally 8 radial canals.—Type species: *P. medium* KRAMP.— The genus was established to comprise several species previously referred to *Octocanna* HAECKEL 1879, which is an altogether doubtful genus. Discussion in KRAMP 1955 pp. 256 ff.

Key to the species of Octophialucium.

With 16 tentacles and about three times as many young bulbs; gonads elongated ..... *medium.*
With 64—128 tentacles, very few young bulbs; gonads very short ..... *funerarium.*

Octophialucium funerarium (QUOY & GAIMARD 1827). 30—40 mm. wide, lens-shaped, very thick with a thin margin; stomach very small, four small, simple lips; gonads along distal $^1/_4$ of radial canals, near margin; 64—128 temtacles; usually 2 marginal vesicles between successive tentacles, each with 1—3 concretions.—Mediterranean; North-western Europe; in deep and intermediate water. (KRAMP & DAMAS 1925 p. 306, fig. 27—33; RUSSELL 1953 p. 337, Pl. 21 fig. 1, text-fig. 215—219 as *Octocanna funeraria*).

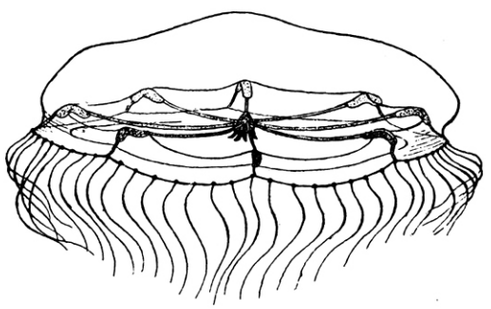


Fig. 213. *Octophialucium funerarium* (after KRAMP & DAMAS).

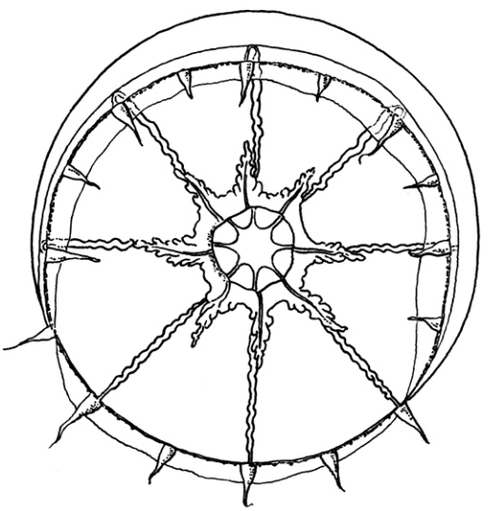


Fig. 214. *Octophialucium medium* (after KRAMP, redrawn by P. W.).

Octophialucium medium KRAMP 1955. 17—30 mm. wide, evenly vaulted, not lenticular; stomach $^1/_7$ as wide as umbrella, with broad star-shaped figure; 8 long and pointed, crenulated lips; gonads linear, along distal $^2/_3$—$^3/_4$ part of radial canals; 16 tentacles; between successive tentacles usually three young bulbs and 4 marginal vesicles. The number of radial canals is usually 8, varying from 6 to 11.—Gulf of Guinea. (KRAMP 1955 p. 257, Pl. 2 fig. 1, text-fig. 4, 5).

Octophialucium sp. West Indies; see the present paper, p. 36.

Family **Eirenidae.**

Leptomedusae with small stomach; with 4 or 6 simple radial canals; with a gastric peduncle; with gonads on radial canals restricted to subumbrella, completely surrounding radial canals; with hollow marginal tentacles with or without excretory pores; with or without lateral or marginal cirri; with numerous closed marginal vesicles; without ocelli.

Key to the genera.

1. Without cirri ..... *Eirene.*
   With cirri ..... 2.
2. With lateral cirri ..... *Helgicirrha.*
   With marginal cirri ..... *Phialopsis.*

Eirene ESCHSCHOLTZ 1829. Eirenidae without lateral or marginal cirri.—Type species: *E. viridula* (PÉRON & LESUEUR). Synonyms: *Phortis* MCCRADY 1857; *Irene* HAECKEL 1879.

Key to the species of Eirene.

1. Peduncle slender with pyramidal base ..... 2.
   Peduncle very wide ..... 3.
2. With 60 or more tentacles of different sizes; lips long and pointed, crenulated ..... *viridula.*
   With 18—22 short tentacles; lips fairly short, simple, recurved ..... *lactea.*
3. Umbrella flatter than a hemisphere; stomach very small ..... *pyramidalis.*
   Umbrella higher than wide; stomach quite large ..... *gibbosa.*

Eirene viridula (PÉRON & LESUEUR 1809). 20—30 mm. wide, umbrella hemispherical, middle portion fairly thick; peduncle slender, with pyramidal base; stomach fairly small but with four long, pointed lips with crenulated margins; gonads linear, extending from somewhat beyond base of peduncle almost to bell

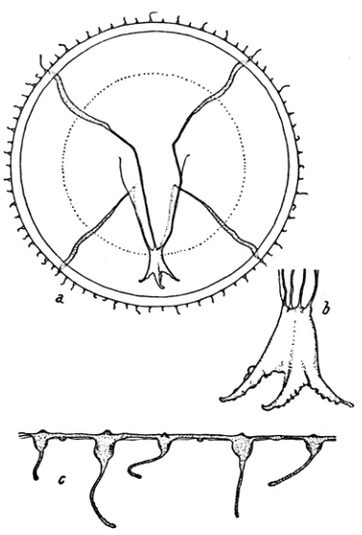


Fig. 215. *Eirene viridula*, with stomach and bell margin (after KÜNNE).

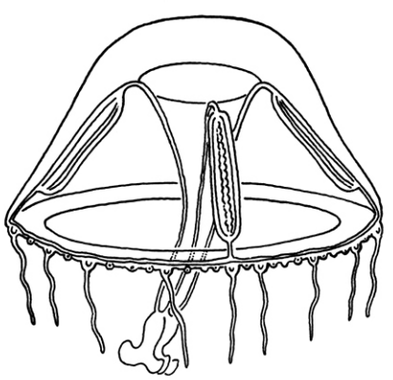


Fig. 216. *Eirene lactea* (after MAYER, redrawn by P. W.).

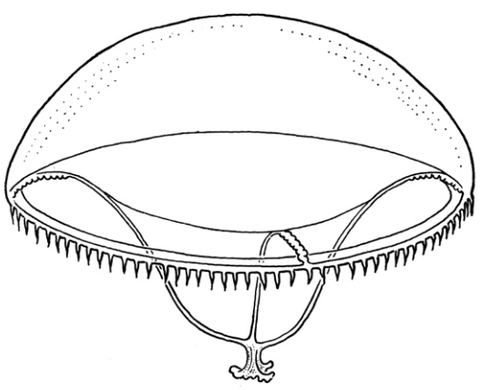


Fig. 217. *Eirene pyramidalis* (after MAYER, redrawn by P. W.).

margin; about 60 or more tentacles of different sizes, large and small frequently alternating; bulbs conical, with distinct adaxial excretory papillae; 40 or more marginal vesicles, each with 1—4 concretions.—Northwestern Europe; Mediterranean; west coast of Africa; east coast of Africa; Cylon. (KRAMP 1936 pp. 244, 245, as *E. viridula* + *pellucida*, bibliography; RUSSELL 1953 p. 321, Pl. 20 fig. 3, 4, text-fig. 201—205; non *Eirene viridula* MAYER 1910 p. 311, fig. 172). Synonym: *Eirene pellucida* (WILL 1844).

Eirene lactea (MAYER 1900). 5 mm. wide, higher than a hemisphere, middle portion fairly thick; peduncle slender with wide base; stomach small, cruciform, four simple, recurved lips fairly short; gonads linear, extending from near base of peduncle to near bell margin; 18—22 short tentacles with large, swollen bulbs; exretory papillae ?; marginal vesicles slightly more numerous than tentacles, each with one concretion.—Florida. (MAYER 1910 p. 308, Pl. 40 fig. 2, Pl. 41 fig. 6, as *Phortis lactea*).

Eirene pyramidalis (L. AGASSIZ 1862). 35 mm. wide, flatter than a hemisphere, jelly very thick; peduncle very wide, cone-shaped; stomach very small, with small, crenated lips; gonads linear, along distal portion of radial canals near margin; about 100 small, slender tentacles, with excretory pores; about 100 marginal vesicles, each with one concretion.—Bahamas; Florida; Jamaica. (MAYER 1910 p. 308, Pl. 39 fig. 3—6, as *Phortis pyramidalis*; KRAMP 1936 p. 247, bibliography).

Eirene gibbosa (MCCRADY 1857), non ESCHSCHOLTZ. About 25 mm. wide, somewhat higher than wide; peduncle wide and not very long; stomach quite large; gonads linear, along distal portions of radial canals, between base of peduncle and bell margin; about 60 long slender tentacles with large basal bulbs; about 60 marginal vesicles, each with one concretion.—Southern part of the New England coast. (MAYER 1910 p. 307, as *Phortis gibbosa*; KRAMP 1936, bibliography). This was the type species of *Phortis*; it has been observed only twice, and it has never been figured. It may prove to be identical with *E. pyramidalis*, from which it should be distinguished by the high shape of the umbrella.

Helgicirrha HARTLAUB 1909. Eirenidae with lateral cirri at the base of some or all the tentacle bulbs; with excretory pores. Type species: *H. schulzei* HARTLAUB.—Frequently confounded with *Eirene*.

Key to the species of Helgicirrha.

Mouth with long, pointed, crenulated lips ..... *cari.*
Lips almost rudimentary ..... *schulzei.*

Helgicirrha schulzei HARTLAUB 1909. 30—40 mm. wide, flatter than a hemisphere, jelly fairly thin; peduncle narrow, elongated conical; stomach small, mouth with four very short, slightly folded lips; gonads linear,

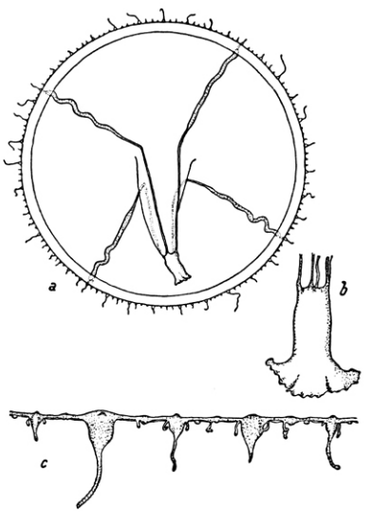


Fig. 218. *Helgicirrha schulzei*, with stomach and bell margin (after KÜNNE).

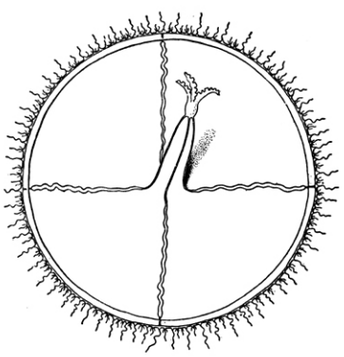


Fig. 219. *Helgicirrha cari* (after MAYER).

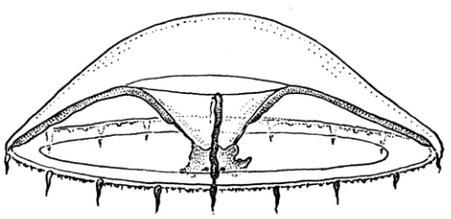


Fig. 220. *Phialopsis diegensis* (after RUSSELL, redrawn by P. W.).

extending from near base of peduncle almost to bell margin; 30—40 large tentacles with elongated conical basal bulbs with adaxial excretory pore and with or without lateral cirri; up to 100 or more small tentacles or rudimentary bulbs each with one pair of lateral cirri; 50 or more marginal vesicles, each with 1—4 concretions.—North-western Europe; Mediterranean; off Congo, West Africa (KRAMP 1936 p. 254, bibliography; RUSSELL 1953 p. 328, Pl. 20 fig. 1, 2, text-fig. 206—212).

Helgicirrha cari (HAECKEL 1864). 25—50 mm. wide, rather flat, jelly thin; peduncle narrow, short, half as long as radius of umbrella; stomach small, lips long, lanceolate, with crumpled margins; gonads linear narrow, extending from near base of peduncle to near bell margin; 50—60 short tentacles with excretory papillae, but without lateral cirri; moreover about 100 smaller tentacles, each with one pair of lateral cirri; about 100 marginal vesicles, each with 2—4 concretions.—Mediterranean and adjacent parts of Atlantic Ocean. (MAYER 1910 p. 311, text-fig. 172, as *Eirene viridula*; KRAMP 1936 p. 253, bibliography).

Phialopsis TORREY 1909. Eirenidae with marginal cirri; without excretory pores.—Type species: *P. diegensis* TORREY.

Phialopsis diegensis TORREY 1909. 20—30 mm. wide, 3—4 times as wide as high, jelly moderately thick in middle portion; peduncle very short, conical; stomach very short, mouth with very short, crenulated lips; gonads linear, extending from base of peduncle almost to bell margin; 16—28 tentacles with elongated conical bulbs; between successive tentacles 3—9 triangular rudimentary bulbs, 3—9 scattered marginal cirri, and 2—5 marginal vesicles, each with 2—6 concretions; no lateral cirri.—Northern Atlantic as far north as the Irminger Sea; common in the eastern tropical Atlantic; off the Cape of Good Hope; off Uruguay in South America; off the east coast of Africa; in the Pacific it is recorded from S. W. of the Galapagos Islands and from San Diego in California, from where it was first described. It belongs mainly to the deeper parts of the epipelagic region and it has a predominantly oceanic distribution. (RUSSELL 1953 p. 333, Pl. 20 fig. 5, text-fig. 213, 214; see also the present paper p. 37).

Family **Eutimidae.**

Leptomedusae with small stomach; with 4 simple radial canals; with distinct gastric peduncle; with gonads on radial canals separated from stomach, longitudinally divided; with hollow marginal tentacles; without excretory pores; without marginal cirri; with or without lateral cirri; with closed marginal vesicles, usually 8; without ocelli.

Differs from the Eirenidae in structure of the hydroid. If the number of marginal vesicles exceeds 8 or 12 the gonads are extended without interruption almost from stomach to bell margin. Moreover the gonads are divided into two lateral parts separated by a median groove which, however, is sometimes difficult to see.

Key to the genera.

1. With 8 (rarely 12) marginal vesicles ..... 2.
   With numerous marginal vesicles and marginal warts ..... 3.
2. With lateral cirri and with marginal warts ..... *Eutima.*
   Without cirri and without marginal warts ..... *Eutonina.*
3. Tentacles and marginal warts with lateral cirri. ..... *Irenium.*
   Without cirri ..... *Tima.*

Eutima MCCRADY 1857. Eutimidae with 8 (rarely 12) marginal vesicles; with lateral cirri and with marginal warts; with 2—32 tentacles.—Type species: *E. mira* MCCRADY.

The genus may be divided into two sub-genera: *Octorchis,* with marginal warts with adaxial papillae (which have no excretory pores), and *Eutima,* with marginal warts without adaxial papillae. Since, however, the descriptions of the species rarely give information of presence or absence of such papillae, the distinction of the two sub-genera (or genera, RUSSELL 1953), cannot be carried through.

Key to the species of Eutima.

1. With 8 gonads, 4 on subumbrella and 4 on peduncle ..... 2.
   With 4 gonads, usually restricted to peduncle ..... 4.

2. Peduncular gonads along greater part of peduncle; 4 tentacles ..... *mira.*
   Peduncular gonads short; 8—16 tentacles ..... 3.
3. Peduncular gonads in middle part of peduncle; tentacle bulbs and marginal warts with adaxial papillae ..... *gegenbauri.*
   Peduncular gonads near proximal end of peduncle; no adaxial papillae ..... *variabilis.*
4. Umbrella higher than wide; 8 tentacles ..... *gentiana.*
   Umbrella not as high as wide ..... 5.
5. With 2 or 4 tentacles; gonads restricted to narrow portion of peduncle ..... *gracilis.*
   With 32 tentacles; gonads extending from peduncle somewhat out on subumbrella ..... *coerulea.*

Eutima (*Octorchis*) *gegenbauri* (HAECKEL 1864). 20 mm. wide, almost hemispherical, apical jelly thick; peduncle very long, narrow, prismatic with rather broad base; stomach short, four very short lips; four

Fig. 221. *Eutima gegenbauri* (after HAECKEL, from KRAMP).

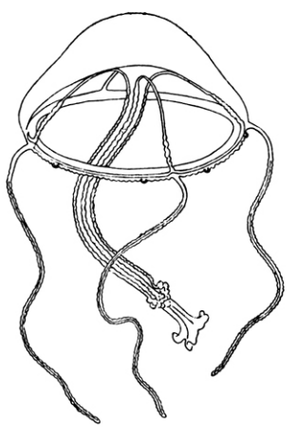


Fig. 222. *Eutima mira* (after MAYER, from KRAMP).

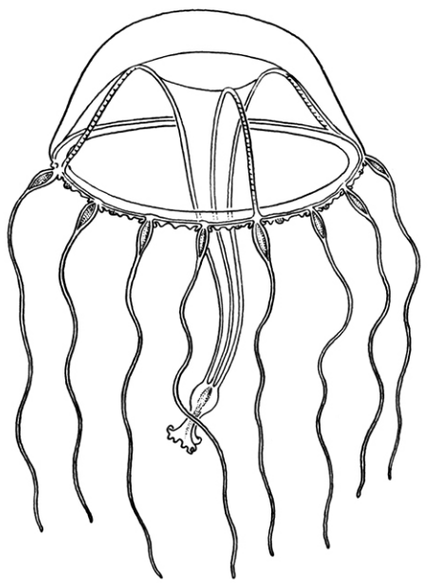


Fig. 223. *Eutima variabilis* (after MAYER, redrawn by P. W.).

short gonads on middle portion of peduncle or nearer stomach (in young specimens), four gonads on subumbrella only, extending from base of peduncle almost to bell margin; 8—16 tentacles and 60—80 marginal warts with adaxial papillae; tentacle bulbs and warts each with one or two lateral cirri; 8 marginal vesicles each with 6—12 or more concretions.—North-western Europe; Mediterranean. (MAYER 1910 p. 302, fig. 166, 167, as *Eutima campanulata*; RUSSELL 1953 p. 367, Pl. 22 fig. 4, text-fig. 233—239, as *Octorchis gegenbauri*). Synonyms: *Octorchis gegenbauri* + *campanulatus, Octorchandra germanica* and ? *canariensis* HAECKEL 1879.

Eutima mira MCCRADY 1857. Up to 30 mm. wide, as broad as high; peduncle long, slender, tapering; stomach small, flask-shaped; four simple recurved lips; 8 gonads, four along greater part of peduncle and four on subumbrella extending from base of peduncle outwards; 4 long tentacles with or without cirri; about 100 marginal warts, some of which have cirri; 8 marginal vesicles each with 4—8 concretions.—American coast from Woods Hole to Florida. (MAYER 1910 p. 295, Pl. 39 fig. 1, Pl. 40 fig. 3, 3′, text-fig. 160, 161).

Eutima variabilis MCCRADY 1857. 30 mm. wide, about three times as wide as high; jelly quite thick; peduncle conical, about twice as long as bell-diameter; 8 gonads, four near proximal end of peduncle and four on subumbella extending from base of peduncle to near bell margin; 16 tentacles of equal length, with lateral cirri; usually three marginal warts between successive tentacles, with cirri; 8, sometimes 12 marginal

vesicles, each with 5—8 concretions.—American coast from North Carolina to Florida. (MAYER 1910 p. 312, Pl. 38 fig. 4, Pl. 39 fig. 2, as *Eirene variabilis*).

Eutima gracilis (FORBES & GOODSIR 1853). Up to 13 mm. wide, almost hemispherical, jelly thick; peduncle very long, narrow with small conical base; stomach short; four small simple lips; four gonads restricted to narrow portion of peduncle, extending almost from base to stomach; 2 or 4 long perradial tentacles; 40—80 or more marginal warts; lateral cirri usually on all tentacle bulbs and warts; 8 marginal vesicles, each with 1—6, usually 3 concretions.—North-western and western Europe; Mediterranean; west coast of Africa; (RUSSELL 1953 p. 359, Pl. 22 fig. 1, text-fig. 226—232). Synonyms: *Eutima insignis* (KEFERSTEIN 1862) HAECKEL 1879; *Saphenia mirabilis* (WRIGHT 1859) HAECKEL 1879; *Saphenia gracilis* (FORBES & GOODSIR) MAYER 1910; *Eutimium elephas* HAECKEL 1879.

Eutima coerulea (L. AGASSIZ 1862). 10 mm. wide, a little broader than high, jelly thick at apex; peduncle half as long as bell diameter, slender, tapering; stomach short; four slightly fimbriated lips; four gonads

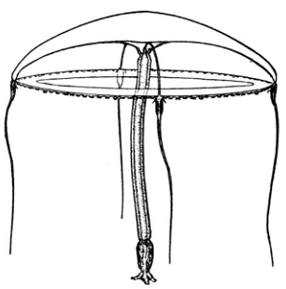


Fig. 224. *Eutima gracilis* (after KRAMP).

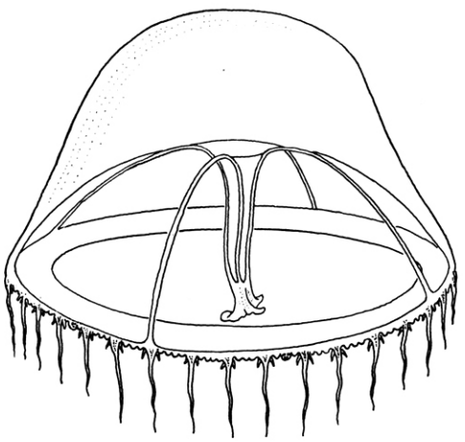


Fig. 225. *Eutima coerulea* (after MAYER, redrawn by P. W.).

extending from near stomach along peduncle and some way out onto subumbrella; about 32 tentacles with lateral cirri; about 96 marginal warts with cirri; 8 marginal vesicles, each with 3—5 concretions.—Bahamas and Florida. (MAYER 1910 p. 304, Pl. 41 fig. 4, 5).

Eutima gentiana (HAECKEL 1879). 8 mm. wide, 10 mm. high; peduncle prismatic, as long as bell diameter; four long gonads on peduncle; 8 tentacles each with two pairs of lateral cirri; 16 marginal warts with lateral cirri; 8 marginal vesicles each with 3—4 concretions.—Canary Islands. (MAYER 1910 p. 302, text-fig. 165).

This species has not been observed since it was described by HAECKEL, though recorded from Amoy in China by VANHÖFFEN (1912 *b*) who, however, identifies it with two or three other species.

Doubtful species:

Eutima cuculata BROOKS 1883. 8 mm. wide, flat, peduncle about as long as diameter of bell; 4 gonads, from base of peduncle to bell margin; 4 tentacles, without lateral cirri; 9—10 very small marginal cirri in each quadrant; 8 marginal vesicles, each with 3—8 concretions.—North Carolina, New England coast. (MAYER 1910 p. 208).—If the description of this species is correct, it cannot be included neither among the Eutimidae nor among the Eirenidae.

Eutonina HARTLAUB 1897. Eutimidae with 8 marginal vesicles; without cirri; without marginal warts.—Type species: *E. indicans* (ROMANES). Synonyms: *Eutimium* + *Eutimalphes* HAECKEL 1879 in part.

Key to the species of Eutonina.

With more than 100 tentacles; gonads long ..... *indicans.*
With about 30 tentacles; gonads short, distal ..... *scintillans.*

Eutonina indicans (ROMANES 1876). 25—35 mm. wide, slightly flatter than a hemisphere; jelly rather thick; peduncle thick, conical; stomach short, four folded lips; gonads linear, sinuous, along nearly whole subumbrellar portion of radial canals; about 200 short tentacles; 8 marginal vesicles, each with about 12 concretions.—North-western Europe; Iceland; Vancouver; Aleutian Islands; Kamchatka; Japan. (MAYER 1910 p. 306, as *Eutimium socialis*; RUSSELL 1953 p. 374, Pl. 22 fig. 2, text-fig. 240—254). Synonym: *Eutonina socialis* HARTLAUB 1897.

Eutonina scintillans (BIGELOW 1909). 10 mm. wide, 5 mm. high, jelly thick; peduncle short; stomach globular; four simple or slightly crenulated lips; gonads extending along distal $^1/_4$—$^1/_3$ of radial canals; about

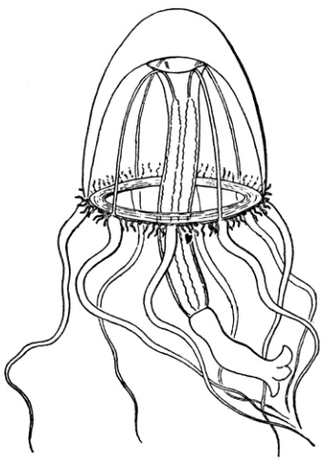


Fig. 226. *Eutima gentiana* (after HAECKEL, from MAYER).

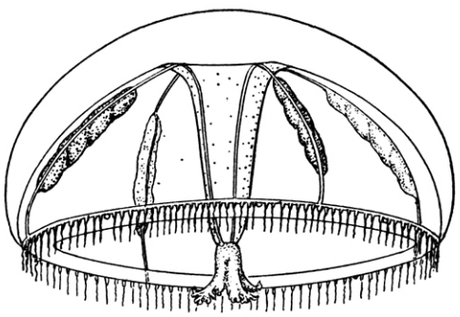


Fig. 227. *Eutonina indicans* (after KRAMP).

30 tentacles; 8 marginal vesicles, each with 2—5 concretions.—Adriatic Sea (young specimen); Djibouti on east coast of Africa; Pacific coast of Mexico. (BIGELOW 1909 *a* p. 167, Pl. 5 fig. 8, 9, Pl. 37 fig. 11, as *Eutimalphes scintillans*; MAYER 1910 p. 306, as *Eutimium scintillans*; NEPPI & STIASNY 1913 p. 48, Pl. 4 fig. 36, as *Eutimium scintillans*).

Tima ESCHSCHOLTZ 1829. Eutimidae with numerous marginal vesicles; without cirri; with marginal warts; with gonads upon entire length of radial canals; tentacles with an abaxial longitudinal groove.—Type species: *T. flavilabris* ESCHSCHOLTZ.

Key to the species of Tima.

1. With about 16 tentacles ..... *bairdi.*
   With about 40 or more tentacles ..... 2.
2. With 3 marginal warts between tentacles ..... *flavilabris.*
   With 7 marginal warts between tentacles ..... *lucullana.*

Tima bairdi (JOHNSTON 1833). 50—65 mm. wide, hemispherical or somewhat higher, jelly very thick; peduncle thick, conical, about as long as diameter of umbrella; stomach fairly small, four large complexly folded lips; gonads along entire length of radial canals, much folded in regular waves; normally 16 long tentacles with endodermal abaxial spur; between successive tentacles about 12 marginal warts and half

as many marginal vesicles, each with 4—20 concretions.—North-western Europe: North Sea, Skagerrak and Kattegat. (KRAMP 1919 p. 102, Pl. 5 fig. 4—10; RUSSELL 1953 p. 379, Pl. 22 fig. 3, text-fig. 246—249).

Tima flavilabris ESCHSCHOLTZ 1829. 60—80 mm. wide, flatter than a hemisphere, jelly thick; peduncle conical with broad base, about as long as diameter of umbrella; gonads along entire length of radial canals,

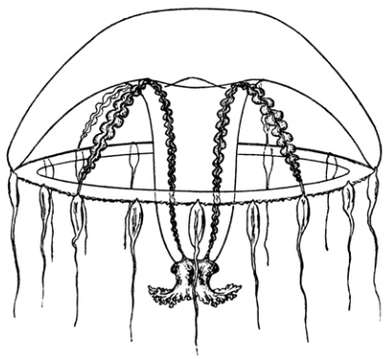


Fig. 228. *Tima bairdi* (after KRAMP).

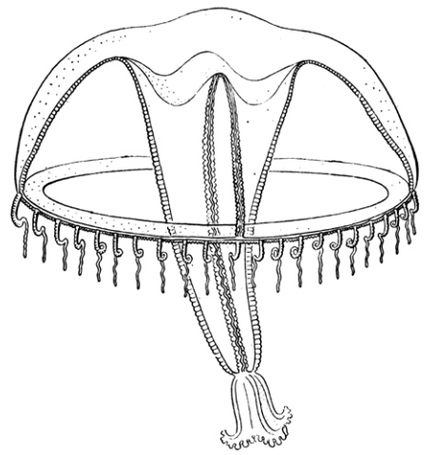


Fig. 229. *Tima lucullana* (after MAYER).

wavy; 70—80 tentacles; between successive tentacles 3 marginal warts and 4 marginal vesicles.—North-west and north of the Azores. (ESCHSCHOLTZ 1829 p. 103, Pl. 8 fig. 3 *a*, 3 *b*; MAYER 1910 p. 319; PETERSEN 1957 p. 40).

Not observed since it was described from N.W. of the Azores by ESCHSCHOLTZ, until a specimen was recently collected in a locality somewhat further north in the Atlantic.

It seems possible, however, that *Tima formosa* L. AGASSIZ, 1862, belongs to the same species; it is a somewhat larger medusa with fewer tentacles, 100 mm. wide and 65 mm. high with 32—40 tentacles, but the

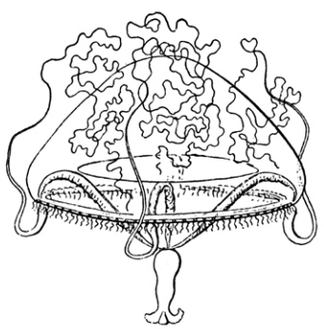


Fig. 230. *Irenium quadrigatum* (after HAECKEL, from MAYER).

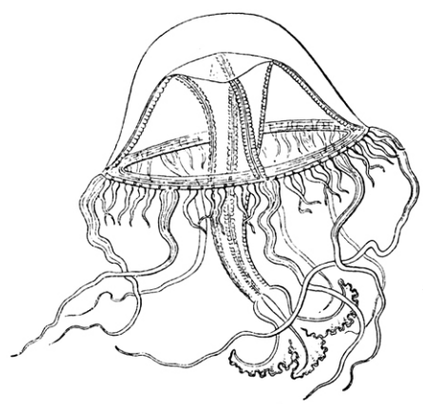


Fig. 231. *Irenium teuscheri* (after HAECKEL, from MAYER).

number of marginal warts and marginal vesicles between successive tentacles is the same as in *T. flavilabris*. It occurs off the coast of New England from Newport to Massachusetts Bay. Records from Japan are open to doubt.

Tima lucullana (DELLE CHIAJE 1822). Similar to *T. flavilabris*, but the jelly is thin, and the number of marginal warts between successive tentacles seems to be constantly seven.—Mediterranean and Adriatic Seas. (MAYER 1910 p. 314, text-fig. 177).

Irenium HAECKEL 1879. Eutimidae (?) with numerous marginal vesicles; with numerous marginal warts; tentacles and warts with lateral cirri; four gonads along the radial canals.—Type species: *I. quadrigatum* HAECKEL.

Neither of the two species have been observed since they were described by HAECKEL. The genus is provisionally referred to the Eutimidae.

Irenium quadrigatum HAECKEL 1879. 15 mm. wide, 8 mm. high, jelly very thick; peduncle short with very broad base; stomach pyriform; four short, folded lips; gonads along almost entire length of radial canals; 4 very long perradial tentacles; 30—40 marginal warts with excretory papillae (!); 120—160 cirri; 60—80 marginal vesicles, each with 4—6 concretions.—Atlantic coast of Morocco. (MAYER 1910 p. 313, text-fig. 173).

Irenium teuscheri (HAECKEL 1879). 40 mm. wide, 20 mm. high, thick at apex; peduncle as long as bell diameter, pyramidal, about three times as long as broad; stomach fairly small, large folded lips; gonads wavy, along entire length of radial canals; 8 large and 40 small tentacles; 60—80 marginal warts and between them 60—80 spiral cirri; 70—80 marginal vesicles, each with 2—4 concretions.—Brazil. (MAYER 1910 p. 319, text-fig. 179, as *Tima teucheri*).

In general appearance this medusa resembles a *Tima*, but since spiral cirri are present on the bell margin, it cannot belong to that genus; it is provisionally referred to *Irenium*.

Family **Aequoreidae.**

Leptomedusae with very broad stomach; without peduncle; with many simple or branched radial canals; with excretory pores; with gonads on radial canals separated from stomach, longitudinally divided; with hollow marginal tentacles; without marginal or lateral cirri; with closed marginal vesicles; with or without ocelli.

Key to the genera.

1. With branched radial canals ..... *Zygocanna.*
   With simple radial canals ..... 2.
2. Subumbrella with radial rows of gelatinous papillae ..... *Rhacostoma.*
   Without rows of gelatinous papillae ..... *Aequorea.*

Aequorea PÉRON & LESUEUR 1809. Aequoreidae with numerous simple radial canals; subumbrella without rows of papillae.—Type species: *A. aequorea* (FORSKÅL).

The numerous species need a revision; most of them are very variable, and the numbers of radial canals and marginal organs given in the following are only approximate. Among the Atlantic species *floridana* and *tenuis* are characterized by their comparatively small stomach, *coerulescens* and *vitrina* by their very numerous tentacles, *macrodactyla* and *pensilis* by very few tentacles in proportion to the number of radial canals; in this respect *albida* and *aequorea* are intermediary. In all the Atlantic species the gonads occupy almost the whole length of the radial canals.

Key to the species of Aequorea.

1. Stomach about $^1/_5$ as wide as umbrella ..... 2.
   Stomach at least $^1/_3$ as wide as umbrella ..... 3.
2. About 16 radial canals; 80—100 tentacles ..... *floridana.*
   24—32 radial canals; 48—90 tentacles ..... *tenuis.*
3. More than 3 times as many tentacles as radial canals ..... 4.
   Less, usually much less than 3 times as many tentacles as radial canals ..... 5.

4. With numerous small bulbs between the tentacles ..... *coerulescens.*
   With few small bulbs between the tentacles ..... *vitrina.*
5. With about 6—10 or more times as many radial canals than tentacles; umbrella more or less biconvex 6.
   With at least half as many tentacles as radial canals; umbrella saucer-shaped, gradually thinner towards margin ..... 7.
6. Tentacle bulbs broad, with abaxial keel and prominent adaxial excretory papilla..... *macrodactyla.*
   Tentacle bulbs with long lateral extensions, without keel and without excretory papilla..... *pensilis.*
7. Tentacles 2—3 times as numerous as radial canals; numerous small bulbs between tentacles *albida.*
   Tentacles usually somewhat less numerous than radial canals, rarely up to twice as many; few small bulbs ..... *aequorea.*

Aequorea tenuis (A. Agassiz 1862). 80—100 mm. wide, 3—4 times as wide as high, fairly thick in centre, gradually thinning towards margin; stomach about $^1/_5$ as wide as umbrella; 24—32 radial canals; 48—90

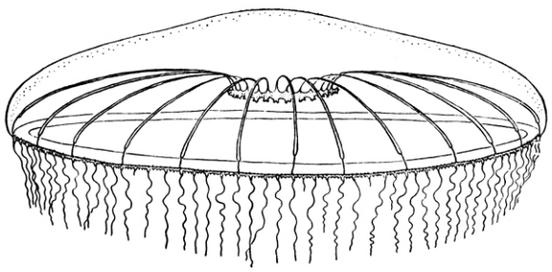


Fig. 232. *Aequorea tenuis* (after Mayer).

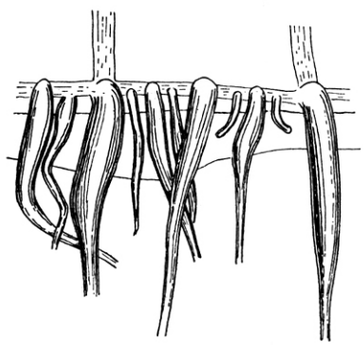


Fig. 233. *Aequorea vitrina*, bell margin (after Russell.)

tentacles and 3—4 times as many small bulbs; tentacle bulbs conical, with excretory papillae; statocysts 1—2, up to 4 times as many as tentacles.—New England coast south of Cape Cod. (Mayer 1910 p. 332, fig. 190, 191; Bigelow 1938 pp. 110—112).

Aequorea floridana (L. Agassiz 1862). 30—50 mm. wide, flatter than a hemisphere, thick in centre; stomach about $^1/_5$ as wide as umbrella; about 16 radial canals; 80—100 tentacles and 1—3 times as many small bulbs; tentacle bulbs fusiform, with short abaxial spurs and with excretory papillae; statocysts 1—2 or 3 times as many as tentacles.—Florida; Bermudas. (Mayer 1910 p. 330, Pl. 43 fig. 6, 7; Bigelow 1938 p. 111).

Aequorea vitrina Gosse 1853. 100—170 mm. wide, flatter than a hemisphere, thick in centre, gradually thinning towards margin; stomach about half as wide as umbrella; 60—100 radial canals; more than 3 times as many tentacles as radial canals and some few small bulbs; tentacle bulbs elongated, slightly laterally compressed, with excretory papillae; statocysts usually 1—2, up to 5 between successive radial canals.—North-western Europe. (Russell 1953 p. 350, Pl. 21 fig. 2, 4, 5, Pl. 32 fig. 3, text-fig. 220 B, 222—224).

Aequorea coerulescens (Brandt 1838). Up to 145 mm. wide, usually 60—80, low and thick; stomach about half as wide as umbrella; about 100 radial canals; 3—6 times as many tentacles as radial canals and numerous small bulbs; tentacle bulbs elongated, laterally compressed, with prominent excretory papillae; statocysts numerous, crowded.—Pacific coasts of North and South America; Japan; S. W. Africa; Falkland Islands. (Bigelow 1909 *a* p. 177, Pl. 4 fig. 4, Pl. 35 fig. 3—8).

Aequorea albida A. Agassiz 1862. About 60 mm. wide, higher than a hemisphere (?);, thick in centre; stomach $^1/_3$—$^1/_2$ as wide as umbrella; 80—100 radial canals; 2—3 times as many tentacles as radial canals and 2—3 times as many small bulbs as tentacles; tentacle bulbs fusiform with abaxial spur and with excretory

papilla; statocysts about twice as many as tentacles.—New England coast from Newport to Bay of Fundy; ? Dutch Harbour (MAYER 1910 p. 331, Pl. 43 fig. 1—5, text-fig. 189).

There are no recent descriptions of this species which is sometimes regarded as a variety of *A. aequorea.*

Aequorea aequorea (FORSKÅL 1775). Up to 175 mm. wide, saucer-shaped, thick in centre, gradually thinning towards margin; stomach usually half as wide as umbrella; radial canals usually 60—80, sometimes fewer or up to 160; tentacles usually less numerous than radial canals but varying from half to twice as many; small bulbs few, scattered; tentacle bulbs elongated conical, excretory pores on short papillae; 5—10 stato-

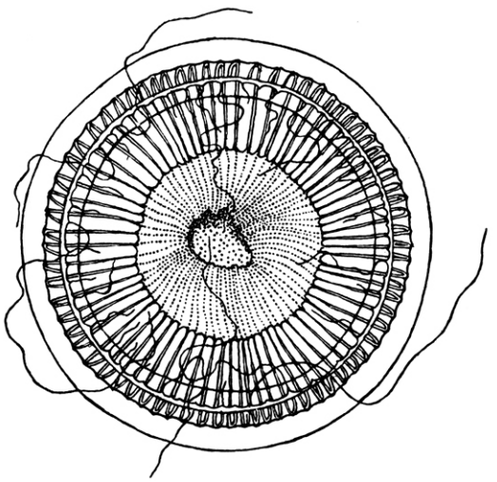


Fig. 234 *a*. *Aequorea aequorea* (after MAYER, from KRAMP).

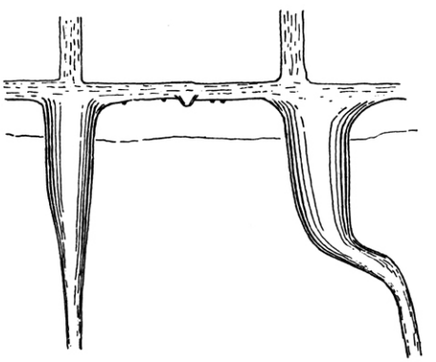


Fig. 234 *b*. *Aequorea aequorea*, bell margin (after RUSSELL).

cysts between successive radial canals.—Mediterranean; Atlantic coasts from Norway to South Africa and from Cape Cod to Tierra del Fuego; Iranian Gulf; records from the northern Pcific are doubtful. (MAYER 1910 p. 325, in part, Pl. 42 fig. 1—4, Pl. 43 fig. 8, text-fig. 186, 187 *as A forskalea*; RUSSELL 1953 p. 342, Pl. 21 fig. 3, Pl. 32 fig. 1, 2, text-fig. 220, 221, as *A. forskalea*). Synonym: *A. forskalea* PÉRON & LESUEUR 1809.

Aequorea macrodactyla (BRANDT 1834). Up to 75 mm. wide, central disk thick, lens-shaped, margin thin; stomach about half as wide as umbrella; 60—100, up to 150 radial canals; 10—30 (rarely up to 40) tentacles and 6—8 times as many small bulbs; tentacle bulbs broad, each with a distinct abaxial keel and

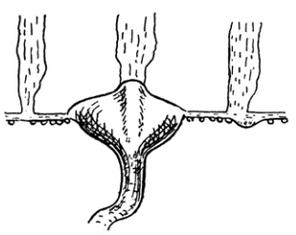


Fig. 235. *Aequorea macrodactyla*, tentacle bulb (after RUSSELL).

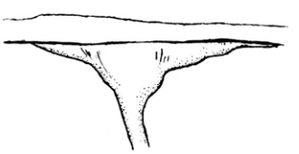


Fig. 236. *Aequorea pensilis*, tentacle bulb (after MAAS, redrawn by the author).

with a prominent excretory papilla; statocysts very numerous.—Indian and Pacific Oceans; West Africa; Strait of Magellan; England; West Indies. (BIGELOW 1909 *a* p. 174, Pl. 36 fig. 5—10; RUSSELL 1953 p. 355, Pl. 33 fig. 1—5, text-fig. 220 C, D, 225, as *A. pensilis*).

Aequorea pensilis (HAECKEL 1879). Up to 100 mm. wide, central disk thick, lens-shaped, margin thin; stomach $^1/_2$—$^2/_3$ as wide as umbrella; 100—250 radial canals; 10—16 tentacles and 8—16 times as many

small bulbs; tentacle bulbs with long lateral extensions, no abaxial keel; no excretory papillae but excretory pores; statocysts very numerous.—Indian and Pacific Oceans; not with certainty stated to occur in the Atlantic Ocean, though recorded from the English Channel by RUSSELL (1953), who unites it with *A. macrodactyla*. (MAYER 1910 p. 333; BIGELOW 1919 p. 311, Pl. 42 fig. 3, 4). Synonym: *Mesonema pensile* HAECKEL 1879.

Rhacostoma L. AGASSIZ 1850. Aequoreidae with numerous simple radial canals; subumbrella with radial rows of gelatinous papillae.—Type species: *R. atlanticum* L. AGASSIZ.

Rhacostoma atlanticum L. AGASSIZ 1850. Up to 300—400 mm. wide, 3—4 times as wide as high, thick in centre; stomach $^1/_3$—$^1/_2$ as wide as umbrella; 80—100 radial canals; gonads extending along greater part of radial canals leaving both ends free; tentacles slightly more numerous than radial canals; tentacle bulbs

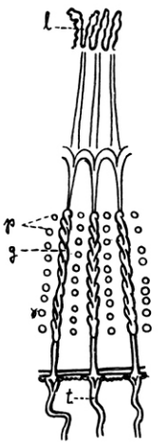


Fig. 237. *Rhacostoma atlanticum* (after MAYER, from KRAMP).

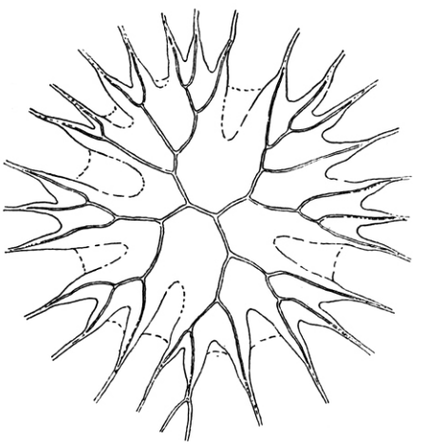


Fig. 238. *Zygocanna vagans*, aboral view of stomach (after BIGELOW).

elongated conical; excretory papillae present; numerous statocysts.—Northern part of the New England coast; West Africa near Cape Verde and off Congo. (MAYER 1910 p. 335, Pl. 44 fig. 1—4; as *Zygodactyla groenlandica*; KRAMP 1942 p. 68).

Zygocanna HAECKEL 1879. Aequoreidae with numerous radial canals, bifurcated or branched.—Type species: *Z. pleuronota* (PÉRON & LESUEUR 1809).

Zygocanna vagans BIGELOW 1912. Up to 76 mm. wide, flat, thin; stomach $^1/_3$—$^1/_2$ as wide as umbrella; subumbrella with radial rows of gelatinous papillae; about 30—45 radial canals leave the periphery of the stomach without branching, but from a cruciform figure in centre of stomach branching ridges pass to the points of origin of the free canals; gonads extending along greater portions of radial canals; 28—70 tentacles and several small bulbs, with long excretory papillae; statocysts very numerous.—Philippine Islands; Pacific coasts of Panama and Colombia; west of the Cape of Good Hope; Azores. (BIGELOW 1919 p. 315, Pl. 42 fig. 5—7, Pl. 43 fig. 6; see also the present paper p. 39).

III. Order **Limnomedusae.**

Hydrozoa with alternating generations. The sexual generation is a velar medusa with hollow tentacles; gonads either on the stomach wall with or without perradial lobes extending along the radial canals, or on the radial canals only; if statocysts are present they are internal and provided with an endodermal axis.

The asexual generation is a sessile polyp with power of vegetative propagation, with or without tentacles; the endoderm of the tentacles in direct connection with that of the gastral cavity.

Key to the families of Limnomedusae.

1. With gonads on radial canals only; with internal statocysts; without ocelli ..... *Olindiidae.*
   With gonads on stomach walls, usually extending along radial lobes of stomach ..... 2.
2. With four simple radial canals; tentacle bulbs with abaxial ocelli; without statocysts, except in *Ostroumovia* where they are difficult to see ..... *Moerisiidae.*
   With four or six or more radial canals generally branched; without ocelli; without statocysts... *Proboscidactylidae.*

The order also comprises the fresh-water medusae Limnocnididae which occur in African lakes.

Family **Moerisiidae.**

Limnomedusae usually without statocysts; with gonads on the stomach walls with lobes extending outwards along the radial canals; with four simple, unbranched radial canals; tentacle bulbs with abaxial ocelli. Polyps, where known, small, with hollow tentacles.

Key to the genera of Moerisiidae.

1. Stomach on a short gelatinous peduncle; mouth with four well-developed, crenulated lips.. *Tiaricodon.*
   No peduncle; mouth without distinct lips ..... 2.
2. Radial lobes of stomach with twisted and folded gonads ..... *Halmomises.*
   Gonads smooth ..... 3.
3. Tentacles with irregular transverse clasps of nematocysts ..... *Odessia.*
   Tentacles with nematocysts in rings ..... 4.
4. Tentacle bulbs globular, not clasping over exumbrella; without statocysts ..... *Moerisia.*
   Basal part of tentacles adnate to exumbrella; with internal statocysts (almost invisible) *Ostroumovia.*

The Moerisiidae have only one gonad, cruciform, continuous around the stomach; they all live in fresh or brackish water, except *Tiaricodon*. *Moerisia* is the only genus in which more than one species have been described.

Halmomises VON KENNEL 1891. Moerisiidae with radial lobes of stomach with twisted and folded gonads; tentacles with rings of nematocysts. Polyp unknown.—Type species: *H. lacustris* VON KENNEL.

Halmomises lacustris VON KENNEL 1891. 2—2.5 mm. wide, half or more as high as wide; manubrium powerful, cross-shaped in section; no oral lips; radial lobes with twisted and folded gonads on proximal three-quarters of radial canals; 16—18 very long and fine tentacles with rings of nematocysts throughout their length.—Trinidad, in fresh water. (MAYER 1910 p. 199, as *Thaumantis lacustris*).

Moerisia BOULENGER 1908. Moerisiidae with four or more tentacles with rings of nematocysts throughout their length, bulbs globular, not clasping over margin of umbrella; stomach cruciform, without a peduncle; mouth without lips; gonads on radial canals continuous with those in the stomach walls, smooth. Polyp with filiform tentacles and with a thin perisarc.—Type species: *M. lyonsi* BOULENGER.

Key to the species of Moerisia.

1. With up to 32 tentacles of different lengths. Caspian Sea ..... *pallasi.*
   Tentacles of about equal length ..... 2.
2. Radial lobes of stomach up to about two-thirds the length of the radial canals; usually only four tentacles (up to 22). Egypt ..... *lyonsi.*
   Radial lobes of stomach almost to ring-canal; 19 tentacles ..... *gangetica.*

Moerisia lyonsi BOULENGER 1908. 4.5 mm. wide, 4 mm. high, globular, very thick; manubrium cylindrical, mouth round, without lips; radial lobes about two-thirds the length of the radial canals; tentacles usually four, sometimes 16, rarely up to 22, long, with prominent rings of nematocysts. Polyp with 4—8 tentacles at approximately same level, near distal end of hydranth.—Lake Qurun, Egypt. (BOULENGER 1908 pp. 357—378, Pl. 22—23; MAYER 1910 p. 488; HARTLAUB 1917 p. 417, fig. 347; PICARD 1951 *c* p. 5, as *Halmomises lyonsi*).

Moerisia gangetica KRAMP n. sp. 3 mm. wide, 2 mm. high, globular, very thick; manubrium very small, mouth opening cross-shaped, no lips; radial lobes extending nearly to ring canal, distal parts sac-like, pendent; 19 tentacles of equal size, with semiglobular basal bulbs. Polyp unknown.—Ganges estuary. (KRAMP, Indian Medusae, in press).

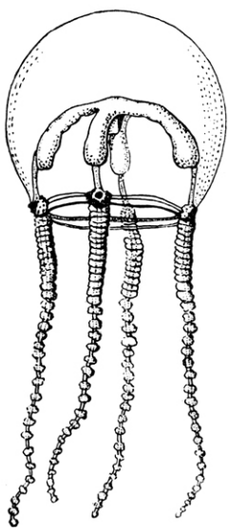


Fig. 239. *Moerisia lyonsi* (after BOULENGER, from HARTLAUB).

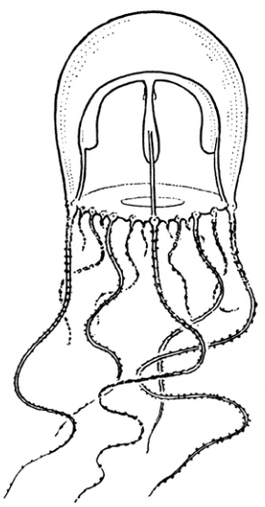


Fig. 240. *Moerisia pallasi* (after DERZHAVIN, redrawn by P. W.).

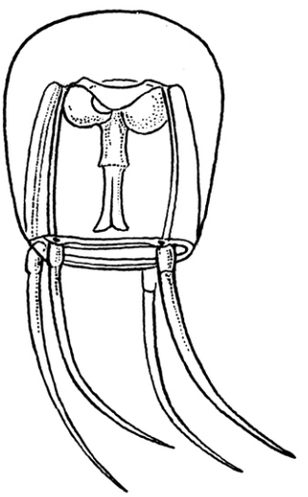


Fig. 241. *Tiaricodon coeruleus* (after BROWNE & KRAMP, redrawn by P. W.).

Moerisia pallasi (DERZHAVIN 1912). 3 mm. wide, 3.5 mm. high, dome-shaped, jelly thick; manubrium short, cruciform, mouth with four slightly indicated lips; radial lobes about two-thirds the length of the radial canals; up to 32 tentacles of different lengths in regular succession according to age. Polyp with 10—15 scattered tentacles, mainly pelagic.—Caspian Sea. (DERZHAVIN 1912 *a* pp. 390—396, fig. 1—5, as *Caspionema pallasi*; 1912 *b* p. 58, as *Moerisia pallasi*; PICARD 1951 *c* p. 5, as *Halmomises pallasi*).

Tiaricodon BROWNE 1902. Moerisiidae with a gelatinous peduncle; stomach with four perradial lobes extending along the peduncle; mouth with four distinct lips; with four tentacles.—Type species: *T. coeruleus* BROWNE.

Tiaricodon coeruleus BROWNE 1902. 24 mm. wide, 25 mm. high, bell-shaped, thick; manubrium almost to velar level, mouth with four distinct, crenulated lips; radial lobes sac-like, on peduncle only; four perradial tentacles, stout, tapering; nematocysts in proximal part in small, rounded warts, in middle part forming transverse clasps, in distal part in rings. Polyp unknown.—Falkland Islands; Weddell Sea; Callao in Peru. (BROWNE & KRAMP 1939 p. 311, Pl. 18 fig. 1—6, Pl. 19 fig. 8—11).

Odessia PASPALEFF 1937. Moerisiidae with tentacles with nematocysts in transverse clasps, not in rings; basal bulbs globular, not clasping margin of umbrella; stomach cruciform, without a peduncle. Polyp with scattered tentacles, each with a terminal knob and adaxial clasps of nematocysts.—Type species: *O. maeotica* (OSTROUMOFF).

Odessia maeotica (OSTROUMOFF 1896). Up to 18 mm. wide, usually much smaller, about as high as wide or somewhat lower, bell-shaped, thick; radial lobes along proximal half or more of radial canals; in the adult medusa the gonads on the radial canals are separated from those on the stomach walls; 16—32 tentacles.—Mainly in brackish water: Black Sea; Mediterranean; Atlantic coast of Morocco. (MAYER 1910 p. 200, fig. 103, as *Thaumantias maeotica*; PASPALEFF 1936 pp. 1—34, fig. 1—29 and one plate, as *Pontia ostroumovi*; 1937 p. 112 as *Odessia maeotica*; PICARD 1951 *c* pp. 6 ff., 7 fig., as *Odessia maeotica*, with four varieties).

Ostroumovia HADZI 1928. Moerisiidae with stomach without a peduncle, cruciform with long perradial lobes; mouth cruciform without distinct lips; with gonads on radial lobes continuous with those in the sto-

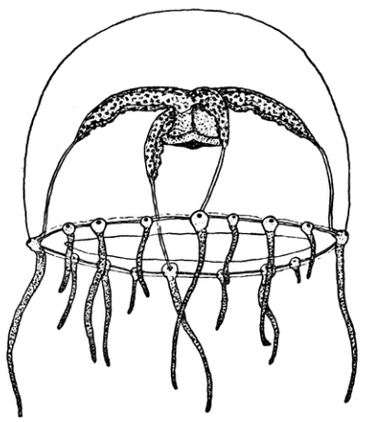


Fig. 242. *Odessia maeotica* (after PICARD).

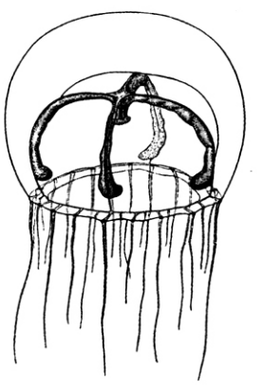


Fig. 243. *Ostroumovia inkermanica* (after KRAMP).

mach walls; tentacles with rings of nematocysts throughout their length, basal part of tentacles adnate to exumbrella; with small internal statocysts; Polyp sessile, with scattered moniliform tentacles.—Type species: *O. inkermanica* (PALTSCHIKOWA-OSTROUMOVA 1925).

Ostroumovia inkermanica (PALTSCHIKOWA-OSTROUMOWA 1925). Up to 6.5 mm. wide and 5.5 mm. high, dome-shaped, jelly very thick; manubrium very small, prismatic, with radial lobes containing gonads extending almost to bell margin, gonads in radial lobes with distal portions sac-like, pendent; up to 32 tentacles of different lengths, with distinct rings of nematocysts throughout their length, proximal part of tentacles narrow, adnate to exumbrella, with an ocellus at the point of issue of the free part of the tentacle; internal statocysts very small, almost invisible except in microtome sections.—Brackish-water swamps at the coasts of the Black Sea; Visagapatam Channel on the east coast of India. In the Indian locality the diameter may amount to 8 mm., and the gonads in the stomach walls have been obliterated. (PALTSCHIKOWA-OSTROUMOWA 1925 pp. 273—284, fig. 1—3, as *Moerisia inkermanica*; KRAMP 1938 *a* pp. 103—108, fig. 1, as *Ostroumovia inkermanica*; 1938 *b* pp. 45—60, Pl. fig. 1—6, text-fig. 1—5; PASPALEFF 1938 pp. 29—40, fig. 1—15 (polyp); KRAMP Indian Medusae, in press).

In several papers, 1935—1953, A. VALKANOV has confounded this species with *Odessia maeotica*. Owing to the presence of statocysts I have previously referred *Ostroumovia* to the Olindiidae, with which it also agrees in the structure of the basal part of the tentacles. PICARD (1951 *c* pp. 4 and 7), however, prefers to regard it as a particularly highly developed form among the Moerisiidae establishing a transition towards the Olindiidae.

It was the studies of *Ostroumovia* which induced me to establish the order Limnomedusae (1938), originally comprising the Moerisiidae and the Olindiidae, to which later on (1939) were added the Proboscidactylidae.

Family **Olindiidae.**

Limnomedusae with internal statocysts; with gonads on the radial canals; with simple, unbranched radial canals; without ocelli. Polyps, where known, very small, with or without tentacles.

Key to the genera of Olindiidae.

1. Statocysts in elongated vesicles enclosed in velum; in fresh water ..... *Craspedacusta*.
   Statocysts spherical, enclosed in mesogloea of umbrella margin ..... 2.
2. With centripetal canals ..... 3.
   Without centripetal canals ..... 4.
3. With primary tentacles projecting above bell margin and with terminal adhesive pads; secondary tentacles on bell margin, without adhesive pads ..... *Olindias*.
   All tentacles on bell margin and without adhesive pads ..... *Maeotias*.
4. Tentacles in groups on bell margin, without adhesive pads ..... *Gossea*.
   Tentacles not in groups ..... 5.
5. Some or all tentacles with adhesive pads ..... 6.
   All tentacles without adhesive pads, on bell margin ..... *Aglauropsis*.
6. All tentacles on bell margin and all with an adhesive pad at some distance from outer end ..... 7.
   With two kinds of tentacles, with and without adhesive pads ..... 8.
7. With numerous statocysts ..... *Gonionemus*.
   With no more than 16 statocysts ..... *Scolionema*.
8. Adhesive pads terminal ..... *Vallentinia*.
   Adhesive pads at some distance from outer end of tentacles ..... *Cubaia*.

Craspedacusta LANKESTER 1880. Olindiidae with four simple radial canals; without centripetal canals; with pendent pouch-like gonads on radial canals; with evenly distributed marginal tentacles all of one kind, without organs of adhesion; with statocysts enclosed in elongated vesicles in velum.—Type species: *C. sowerbyi* LANKESTER.

Craspedacusta sowerbyi LANKESTER 1880. Up to 20 mm. wide, slightly flatter than a hemisphere, jelly fairly thick; stomach large, with broad square base, distal portion cruciform; mouth with four simple or slightly folded lips; four large, smooth, triangular, pouch-like gonads, hanging down from points of junction of radial canals with stomach; up to 400 or more tentacles of different sizes, their basal part adherent to exumbrella; statocysts usually about half number of tentacles situated in elongated vesicles in velum.—Polyp without tentacles, mouth surrounded by nematocysts; solitary or in small colonies.—From its original habitat in the Yang-tse-kiang river system in China this species has obtained an almost circumglobal distribution in rivers and fresh-water lakes, mainly in the temperate zones of Asia, Europe and North America; also recorded from a few localities in South America and Australia, but never found in Africa. Frequently appearing in water reservoirs and in aquaria, probably introduced in the polypoid stage with aquatic plants. (MAYER 1910 p. 363, fig. 207; DEJDAR 1934 pp. 595—691, fig. 1—41; KRAMP 1950 pp. 165—184, Pl. 1 fig. 1—4, Pl. 2 fig. 4—5, text-fig. 1—4; RUSSELL 1953 p. 408, Pl. 24 fig. 1, text-fig. 268—274). Synonyms: *Limnocodium victoria* ALLMAN 1880, *Limnocodium* (*Craspedacusta*) *sowerbii* LANKSTER 1880, *Microhydra ryderi* POTTS 1885 (polyp), *Craspedacusta ryderi* PAYNE 1924.

Olindias F. MÜLLER 1861. Olindiidae with four radial canals and with numerous centripetal canals; gonads with papilliform processes; numerous tentacles of two kinds: primary tentacles projecting above bell margin, with distal adhesive pads and with nematocysts in transverse clasps; secondary tentacles on bell margin, without adhesive pads and with nematocysts in rings; also numerous marginal clubs which may develop into tentacles.—Type species: *O. phosphorica* (DELLE CHIAJE 1841).

Besides the Indian species *O. singularis* BROWNE, with usually only one statocyst at base of each primary tentacle, the various forms of *Olindias* described probably belong to one species, distinguished only by numerical characters.

Olindias phosphorica (DELLE CHIAJE 1841). Umbrella almost hemispherical, jelly fairly thick; usually two statocysts at base of each primary tententacle. Varieties:

O. phosphorica (DELLE CHIAJE 1841). 40—60 mm. wide; 11—19 centripetal canals in each quadrant; 50—60 primary tentacles, 100—120 secondary tentacles, 100—170 marginal clubs.—Mediterranean and west coast of Africa. (MAYER 1910 p. 355). Synonym: *O. mülleri* GRAEFFE 1884.

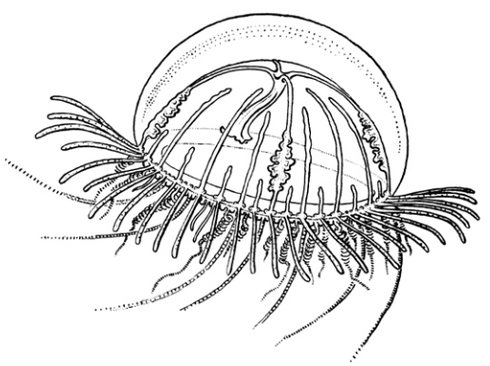


Fig. 244. *Olindias phosphorica tenuis* (after MAYER, redrawn by P. W.).

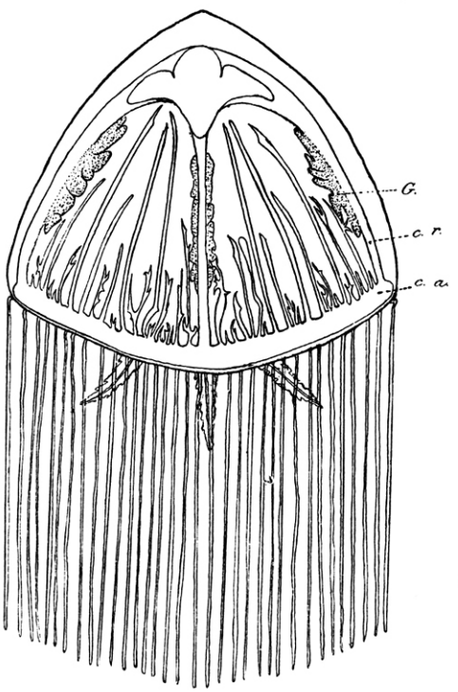


Fig. 245. *Maeotias inexpectata* (after BORCEA).

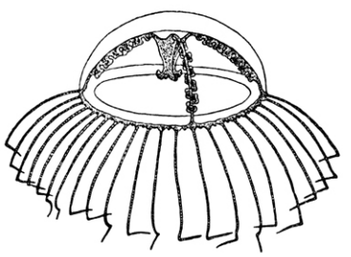


Fig. 246 *Gonionemus vertens* (after MAYER, from KRAMP).

O. sambaquinensis F. MÜLLER 1861. 50—100 mm. wide; 21—27 centripetal canals in each quadrant; 80—100 primary tentacles, 200—300 secondary tentacles, 100—200 clubs.—Brazil. (MAYER 1910 p. 354).

O. tenuis (FEWKES 1882). 35 mm. wide; 7—10 centripetal canals in each quadrant; 32—54 primary tentacles, 38—70 secondary tentacles, 64—69 clubs. Florida, Bermudas, Bahamas. (MAYER 1910 p. 354, Pl. 47 fig. 8—10, Pl. 48 fig. 1—7).

A fourth variety, *O. malayensis* MAAS 1905, is described from the Malayan Archipelago.

Maeotias OSTROUMOFF 1896. Olindiidae with four radial canals and with centripetal canals; with numerous tentacles all of same kind on bell margin, not in groups, without adhesive organs, and with small secondary marginal clubs; with numerous statocysts.—Type species: *M. inexpectata* OSTROUMOFF.

Maeotias inexpectata OSTROUMOFF 1896. Up to 39 mm. wide and 24 mm. high; stomach prismatic, mouth with four very long, crenulated lips with clusters of nematocysts; gonads folded, extending along more than half the length of the radial canals; many centripetal canals of different lengths; up to 360 very long tentacles with rings of nematocysts, and numerous short, club-shaped marginal appendages; statocysts in about same number as clubs.—Black Sea and Sea of Azov. (MAYER 1910 p. 369; BORCEA 1928 pp. 643—655, fig. 1—8).

Gonionemus A. AGASSIZ 1862. Olindiidae with four radial canals, without centripetal canals; with numerous uniform tentacles, all with an abaxial adhesive pad near the outer end, and with rings of nematocysts; with a large and indefinite number of statocysts.—Type species: *G. vertens* A. AGASSIZ.

Gonionemus vertens A. AGASSIZ 1862. 15—20 mm. wide, hemispherical or somewhat flatter; stomach somewhat shorter than bell cavity, mouth with four short, crenulated lips; gonads along greater portion of radial canals, folded; 60—80 long rather stiff tentacles, each with an adhesive pad near distal end which is sharply bent; statocysts about as numerous as tentacles.—Circumglobal in northern temperate coastal waters. (MAYER 1910 pp. 343—348, Pl. 45 fig. 1—4, Pl. 46 fig. 1—3, text-fig. 197; PICARD 1951 *b* p. 40; RUSSELL 1953 p. 398, Pl. 23 fig. 2, text-fig. 263; p. 402, Pl. 35, as *G. murbachi*). Synonyms: *G. murbachi* MAYER 1901, *G. agassizi*

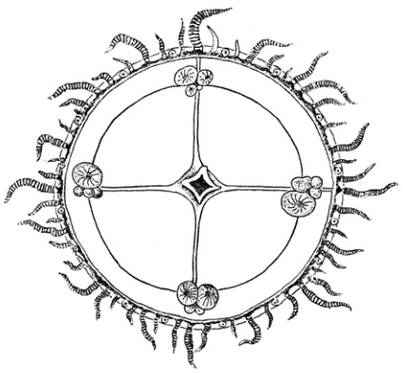


Fig. 247. *Scolionema suvaensis* (after UCHIDA, redrawn by P. W.).

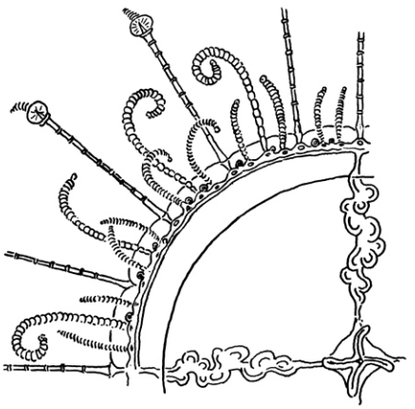


Fig. 248. *Cubaia aphrodite* (after MAYER, redrawn by P. W.).

MURBACH & SHEARER 1902, *G. depressus* GOTO 1903, *G. oshoro* UCHIDA 1929; probably also *G. vindobonensis* JOSEPH 1918.

Scolionema KISHINOUYE 1910. Similar to *Gonionemus*, but number of statocysts not exceeding 16.—Type species: *S. suvaensis* (AGASSIZ & MAYER).

Scolionema suvaensis (AGASSIZ & MAYER 1899). 9 mm. wide, about 6 mm. high, jelly thick; gastric peduncle indicated; stomach cruciform, about half as long as bell cavity, mouth with four small lips; gonads extending along distal $^1/_3$—$^1/_2$ of radial canals, ribbon-shaped, much folded; 40—70 tentacles of different lengths, globular bulbs with brownish pigment spots; nematocyst rings throughout whole length of tentacles; distal end sharply bent, but adhesive pads rudimentary; 16 statocysts.—Bermudas; Mediterranean; tropical coasts of Indian and Pacific Oceans. (MAYER 1910 p. 349, fig. 199, 200, as *Gonionemus suvaensis*; UCHIDA 1929 p. 360, Pl. 1 fig. 2—4, text-fig. 5—7, as *Scolionema gemmifera*; PICARD 1951 *b* p. 44). Synonyms: *Gonionemus hornelli* BROWNE 1905, *Scolionema gemmifera* KISHINOUYE 1910.

Cubaia MAYER 1894. Olindiidae with four radial canals, without centripetal canals; with two series of tentacles, one series issuing above bell margin with tentacles provided with an adhesive pad near terminal end and with a number of nematocyst rings; the other series arising from bell margin, without adhesive pads but with numerous rings of nematocysts; with numerous statocysts.—Type species: *C. aphrodite* MAYER.

Cubaia aphrodite MAYER 1894. 12 mm. wide, slightly flatter than a hemisphere; stomach flask-shaped, mouth with four simple lips; gonads papilliform on middle region of radial canals; about 80 tentacles: about 20 issuing from a zone above bell margin, with about 8 rings of nematocysts and an adhesive pad; 50—60 tentacles arising from bell margin, each with 25—30 rings of nematocysts; about 35 statocysts.—Florida; Bahamas. (MAYER 1910 p. 351, Pl. 46 fig. 6, Pl. 47 fig. 1—7).

Vallentinia BROWNE 1902. Olindiidae with four radial canals, without centripetal canals; with 4—8 large, hollow tentacles with a terminal adhesive pad, and numerous tentacles evenly distributed, without adhesive pad but with numerous rings of nematocysts; with 16 or more statocysts.—Type species: *V. falklandica* BROWNE.

Key to the species of Vallentinia.

With four large tentacles with terminal adhesive pad, perradially situated ..... *falklandica.*
With four or eight large tentacles with terminal adhesive pad, not perradial..... *gabriellae.*

Vallentinia falklandica BROWNE 1902. 2 mm. wide, 3 mm. high; stomach short, mouth with four short, simple lips with nematocysts; gonads oval, sac-like, on upper part of radial canals; four large perradial

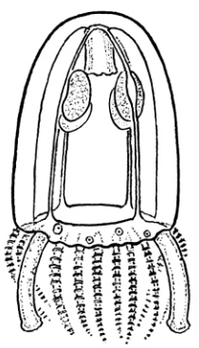


Fig. 249. *Vallentinia falklandica* (after BROWNE & KRAMP, redrawn by P. W.).

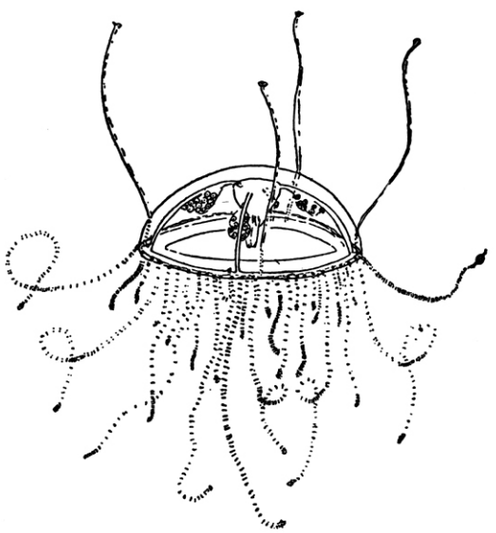


Fig. 250. *Vallentinia gabriellae* (after VANNUCCI).

tentacles with scattered nematocysts and a terminal adhesive pad; 24 tentacles with numerous rings of nematocysts; 16 statocysts.—Falkland Islands. (BROWNE & KRAMP 1939 p. 317, Pl. 18 fig. 17—19, Pl. 19 fig. 6, 7).

Vallentinia gabriellae MENDES 1948. Up to 6 mm. wide, about two-thirds as high as wide; jelly fairly thin; stomach hemispheric, mouth-tube fairly long and thin; four simple lips with nematocysts; gonads sac-like, folded, on proximal portions of radial canals; four large tentacles with scattered nematocysts and with a terminal adhesive disk, arising from the exumbrella above the bell margin and situated at some distance from the radial canals; occasionally also four similar interradial tentacles; 64 or more (up to 75) tentacles arising from the bell margin, with numerous rings of nematocysts, the oldest of them sometimes with a small adhesive disk externally near apex; no small cirrus-like tentacles; one or two statocysts between successive tentacles.— Brazil; recently also found at Bimini, Bahamas. (VANNUCCI MENDES 1948 pp. 73—85, Pl. 1 and 2).

A closely related species, *V. adherens* HYMAN, from California, is distinguished by the presence of a small, cirrus-like tentacle between each successive pair of the ordinary tentacles.

Aglauropsis F. MÜLLER 1865. Olindiidae with four radial canals; with numerous tentacles of one kind, without adhesive pads, not arranged in groups; with numerous enclosed marginal statocysts.—The type species, *A. agassizi* F. MÜLLER 1865, was never properly described, but BROWNE (1902) has adopted the generic name for his new species, *Aglauropsis conanti.*

Key to the species of Aglauropsis.

Gonads transversely lobed, along almost whole length of radial canals; tentacles densely crowded *conanti*.
Gonads smooth, pendent, in distal half of radial canals; 8 large and up to 16 small tentacles well spaced *jarli*.

Aglauropsis conanti BROWNE 1902. Up to 22 mm. wide and 15 mm. high, bowl-shaped, jelly thick and solid; stomach fairly long, mouth with four large folded lips with a band of nematocysts; radial canals broad; gonads transversely lobed, along almost whole length of radial canals; about 200 tentacles closely packed; 50 or more statocysts.—Falkland Islands and southern Patagonia. (BROWNE & KRAMP 1939 p. 314, Pl. 18 fig. 7—16).

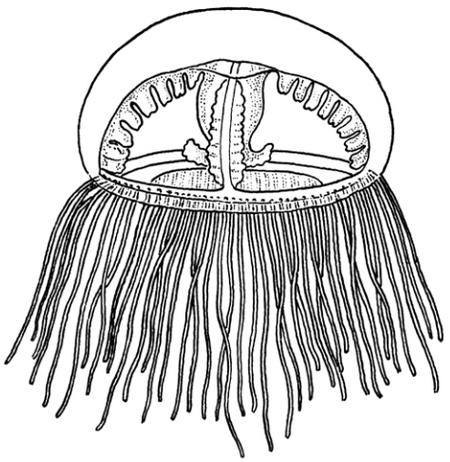


Fig. 251. *Aglauropsis conanti*
(after BROWNE & KRAMP, redrawn by P. W.).

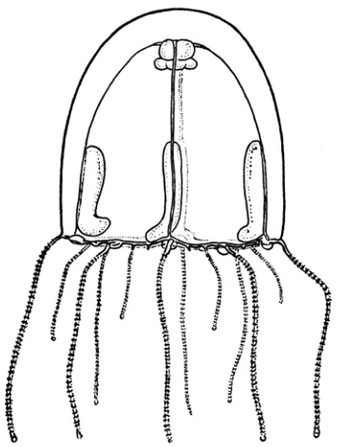


Fig. 252. *Aglauropsis jarli*
(after KRAMP, redrawn by P. W.).

Aglauropsis jarli KRAMP 1955. 4 mm. high and wide, jelly moderately thick; stomach very small, no distinct lips; radial canals narrow; gonads on distal half of radial canals, smooth, distal end pendent; 8 long perradial and interradial tentacles and 16 small, partly almost rudimentary tentacles, with rings of nematocysts; 24 statocysts.—Off Liberia, west coast of Africa. (KRAMP 1955 p. 267, Pl. 3, text-fig. 6).

Gossea L. AGASSIZ 1862. Olindiidae with four radial canals, without centripetal canals; with one kind of tentacles arranged in groups, without adhesive pads.—Type species: *G. corynetes* (GOSSE).

Key to the species of Gossea.

1. With 24 tentacles in eight groups and 8—16 singly placed ..... 2.
   With eight perradial and interradial marginal nematocyst pads, each with one large and one minute tentacle; moreover several tentacles of different lengths singly placed ..... *brachymera*.
2. Tentacles in each of the eight groups of about equal size ..... *corynetes*.
   In each of the eight groups one large, one intermediate and one small tentacle ..... *faureae*.

Gossea corynetes (GOSSE 1853). 12 mm. wide, 10 mm. high, jelly fairly thick and rigid; stomach short, mouth with four crenulated lips; gonads wavy, extending along greater part of radial canals; 24 tentacles in eight groups, all of about equal size, and 8—16 isolated tentacles; all tentacles with rings of nematocysts; endodermal core of tentacles extending into marginal jelly; 24 statocysts, three between adjacent groups of tentacles.—North-western Europe. (MAYER 1910 p. 367, fig. 210; RUSSELL 1953 p. 403, Pl. 23 fig. 1, text-fig. 264—267).

Gossea faureae PICARD 1952. 12 mm. wide; similar to *G. corynetes*, but proximal one-third of radial canals free of gonads; in each of the eight groups of tentacles one large, one intermediate and one small tentacle.—Atlantic coast of Morocco. (PICARD 1952 p. 67).

Gossea brachymera BIGELOW 1909. Up to 20 mm. wide, dome-shaped, jelly thick and rigid; stomach small, on a short, broad peduncle; four short lips with nematocysts; gonads extending from base of peduncle almost to ring canal, wavy, distal ends sac-like, pendent; four perradial and four interradial marginal nematocyst pads, each with one large and one minute tentacle; in addition several isolated tentacles in very different stages of development and singly placed, without adjacent dwarf-tentacle; eight statocysts enclosed in the

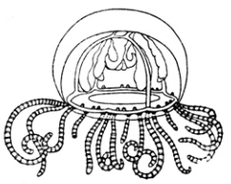


Fig. 253. *Gossea corynetes* (after HAECKEL, altered by RANSON).

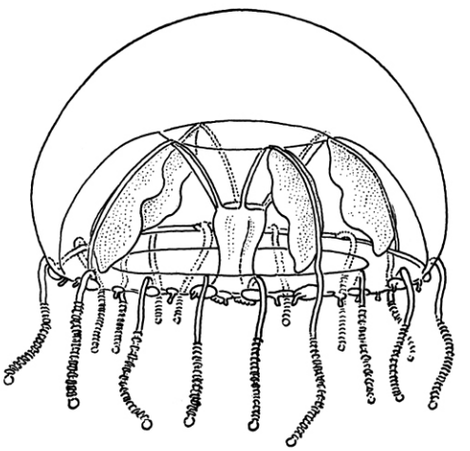


Fig. 254. *Gossea brachymera* (after RUSSELL, redrawn by P. W.).

perradial and interradial nematocyst pads.—Pacific coast of Mexico; coast of Louisiana in Gulf of Mexico; Strait of Magellan. (BIGELOW 1909 p. 103, Pl. 30 fig. 1—10; MAYER 1910 p. 368; RUSSELL 1939 pp. 707—710, Pl. 1 fig. 1—3; KRAMP 1957 p. 42, Pl. 5 fig. 2, 3).

Family **Proboscidactylidae.**

Limnomedusae without statocysts; stomach usually with 4 or 6 or more radial lobes extending along the proximal portions of the radial canals; gonads surrounding stomach and extending on to basal lobes, rarely interradial on stomach wall alone; radial canals generally branched; tentacle bulbs without ocelli. Polyps, where known, *Lar.*

Key to the genera of Proboscidactylidae.

With exumbrellar clusters of nematocysts; gonads on radial lobes of stomach; radial canals branched ..... *Proboscidactyla.*

Without exumbrellar clusters of nematocysts; gonads on stomach wall alone; radial canals generally unbranched ..... *Pochella.*

Proboscidactyla BRANDT 1834. Proboscidactylidae with clusters of nematocysts on the exumbrella between the tentacles; with gonads extending on to radial lobes of stomach; with 4 or 6 or more branched radial canals; usually without a ring canal.—Synonyms: *Willsia* FORBES 1846, *Willia* L. AGASSIZ 1862.—Type species: *P. flavicirrata* BRANDT.

The great number of species which have been described must be considerably reduced; all of them are very variable. The type species, *flavicirrata* BRANDT 1834, is distinguished by the very numerous terminal branches of the radial canals; *occidentalis* (FEWKES 1889) and *pacifica* (MAAS 1909) are probably identical with *flavicirrata.* All these occur only in the Pacific (North America and Japan). *P. abyssicola* UCHIDA 1947, in Japan, may provisionally be retained owing to the great number of radial canals issuing directly from

the stomach. The remaining species, all of which occur in the Atlantic area (partly also in the Indian and Pacific Oceans) may be referred to three species according to the *normal* number of stomach lobes and primary radial canals being 4, 6 or 8, but all of them are variable in this respect. Their ring canal is represented by a solid core of endoderm cells around the umbrella margin, the internal cavity being obliterated. The exumbrellar nematocyst tracks alternate with the tentacles, in well-developed specimens consisting of a longitudinal series of two or more clusters of nematocysts connected by a cellular string just beneath the surface of the exumbrella.

Key to the species of Proboscidactyla.

1. With normally 4 primary radial canals, 16—20 terminal branches and tentacles; tropical and warm-temperate coasts ..... *ornata.*
   With more than four primary radial canals ..... 2.
2. With normally 6 primary radial canals, up to 24 terminal branches and tentacles; northern Atlantic *stellata.*
   With 5—11, most frequently 8, primary radial canals, 24—54 terminal branches and tentacles; southern Atlantic ..... *mutabilis.*

Proboscidactyla ornata (McCrady 1857). 5 mm. wide, slightly higher than a hemisphere, jelly thick and rigid; stomach normally with 4 radial lobes, mouth with four recurved crenated lips; normally 4 primary radial canals, 16—20 (rarely more) terminal branches and as many tentacles; no ring canal; medusa buds may arise from corners of stomach or forkings of radial canals.—Circumglobal in warm coastal waters. (Mayer 1910 p. 189, Pl. 20 fig. 1—10, text-fig. 100, as *P. ornata*; p. 191, fig. 101, as *P. ornata* var. *stolonifera*; p. 192, Pl. 21 fig. 1—3, as *P. ornata* var. *gemmifera*). Synonyms: *Willia gemmifera* Fewkes 1882, *P. tropica* Browne 1904, *P. varians* Browne 1904, *P. flavicirrata* var. *stolonifera* Maas 1905, *Misakia typica* Uchida 1927, *P. conica* Menon 1932.

Proboscidactyla stellata (Forbes 1846). 9 mm. wide, 8 mm. high, jelly thick, evenly rounded; stomach normally with 6 radial lobes; mouth with 6 folded lips; normally 6 radial canals, up to 24 terminal branches and 24 short tentacles with adaxial basal nematocyst cushions; no ring canal.—North-western Europe; Japan.

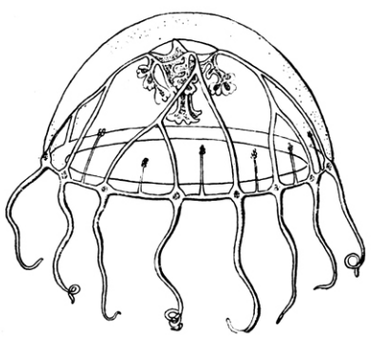


Fig. 255. *Proboscidactyla ornata*, with medusa buds (after Mayer, from Hartlaub).

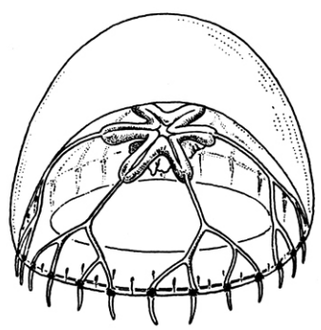


Fig. 256. *Proboscidactyla stellata* (after Russell, redrawn by P. W.).

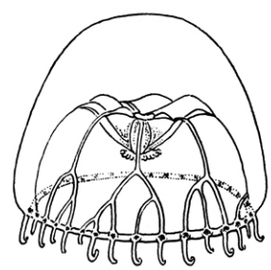


Fig. 257. *Proboscidactyla mutabilis* (after Browne & Kramp, redrawn by P. W.).

(Mayer 1910 p. 193, as *Willsia stellata*; Russell 1953 p. 386, Pl. 23 fig. 3, 4, text-fig. 250—256). Synonyms: *Willsia stellata* Forbes 1846, *Willia stellata* Haeckel 1879.—*Willsia brooksi* Mayer 1910 p. 194, fig. 101a, is probably identical with *P. stellata*; its stomach is three-rayed at centre, but each of the three primary lobes is bifurcated; North Carolina on the Atlantic coast of North America.—*Willia furcata* Haeckel 1879, from the Atlantic coast of France, is probably a mutilated specimen of *P. stellata.*

Proboscidactyla mutabilis (Browne 1902). 6 mm. wide and high, slightly conical, apex very thick; stomach with usually 8, but frequently 6 radial lobes, irregularities frequent; mouth with closely folded lips; 6 or 8

primary radial canals, 24—54 terminal branches; same number of short tentacles; no ring canal.—Falkland Islands; Patagonia. (Browne & Kramp 1939 p. 302, Pl. 14 fig. 8, 9, Pl. 17 fig. 10—12, Pl. 19 fig. 12, text-fig. 2—12, as *Willia mutabilis*).

Pochella Hartlaub 1917. Proboscidactylidae without exumbrellar nematocyst clusters; with four radial canals usually unbranched; with gonads on interradial walls of stomach.—Type species: *P. polynema* Hartlaub.

Key to the species of Pochella.

With 30—40 or more tentacles ..... *polynema.*
With no more than 4 tentacles ..... *oligonema.*

Pochella polynema Hartlaub 1917. 2—3 mm. wide, bell-shaped or hemispherical, jelly fairly thick; stomach large, about two-thirds as long as bell cavity; slightly wavy lips; four radial canals, often with ex-

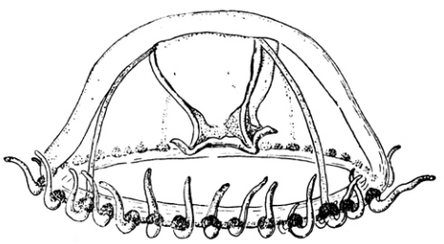


Fig. 258. *Pochella polynema* (after Hartlaub).

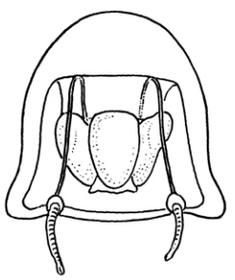


Fig. 259. *Pochella oligonema* (after Kramp, redrawn by P. W.).

ceedingly fine branches; gonads cushion-like; 30—40 or more tentacles.—North-western Europe; Vancouver on the Pacific coast of North America. (Hartlaub 1917 p. 414, fig. 344—346; Russell 1953 p. 394, text-fig. 257—262).

Pochella oligonema Kramp 1955. 2 mm. high and wide, dome-shaped, jelly thick; stomach pyramidal, on a very broad peduncle; mouth with four short simple lips; gonads cushion-like; 4 simple radial canals; 4 perradial tentacles.—Gulf of Guinea, West Africa. (Kramp 1955, p. 270, Pl. 2 fig. 2, text-fig. 7).

IV. Order **Trachymedusae.**

Hydromedusae with umbrella margin entire and not divided into lobes; with thickened marginal nematocyst ring; with radial canals; with gonads usually confined to radial canals; with solid marginal tentacles, or with both solid and hollow tentacles, situated on the margin of the umbrella; with marginal sensory clubs with endodermal axes which may be free or enclosed.

Key to the families of Trachymedusae.

1. Numerous tentacles arranged in groups, most of them with a terminal adhesive disk; stomach broad with eight radial lobes ..... *Ptychogastridae.*
   Tentacles without adhesive disks ..... 2.
2. With centripetal canals and with flattened, leaf-shaped gonads ..... *Geryonidae.*
   Without centripetal canals ..... 3.

3. With 4 radial canals ..... *Petasidae.*
   With 8, rarely more, radial canals ..... 4.
4. With broad circular stomach and broad radial canals ..... *Halicreidae.*
   Stomach and radial canals narrow ..... *Rhopalonematidae.*

Family **Ptychogastridae.**

Trachymedusae with marginal tentacles grouped in more or less well-defined clusters; some tentacles with adhesive organs; with numerous free sensory clubs; with 8 radial canals; stomach eight-lobed, with eight mesenterial partitions; gonads on the sides of the eight stomach-lobes, or on radial canals adjacent to stomach.

Ptychogastria ALLMAN 1878, with the characters of the family. Synonyms: *Pectyllis* + *Pectis* + *Pectanthis* HAECKEL 1879. —Type species: *P. polaris* ALLMAN.

Key to the species of Ptychogastria.

With 16 gonads on the sides of the stomach lobes ..... *polaris.*
With 8 gonads on the radial canals adjacent to stomach ..... *asteroides.*

Ptychogastria polaris ALLMAN 1878. 18—22 mm. wide, hemispherical or somewhat conical, exumbrella with 16 radiating ridges; velum very wide. Stomach about half as long as bell cavity, eight-rayed above, mouth with four lips. 16 separated gonads along the sides of the eight stomach-lobes. About 48 clusters of solid tentacles (in adult), each cluster with three filiform tentacles and numerous tentacles with adhesive organs. 16 statocysts.—Circumpolar in arctic waters; Norway as far south as Bergen; off Nova Scotia on the east coast of North America; South Shetland Islands in Antarctic and near the antarctic continent at about

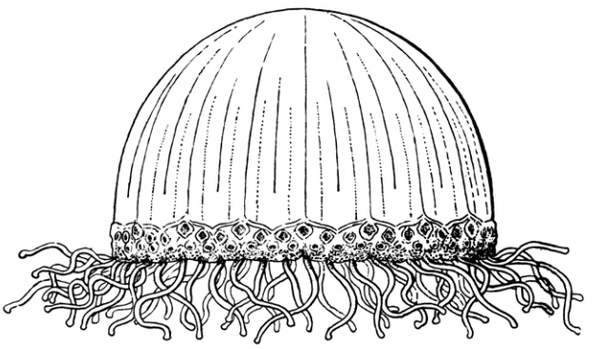


Fig. 260. *Ptychogastria polaris* (after HAECKEL, from BROCH).

90° E. (MAYER 1910 p. 372; KRAMP 1947 p. 4, Pl. 1 fig. 1—4, Pl. 6 fig. 1, 2). Synonyms: *Pectyllis arctica* HAECKEL 1879, *Ptychogastria opposita* VANHÖFFEN 1912 (the antarctic form).

The medusa is usually attached to the bottom of the sea by its sucker-bearing tentacles, but occasionally it swims towards the surface.

Ptychogastria asteroides (HAECKEL 1879). 4—5 mm. wide, flatter than a hemisphere, with a small, sharply pointed apical projection; exumbrella with 16 radiating ridges. 8 egg-shaped gonads on radial canals adjacent to stomach. 16 groups of tentacles (? hollow), most of them with a terminal adhesive organ. 16 statocysts.—Mediterranean. (HAECKEL 1881 p. 20, Pl 7—8, fig. 1—10; MAYER 1910 p. 374; PICARD 1955 p. 68).

Family **Petasidae.**

Trachymedusae with four radial canals; with well-developed manubrium; marginal tentacles solid, with a terminal, club-shaped knob of nematocysts; with free, club-shaped statocysts.

Petasus HAECKEL 1879. Petasidae with marginal tentacles regularly arranged, at equal intervals, not in clusters.—Type species: *P. atavus* HAECKEL.

Petasus atavus HAECKEL 1879. 1 mm. wide and high. Gonads spindle-shaped or band-shaped, along greater part of radial canals. 4 tentacles, 4 statocysts.—Smyrna in the Ægean Sea; Canary Islands. (MAYER 1910 p. 361, fig. 205). Synonym: *P. tetranema* HAECKEL 1879.

Family **Halicreidae.**

Trachymedusae with broad, circular stomach; without peduncle nor proboscis; with broad radial canals; with numerous marginal 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.

Key to the genera of Halicreidae.

1. With about 16 or more radial canals ..... *Halitrephes.*
   With 8 radial canals ..... 2.
2. With tentacles arranged in 16 groups ..... *Botrynema.*
   With tentacles in a continuous row ..... 3.
3. With perradial gelatinous papillae on exumbrella ..... *Halicreas.*
   Without exumbral papillae ..... *Haliscera.*

Halicreas FEWKES 1882. Halicreidae with 8 radial canals; with a continuous row of tentacles; with perradial gelatinous papillae on the exumbrella.—Type species: *H. minimum* FEWKES.

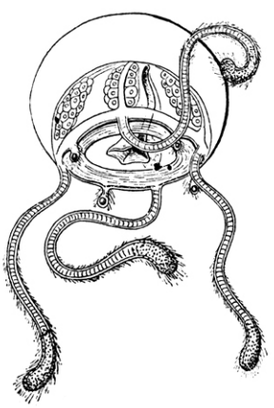


Fig. 261. *Petasus atavus* (after HAECKEL, from MAYER).

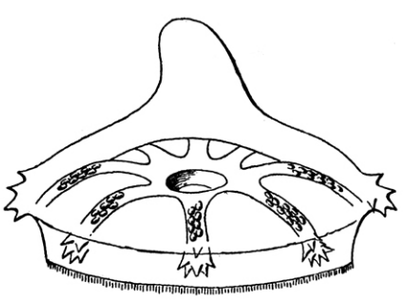


Fig. 262. *Halicreas minimum* (after VANHÖFFEN, from MAYER).

Halicreas minimum 1882. 30—40 mm. wide, thick, disk-like, with a conical apical projection of varying size; 8 clusters of gelatinous papillae above margin. Mouth a wide, circular opening. 8 broad, band-like radial canals and a broad ring canal. Gonads flattened, extending along greater part of radial canals. Tentacles very numerous, up to 640. 3—4 sensory clubs in each octant.—Widely distributed in all the oceans except in arctic

seas and in the Mediterranean; in deep and intermediate water. (BIGELOW 1909*a* p. 138, Pl. 3 fig. 3, Pl. 33 figs. 8, 9, Pl. 34 fig. 1, 2, 3, 5, 8, 10, 11; MAYER 1910 p. 391, fig. 242; RUSSELL 1953 p. 452, text-fig. 299, 300). Synonym: *H. papillosum* VANHÖFFEN 1902.

Haliscera VANHÖFFEN 1902. Halicreidae with 8 radial canals; with a continuous row of tentacles; without papillae on exumbrella.—Type species: *H. conica* VANHÖFFEN.

Key to the species of Haliscera.

1. Umbrella hemispherical, evenly rounded, with fairly thin walls; gonads close to stomach; 48 tentacles ..... *racovitzae.*
   Umbrella very thick at apex; gonads well separated from stomach ..... 2.
2. Umbrella with distinct conical apical projection; 64—72 tentacles in adult ..... *conica.*
   Umbrella with very thick, hemispherical apex; about 96 tentacles in adult ..... *bigelowi.*

Haliscera conica VANHÖFFEN 1902. Up to 18 mm. wide, with a thick, bluntly conical apical projection. Gonads oval, on middle portion of the eight broad radial canals. 8—9 tentacles and 2 statocysts in each octant, the base of each tentacle surrounded by a broad thickening of the marginal nematocyst tissue.—Mediterranean; Atlantic Ocean from the Azores and the Canary Islands to antarctic waters; southern parts of the Indian and Pacific Oceans; bathypelagic. (MAYER 1910 p. 394, fig. 248, as *Halicreas conica*; KRAMP 1947 p. 6; KRAMP 1957 p. 48).

Owing to the rigidity of the jelly the conical shape of the umbrella may be recognized even in badly preserved specimens.

Haliscera bigelowi KRAMP 1947. 15—17 mm. wide, 9—10 mm. high, almost hemispherical, with very thick hemispherical apex and thin jelly in marginal region. Gonads broadly oval, about two-fifth as long as the

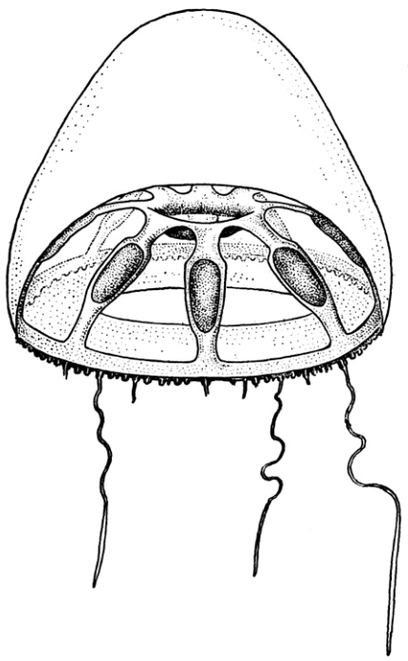


Fig. 264. *Haliscera bigelowi*
(after RUSSELL, redrawn by P. W.).

Fig. 263. *Haliscera conica*
(after VANHÖFFEN, from MAYER).

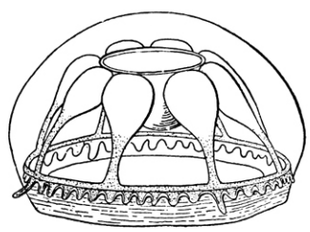


Fig. 265. *Haliscera racovitzae*
(after MAAS, from MAYER).

radial canals, situated slightly nearer to stomach than to bell margin. About 12 tentacles and 3 statocysts in each octant; the thickenings of the nematocyst tissue around the bases of the tentacles are less pronounced than in *H. conica*.—Northern Atlantic from south of Iceland to the northern part of the west coast of Africa;

eastern tropical Pacific; bathypelagic. (KRAMP 1947 p. 8, Pl. 1 fig. 5—8, Pl. 2 fig. 1, 2; RUSSELL 1953 p. 456, Pl. 27 fig. 2, text-fig. 301, 302); Synonym: *Homoeonema alba* BIGELOW 1909, non *Haliscera alba* VANHÖFFEN 1902 and *Halicreas alba* MAYER 1910.

Haliscera racovitzae (MAAS 1906). 8 mm. wide, 4 mm. high, almost hemispherical, moderately thick jelly, flaccid, apex evenly rounded. Gonads along proximal $^1/_2$—$^2/_5$ of the radial canals, close to the stomach. 6 tentacles and 2 statocysts in each octant.—Antarctic waters. (MAYER 1910 p. 393, fig. 246, as *Halicreas racovitzae*; KRAMP 1957 p. 49).

Halitrephes BIGELOW 1909. Halicreidae with several (16 or more) radial canals; with a continuous row of tentacles; without papillae on exumbrella.—Type species: *H. maasi* BIGELOW.

Halitrephes maasi BIGELOW 1909. Up to about 100 mm. wide, low, rounded, jelly fairly thin, soft and flaccid. Stomach circular. 16—30 broad, ribbon-like radial canals, some of which may be bifurcated. Shape of gonads unknown. 100—300 tentacles; number of statocysts unknown.—Circumglobal in tropical and subtropical parts of the oceans; bathypelagic. (BIGELOW 1909*a* p. 146, Pl. 33 fig. 1—5, 7, 10, Pl. 45 fig. 13, as *H. maasi*; VANHÖFFEN 1912*a* p. 384, as *H. valdiviae*; KRAMP 1948*a* p. 7, fig. 1, as *H. medius*; see also the present paper p. 44).

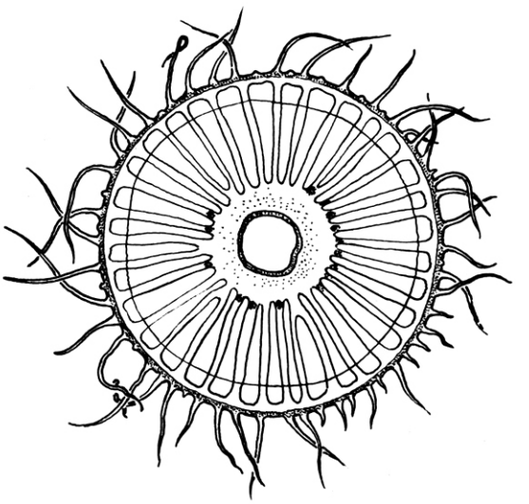


Fig. 266. *Halithephes maasi* (after BIGELOW, redrawn by P. W.).

Botrynema BROWNE 1908. Halicreidae with 8 radial canals; with 16 groups of tentacles (two groups containing many tentacles in a single row in each octant) and 8 solitary perradial tentacles.—Type species: *B. brucei* BROWNE.

Key to the species of Botrynema.

Exumbrella with a distinct apical knob ..... *brucei.*
Exumbrella evenly rounded ..... *ellinorae.*

Botrynema brucei BROWNE 1908. Up to 25 mm. wide; the apical jelly has an enormous thickness and terminates in a very distinct and sharply defined knob. Stomach wide, circular and short; gonads oval, on

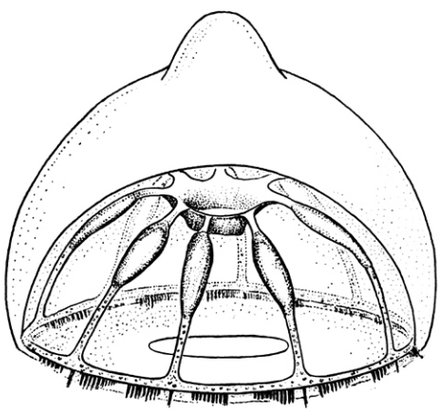


Fig. 267. *Botrynema brucei* (after RUSSELL, redrawn by P. W.).

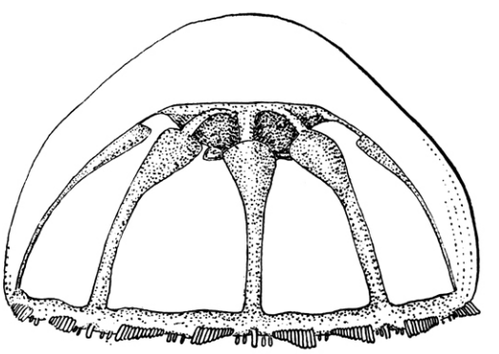


Fig. 268. *Botrynema ellinorae* (after HARTLAUB, from BROCH).

proximal or central halves of radial canals. 11—12 tentacles in each of the 16 groups; usually 3 statocysts in each interradial space and 1—2 on either side of the solitary perradial tentacles.—Atlantic Ocean from south of Iceland and Greenland almost to the antarctic continent; Indian Ocean; South-East Australia and Bering

Sea; bathypelagic. (BROWNE 1908 p. 239, Pl. 1 fig. 8, 9, Pl. 2 fig. 1. KRAMP 1947 p. 11, Pl. 1 fig. 9, Pl. 2 fig. 3, Pl. 6 fig. 4; RUSSELL 1953 p. 459, Pl. 27 fig. 1, text-fig. 303, 304. See also the present paper p. 44). Probably identical with *Halicreas glabrum* VANHÖFFEN 1902, description insufficient, figure misleading.

Botrynema ellinorae (HARTLAUB 1909). Up to 25 mm. wide; higher than a hemisphere, jelly moderately thick, exumbrella evenly rounded without an apical knob. In all other regards similar to *B. brucei*.—Bathypelagic in high-arctic waters. (HARTLAUB 1909 p. 8, Pl. 76 fig. 3, 4, 6, as *Alloionema ellinorae*; KRAMP 1942 pp. 73—77).

Family **Rhopalonematidae.**

Trachymedusae with stomach with or without peduncle; with usually eight, rarely more, radial canals; without centripetal canals; with gonads on radial canals, either globular, linear or pendent; with marginal tentacles evenly distributed, sometimes of two kinds; each tentacle of uniform structure throughout; with free, rarely enclosed, marginal sensory clubs.

Key to the genera of Rhopalonematidae.

1. Gonads a continuous band around stomach, extending outwards on radial canals; numerous tentacles ..... *Homoeonema.*
   Gonads isolated, on radial canals, sometimes adjacent to stomach ..... 2.
2. Without a gastric peduncle (one Pacific species of *Crossota* may have a short peduncle) ..... 3.
   With a gastric peduncle ..... 9.
3. With only 4 gonads, pendent; 8 radial canals; 4 large and about 24 small tentacles ... *Toxorchis.*
   With 8 (rarely more) gonads ..... 4.
4. With 8 long, club-shaped and up to 24 small cirrus-like tentacles; gonads elongated, along radial canals ..... *Rhopalonema.*
   With tentacles all of one kind ..... 5.
5. With gonads adjacent to stomach (sometimes also eight small gonads free of stomach); very numerous tentacles ..... *Arctapodema.*
   Gonads separated from stomach ..... 6.
6. Exumbrella with numerous meridional furrows; gonads sausage-shaped, pendent; very numerous tentacles ..... *Crossota.*
   Exumbrella smooth; gonads not pendent ..... 7.
7. With only 8 tentacles; gonads globular, distal ..... *Sminthea.*
   With 32 or more tentacles; gonads linear ..... 8.
8. With 32 tentacles successively developed ..... *Colobonema.*
   With 48 or more tentacles of equal size ..... *Pantachogon.*
9. Peduncle short, conical (in young specimens almost invisible) ..... 10.
   Peduncle long, slender ..... 11.
10. With only two, pendent gonads ..... *Persa.*
    With 8 globular or oval gonads ..... *Amphogona.*
11. Gonads linear, on peduncle only ..... *Ransonia.*
    Gonads sausage-shaped, pendent ..... 12.
12. Gonads attached to peduncle ..... *Aglaura.*
    Gonads attached to subumbrellar portions of radial canals ..... *Aglantha.*

Homoenema (MAAS 1893) BROWNE 1903. Rhopalonematidae without a gastric peduncle; with gonads forming a continuous band around the base of the stomach extending outwards along the eight radial canals; with numerous tentacles all alike; with vesicular marginal statocysts.—Type species: *H. platygonon* BROWNE.

Homoeonema platygonon BROWNE 1903. 1—2 mm. wide and high. Gonads extending from stomach outwards along proximal half of radial canals. About 80 or more tentacles. 4 statocysts.—Norway; Kara Sea; ? Mediterranean and coast of Brazil. (BROWNE 1903 p. 21, Pl. 2 fig. 2, 3; MAYER 1910 p. 386, fig. 232—234; KRAMP 1947 p. 17).—An insufficient description was given by MAAS (1893 p. 15, Pl. 1 fig. 8), based on a specimen found between Iceland and Greenland; the specimen may or may not have belonged to the species which was adequately described from a Norwegian specimen by BROWNE (1903), who referred it to *H. platygonon* MAAS; this being uncertain, BROWNE should rather be regarded as the author of the species. Several other medusae belonging to different genera have been referred to the genus *Homoeonema*, partly even to *H. platygonon*. A revision was carried out by KRAMP (1947).

Rhopalonema GEGENBAUR 1856. Rhopalonematidae without a gastric peduncle; with gonads along the eight radial canals separated from stomach; with tentacles of two kinds: radial clubs, and inter- and adradial cirri; with enclosed marginal statocysts.—Type species: *R. velatum* GEGENBAUR.

Key to the species of Rhopalonema.

Umbrella with a gelatinous apical knob; gonads oval, along middle third of radial canals; statocysts close beside tentacles and cirri ..... *velatum.*
Umbrella without an apical knob; gonads along distal two-thirds of radial canals; statocysts in middle of the spaces between tentacles and cirri ..... *funerarium.*

Rhopalonema velatum GEGENBAUR 1856. 8—10 mm. wide, somewhat flatter than a hemisphere, with a conical apical thickening. Stomach narrow, elongated, reaching almost to velar opening; four short, simple lips. Gonads linear or oval extending along middle third of radial canals. 8 radial, club-shaped tentacles; 8 interradial and, in adult specimens, 16 adradial cirrus-like very small tentacles. A statocyst close beside each of the radial tentacles and the interradial cirri. Velum very broad.—Abundant in the warm parts of all the oceans, northwards to the Gulf of Maine and the British Isles; Mediterranean. Mainly in the upper layers, but occasionally also in deep water. (MAYER 1910 p. 378, fig. 213—219, as *R. velatum*; p. 379, fig. 220, as *R. polydactylum*; p. 380, fig. 221, 222, as *R. coeruleum*, in part; p. 381, fig. 224, as *R. striatum*; p. 382, fig. 225, as *R. clavigerum*; RUSSELL 1953 p. 430, text-fig. 283, 284).

Rhopalonema funerarium VANHÖFFEN 1902. Up to 17 mm. wide and 14 mm. high, somewhat conical, without an apical projection. Stomach narrow, elongated, hardly reaching velar opening. Gonads linear, extending along distal two-thirds of radial canals. 8 radial tentacles; 8 interradial and 16 adradial cirrus-like, very small tentacles, each with a globular terminal knob. 32 statocysts in middle of the spaces between tentacles and cirri. Velum very broad.—Atlantic Ocean between about 50° S. and 50° N., fairly common in deep water; scattered localities in the Indian and Pacific Oceans; bathypelagic. Records from the Mediterranean are probably erroneous. (VANHÖFFEN 1902 p. 61, Pl. 9 fig. 2, Pl. 10 fig. 17, Pl. 11 fig. 31; MAYER 1910 p. 380, as *R. coeruleum*, in part; KRAMP 1947 p. 14, Pl. 2 fig. 4, 5; RUSSELL 1953 p. 434, text-fig. 285, 286).

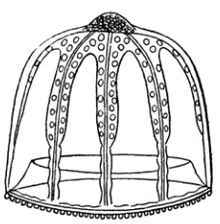


Fig. 269. *Homoeonema platygonon* (after BROWNE, from MAYER).

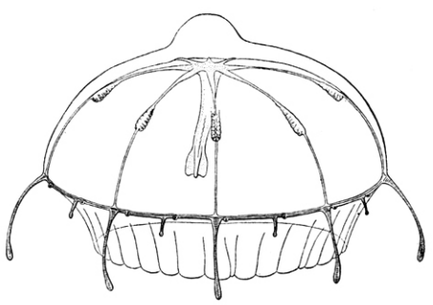


Fig. 270. *Rhopalonema velatum* (after MAYER).

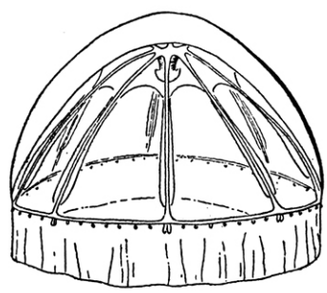


Fig. 271. *Rhopalonema funerarium* (after VANHÖFFEN, from MAYER).

Pantachogon MAAS 1893. Rhopalonematidae without a gastric peduncle; with gonads along the eight radial canals separated from stomach; with 48 or more tentacles all alike; with free club-shaped statocysts; with the apical outlines of the subumbrellar muscular fields forming an entire circle.—Type species: *P. haeckeli* MAAS.

Key to the species of Pantachogon.

1. Umbrella mitre-shaped, with a gelatinous apical projection; 48 tentacles ..... *militare.*
   Umbrella without an apical projection; 64—120 tentacles ..... 2.
2. With 64 tentacles ..... *haeckeli.*
   With about 120 tentacles ..... *scotti.*

Pantachogon haeckeli MAAS 1893. About 12 mm. high and wide, bell-shaped, with thin jelly and without an apical projection; with very strong and conspicuous musculature. Stomach short; 4 small, simple lips.

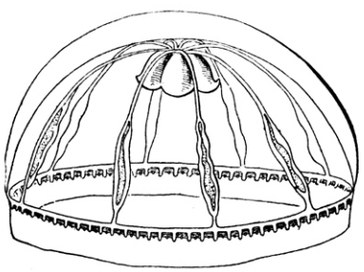


Fig. 272. *Pantachogon haeckeli* (after VANHÖFFEN, from MAYER).

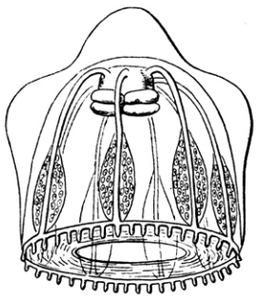


Fig. 273. *Pantachogon militare* (after MAYER).

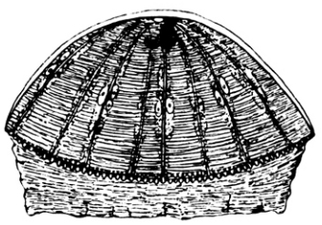


Fig. 274. *Pantachogon scotti* (after VANHÖFFEN).

Gonads extending along greater portion of the eight radial canals. 64 tentacles all alike. 64 club-shaped statocysts. Velum very broad.—Widely distributed in all the oceans except in the Mediterranean and in arctic seas; it penetrates southwards almost to the antarctic continent; bathypelagic. (MAYER 1910 p. 389, fig. 239—241, as *P. haeckeli* + *rubrum*; RUSSELL 1953 p. 440, Pl. 25 fig. 2, text-fig. 290—292). Synonym: *P. rubrum* VANHÖFFEN.

Pantachogon militare (MAAS 1893). 7—10 mm. wide, 6 mm. high, mitre-shaped, with a well-developed apical projection. Gonads lancet-shaped, on distal half of the eight radial canals. 48 tentacles all alike. 4 (or more?) statocysts.—North of the Bermuda Islands; Mediterranean; west of Africa (see above, p. 52); bathypelagic. (MAYER 1910 p. 387, fig. 235, as *Homoeonema militare*).

Pantachogon scotti BROWNE 1910. About 4 mm. wide, a little broader than high, with thin jelly and without apical projection; with strong musculature; Stomach very small; four short lips. Gonads linear, extending along proximal two-thirds of the eight radial canals. About 120 tentacles, all alike. Number of statocysts unknown.—Antarctic. (BROWNE 1910 p. 36, Pl. 3 fig. 5, 6; VANHÖFFEN 1912*a* p. 378, fig. 16). Examination of the type specimen in British Museum, London, shows that *P. scotti* is a valid species.

Colobonema VANHÖFFEN 1902. Rhopalonematidae without a gastric peduncle; with elongated gonads extending along the eight radial canals; with tentacles all of one kind, developing in succession; with free, club-shaped marginal statocysts; with the apical outlines of the subumbrellar muscular fields forming a star-shaped figure.—Type species: *C. sericeum* VANHÖFFEN.

Colobonema sericeum VANHÖFFEN 1902. Up to 45 mm. wide and 35 mm. high, bell-shaped, slightly conical, with fairly thin jelly and without an apical projection. Stomach more or less elongated, tubular; four small

lips. Gonads linear, straight, extending along greater part of the eight radial canals. 32 tentacles, the adradial tentacles developed before the interradial. Statocysts probably alternating with the tentacles. Velum broad.—Widely distributed in the deep parts of the oceans except in the Mediterranean and in arctic and antarctic seas; bathypelagic. (MAYER 1910 p. 385, as *Homoeonema typicum*, in part; RUSSELL 1953 p. 436, Pl. 25 fig. 1, text-fig. 287—289). Synonym: *C. typicum* MAAS 1905, *non* 1897.

Sminthea GEGENBAUR 1856. Rhopalonematidae without a gastric peduncle; with globular gonads on the eight radial canals; with only 8, radial tentacles; with enclosed marginal statocysts.—Type species: *S. eurygaster* GEGENBAUR.

Sminthea eurygaster GEGENBAUR 1856. Up to 6 mm. wide and about half as high, with a small apical, gelatinous projection. Stomach short; 4 very short lips. Gonads globular, on the eight radial canals close to the ring canal. 8 radial tentacles; 8 marginal statocysts.—Mediterranean; warm parts of the Atlantic and

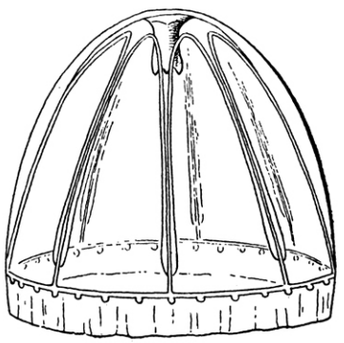


Fig. 275. *Colobonema sericeum* (after VANHÖFFEN, from MAYER).

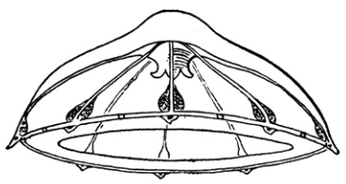


Fig. 276. *Sminthea eurygaster* (after HAECKEL, from MAYER).

Indian Oceans, in deep and intermediate water. (MAYER 1910 p. 383, fig. 226, 227). Synonym: *Marmanema mammaeforme* HAECKEL.

Arctapodema DALL 1907. Rhopalonematidae without a gastric peduncle; with urn-shaped stomach; with gonads on radial canals adjacent to stomach; with eight narrow radial canals; with numerous tentacles all alike, in a single row; with free, club-shaped marginal statocysts.—Synonyms: *Isonema* MAAS 1906 (preoccupied); *Homoeonema* MAAS, in part. A revision of the species is given by KRAMP 1957.—Type species: *A. amplum* (VANHÖFFEN).

Key to the species of Arctapodema.

1. With four interradial gonads encircling base of stomach ..... *antarcticum.*
   Gonads partly on radial canals ..... 2.
2. With eight gonads, pendent, on radial canals near base of stomach ..... *australe.*
   With eight gonads extending from radial lobes of stomach outwards on proximal parts of radial canals, sometimes also eight pairs of small gonads on radial canals separated from stomach *amplum.*

Arctapodema antarcticum (VANHÖFFEN 1912). Up to 16 mm. wide, hemispherical, fairly thin jelly. Stomach tubular. Four interradial gonads encircling base of stomach but interrupted in the four perradial corners; no gonads on the radial canals. About 120 tentacles; statocysts unknown. Stomach red in adult.—Antarctic waters; southern Indian Ocean; in deep water (VANHÖFFEN 1912*a* p. 375, text-fig. 8, 9, as *Isonema antarcticum*; KRAMP 1957 p. 56).

Arctapodema australe (VANHÖFFEN 1912). Up to 23 mm. wide and 14 mm. high; thin jelly. Stomach short and broad, with 16 radial folds; four lips. Eight gonads globular or club-shaped, pendent, on the radial

canals near base of stomach. About 112 tentacles; statocysts unknown. Stomach violet, canals and tentacles wine-red, gonads yellow.—Antarctic waters and southern Indian Ocean; intermediate and deep water. (VANHÖFFEN 1912*a* p. 376, text-fig. 10, 11, as *Isonema australe*; KRAMP 1957 p. 58, Pl. 5 fig. 5, 6). Synonym: ? *A. macrogaster* VANHÖFFEN 1902.

Arctapodema amplum (VANHÖFFEN 1902). Up to 15 mm. wide, somewhat flatter than a hemisphere, thin walls, thicker at apex. Stomach short, urn-shaped, with eight radial lobes; four simple lips. Eight swollen gonads adjacent to the gastral lobes; the gonads may be of unequal sizes, and some of them may be radially divided into two halves; small additional gonads may also appear in pairs on the radial canals at a short distance from the gastral lobes. About 100 tentacles; 4—8 marginal statocysts.—Antarctic waters; southern

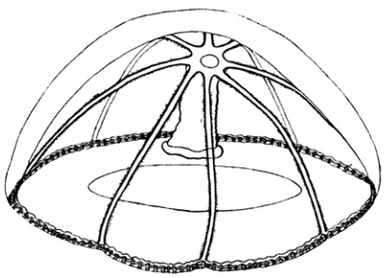


Fig. 277. *Arctapodema antarcticum* (after VANHÖFFEN).

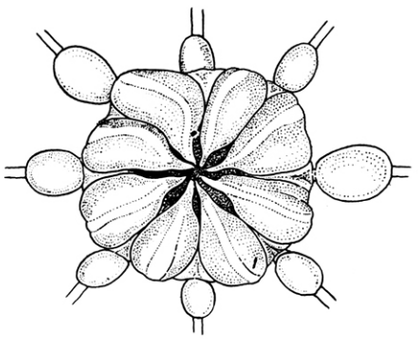


Fig. 278. *Arctapodema australe*, aboral view of stomach and gonads (after KRAMP, redrawn by P. W.).

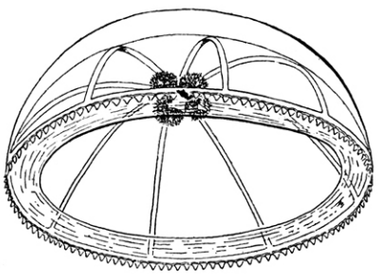


Fig. 279. *Arctapodema amplum* (after VANHÖFFEN, from MAYER).

and tropical Atlantic; Mediterranean; intermediate and deep water. (MAYER 1910 p. 387, fig. 236—237, as *Homoeonema amplum*; VANHÖFFEN 1912*a* p. 374, text-fig. 4—7, as *Isonema amplum*; KRAMP 1957 p. 56, Pl. 5 fig. 4). Synonyms: *A. najadis* PELL and probably *A. tetragonium* (VANHÖFFEN).

Amphogona BROWNE 1904. Rhopalonematidae with a short, conical gastric peduncle; with ellipsoidal or sac-shaped, pendent gonads on the eight radial canals; gonads usually of unequal size; with tentacles all alike; with free, club-shaped marginal statocysts.—Type species: *A. apsteini* (VANHÖFFEN).

Key to the species of Amphogona.

Umbrella without an apical projection; gonads near ring canal ..... *apsteini.*
Umbrella with a conical apical projection; gonads near middle points of radial canals ..... *apicata.*

Amphogona apsteini (VANHÖFFEN 1902). 4—6 mm. wide, lower than a hemisphere, with thin jelly. Peduncle short, conical; stomach small; four short simple lips. Gonads ellipsoidal, pendent, near ring canal, of unequal size, occasionally four male and four female gonads in the same individual. 50—70 tentacles; 16—24 statocysts.—Tropical Pacific and Indian Oceans; West Africa; surface. (MAYER 1910 p. 405, fig. 257; KRAMP 1955 p. 274).

Amphogona apicata KRAMP 1957. Up to 7 mm. wide and 8 mm. high, with thin walls and a bluntly conical apical projection. Peduncle short, conical. Stomach small, tubular; four short, simple lips. Gonads sac-shaped, pendent, near middle points of radial canals. About 64 tentacles; statocysts unknown.—Southern and tropical Atlantic; Mozambique Channel east of Africa; bathypelagic. (KRAMP 1957 p. 59, Pl. 5 fig. 7; see also the present paper p. 54).

Tetrorchis BIGELOW 1909. Rhopalonematidae without a gastric peduncle; with only four gonads attached to four of the eight radial canals, sausage-shaped, pendent; with 4 large perradial and several small tentacles; statocysts unknown.

Tetrorchis erythrogaster BIGELOW 1909. 10—12 mm. wide, 8 mm. high, pyriform, apex very thick, lateral walls thin. Stomach tubular, reaching slightly beyond velar level; four small lips. Gonads sausage-shaped, pendent, attached to four of the eight radial canals near their middle points. 4 large perradial tentacles opposite to the four fertile radial canals, and 16—24 small tentacles. Statocysts unknown. Stomach a brilliant carmine.—Eastern tropical Pacific; tropical Atlantic; bathypelagic. (BIGELOW 1909*a* p. 114, Pl. 29 fig. 1—3; MAYER 1910 p. 388; see also the present paper p. 55).

Persa MCCRADY 1857. Rhopalonematidae with a short gastric peduncle; with only two gonads, pendent, on the subumbrellar portions of two opposite radial canals; with 8 radial canals; with numerous long tentacles all alike; each with a terminal knob. Statocysts free, club-shaped.—Type species: *P. incolorata* MCCRADY.

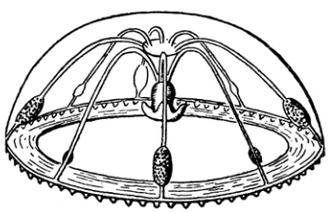


Fig. 280. *Amphogona apsteini* (after VANHÖFFEN, from MAYER).

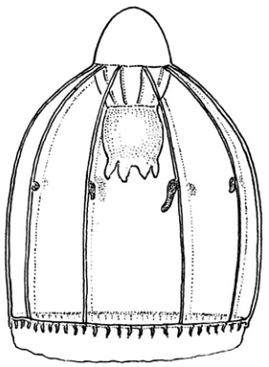


Fig. 281. *Amphogona apicata* (after KRAMP, redrawn by P. W.).

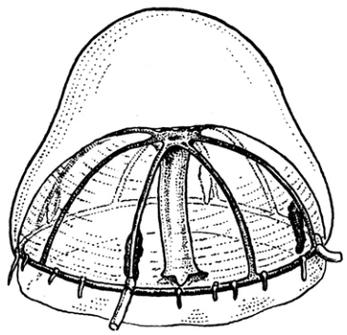


Fig. 282. *Tetrorchis erythrogaster* (after BIGELOW, redrawn by P. W.).

Persa incolorata MCCRADY 1857. 2 mm. wide, 3 mm. high; umbrella with or without a small apical knob, lateral walls thin. Stomach tubular, elongated; four small, broadly rounded lips. Gastric peduncle short, very contractile. Two oval or sausage-shaped, pendent gonads near middle points of two opposite radial canals.

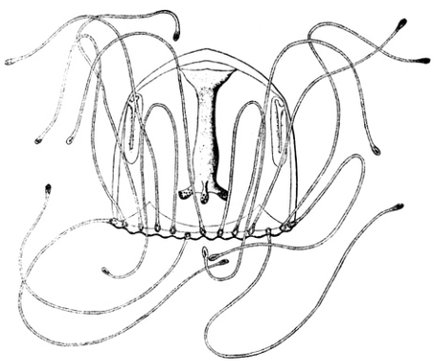


Fig. 283. *Persa incolorata* (after MAYER).

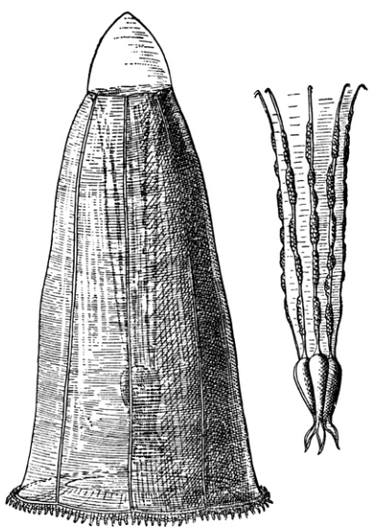


Fig. 284. *Ransonia krampi*, medusa and peduncle with gonads (after RANSON).

Up to 48 long tentacles with a terminal knob; 8 statocysts.—Mediterranean; tropical and southern Atlantic; South-east Australia (MAYER 1910 p. 408, fig. 259—262; PICARD 1951*a* pp. 20—23, figs.). Synonyms: *P. lucerna* + *dissogonima* HAECKEL 1879, *Quadralaria pyramidalis* WEILL 1935.

Ransonia KRAMP 1947. Rhopalonematidae with a high, conical umbrella (similar to *Aglantha*); with a long and narrow gastric peduncle; with 8 radial canals; with linear gonads along the peduncular portions of the radial canals, not on subumbrella; with numerous tentacles all alike; statocysts unknown.—Type species: *R. krampi* (RANSON).

Ransonia krampi (RANSON 1932). 15 mm. high, 8 mm. wide, conical, with thin walls and a small, solid, conical apical projection. Gonads more or less discontinuous along the eight radial canals on the long, narrow peduncle; about 88 tentacles. Statocysts unknown.—Western part of Mediterranean; west coast of Africa from Gibraltar to the Cape of Good Hope, mainly in deep water. (RANSON 1936 p. 183, Pl. 2 fig. 21, as *Aglantha krampi*; see also the present paper p. 55).

Crossota VANHÖFFEN 1902. Rhopalonematidae with or without a short gastric peduncle; with numerous meridional furrows on the exumbrella; with 8 or more radial canals; with pendent, sausage-shaped gonads on the radial canals; with numerous densely crowded tentacles all alike; with free, club-shaped marginal statocysts.—Type species: *C. brunnea* VANHÖFFEN.

Key to the species of Crossota.

1. With 10—14 radial canals; umbrella deep reddish brown ..... *norvegica.*
   With 8 radial canals ..... 2.
2. Gonads nearer ring canal than stomach; umbrella colourless ..... *alba.*
   Gonads near base of stomach ..... 3.
3. With 200—250 tentacles in one row; umbrella deep reddish brown..... *rufobrunnea.*
   With 600 or more tentacles, apparently in several rows; umbrella pure brown ..... *brunnea.*

Crossota brunnea VANHÖFFEN 1902. Up to about 30 mm. wide and 22 mm. high. Without a gastric peduncle. Stomach bottle-shaped, short, with eight large, deep longitudinal fissures and above them eight similar small invaginations; mouth with four small lips. 8 radial canals. Gonads on the radial canals near base of stomach. 600 or more tentacles very densely crowded, giving a false impression of being arranged in several rows. Number of statocysts unknown. Colour of umbrella pure brown.—All oceans south of the equator; bathypelagic. (MAYER 1910 p. 396, fig. 249; KRAMP 1947 p. 21).

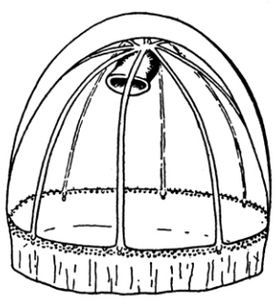


Fig. 285. *Crossota brunnea* (after VANHÖFFEN, from MAYER).

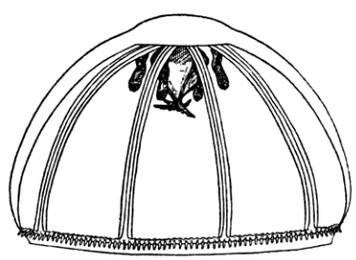


Fig. 286. *Crossota rufobrunnea* (after KRAMP).

Crossota rufobrunnea (KRAMP 1913). Up to 15 mm. wide and 10 mm. high. Without a gastric peduncle. Stomach bottle-shaped, short, with eight large, deep longitudinal fissures and above them eight similar small invaginations; mouth with four small, outturned lips. 8 radial canals. Gonads on the radial canals near base of stomach. About 200—250 tentacles. Number of statocysts unknown. Umbrella, stomach and tentacles deep reddish brown.—Atlantic Ocean north of about 30° N.; northern Pacific; bathypelagic. (KRAMP 1913 p. 273, fig. 1, 2, as *Aglantha rufobrunnea*; KRAMP 1947 p. 22, Pl. 2 fig. 9, 10, Pl. 3 fig. 1—8, Pl. 4 fig. 1—4, Pl. 6 fig. 5; RUSSELL 1953 p. 444, text-fig. 293—296).

Crossota norvegica VANHÖFFEN 1902. 20 mm. wide, 18 mm. high. Without a gastric peduncle. Stomach bottle-shaped, with irregular longitudinal ridges and invaginations; mouth with 5—7 out-turned lips. 10—14 radial canals. Gonads on the radial canals near base of stomach. About 275 tentacles. Statocysts unknown. Colour of umbrella deep reddish brown.—Norwegian Sea, in deep water. (KRAMP & DAMAS 1925 p. 317; KRAMP 1947 pp. 22, 26, Pl. 4 fig. 5, 6).

Crossota alba BIGELOW 1913. Up to 42 mm. wide and 28 mm. high. Without a gastric peduncle. Stomach tubular, narrow, with eight sharp longitudinal ridges separated by eight broad, flat furrows; mouth with four small lips. 8 radial canals. Gonads on the radial canals somewhat nearer ring canal than stomach. Up to 190 tentacles. Number of statocysts unknown. Stomach dark chocolate-brown or violet, almost black,

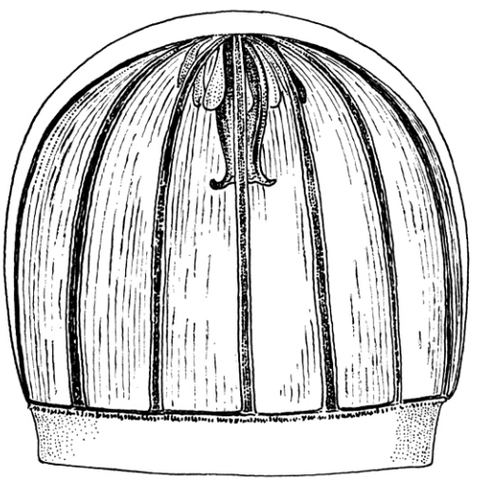


Fig. 287. *Crossota norvegica* (after KRAMP, redrawn by P. W.).

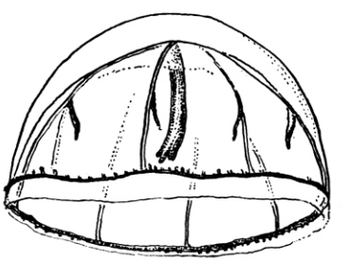


Fig. 288. *Crossota alba* (after BIGELOW, redrawn by P. W.).

oral lips white, umbrella colourless.—Japan; eastern Atlantic from South Africa to the Bay of Biscay; bathypelagic. (BIGELOW 1913 p. 49, Pl. 3 fig. 9—12; KRAMP 1947 p. 22; see also the present paper p. 56).

Aglantha HAECKEL 1879. Rhopalonematidae with a long and slender gastric peduncle; with eight pendent, sausage-shaped gonads on the subumbrellar portions of the eight radial canals; with numerous tentacles all alike; with free, club-shaped marginal statocysts.—Type species: *A. digitale* (O. F. MÜLLER).

Key to the species of Aglantha.

Gonads close to base of peduncle ..... *digitale.*
Gonads about midway between peduncle and bell margin ..... *elata.*

Aglantha digitale (O. F. MÜLLER 1766). 10—40 mm. high, about half as wide as high, thimble-shaped, with a small conical apical projection, lateral walls thin, subumbrellar muscles strong. Peduncle slender, almost as long as bell cavity; stomach small; mouth with four small simple lips. Gonads long, sausage-shaped, pendent from subumbrellar portion of radial canals close to base of peduncle. 80 or more tentacles; 8 statocysts. Local races differ in size and colour, umbrella colourless or roseate, in cold waters often bright carmine.—Abundant in the Atlantic and Pacific Oceans from about 35° N. northwards into high-arctic waters; from surface down to considerable depths. (MAYER 1910 p. 402, Pl. 49 fig. 2; KRAMP 1942 pp. 81—97; RUSSELL 1953 p. 447, Pl. 26 fig. 1—10, text-fig. 297, 298).

Aglantha elata (HAECKEL 1879). 10—12 mm. high, narrow, with a pointed apical projection; peduncle about half as long as bell cavity. Stomach small. Gonads long, attached to about middle points of subumbrellar

parts of the radial canals. 40—48 tentacles; 16 statocysts.—West Africa; South-east Australia. (MAYER 1910 p. 404, fig. 255, as *Aglantha elongata*; BLACKBURN 1955 p. 418). Synonyms: *Agliscra elata* + *elongata* HAECKEL 1879. *Circe anaïs* and *elongata* LESSON 1843 are unrecognizable.

Aglaura PÉRON & LESUEUR 1809. Rhopalonematidae with a slender gastric peduncle; with eight sausage-shaped gonads on the peduncle, not on the subumbrella; with numerous tentacles all alike; with free, club-shaped marginal statocysts.—Type species: *A. hemistoma* PÉRON & LESUEUR.

Aglaura hemistoma PÉRON & LESUEUR 1809. 4—6 mm. high, 3—4 mm. wide, with flat apex, jelly very thin. Peduncle somewhat shorter than bell cavity. Stomach small, mouth with four small, simple lips. Eight

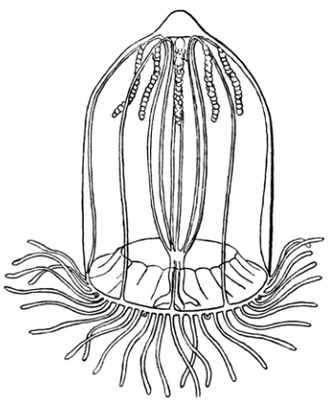


Fig. 289. *Aglantha digitale* (after MAYER, from BROCH).

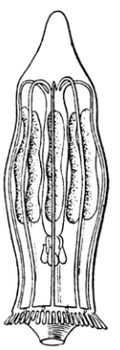


Fig. 290. *Aglantha elata* (after HAECKEL, from MAYER).

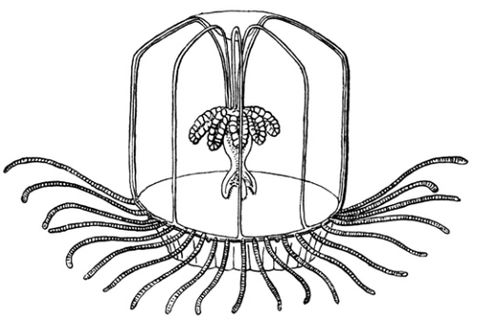


Fig. 291. *Aglaura hemistoma* (after MAYER, from BROCH).

sausage-shaped gonads on the peduncle near stomach. 48—85 tentacles; 8 statocysts.—Generally distributed in the warm and temperate parts of all the oceans, including the Mediterranean; in the surface layers. (MAYER 1910 pp. 398—401, Pl. 46 fig. 4, 5, Pl. 49 fig. 3—7, Pl. 50 fig. 11, text-fig. 250—253; p. 404, text-fig. 254, as *Aglantha globulifera*). Synonyms: *Aglaura laterna* + *nausicaa* HAECKEL 1879, *A. prismatica* MAAS 1897, *A. octagona* BIGELOW 1904, *Aglantha globulifera* HAECKEL 1879, probably also *Stauraglaura tetragonima* HAECKEL 1879.

Family **Geryonidae.**

Trachymedusae with stomach with peduncle; with 4 or 6 radial canals; with centripetal canals; with flattened leaf-shaped gonads on radial canals; with marginal tentacles of two kinds, hollow and solid; with marginal sensory clubs enclosed in mesogloea.

Key to the genera of Geryonidae.

With 6 radial canals and 6 gonads ..... *Geryonia.*
With 4 radial canals and 4 gonads ..... *Liriope.*

Geryonia ESCHSCHOLTZ 1829. Geryonidae with 6 radial canals and 6 gonads. Synonyms: *Carmaris* + *Carmarina* HAECKEL 1879.—Type species: *G. proboscidalis* (FORSKÅL).

Geryonia proboscidalis (FORSKÅL 1775). 35—80 mm. wide, almost hemispherical, jelly moderately thick. Stomach small, on a long conical peduncle; mouth with 6 simple lips. 6 radial canals; up to 7 centripetal canals in each space between the radial canals. Gonads heart-shaped, very broad above. 6 long, hollow

perradial tentacles with nematocyst rings, and 6 small, solid interradial tentacles with adaxial nematocyst clusters. 12 statocysts.—All tropical and subtropical seas. (MAYER 1910 p. 425, Pl. 53 figs. 1—3, Pl. 54 fig. 10, text-fig. 282, 283). Synonym: *Carmarina hastata* HAECKEL.

Liriope LESSON 1843. Geryonidae with 4 radial canals and 4 gonads. Synonyms: *Liriantha* + *Glossoconus* + *Glossocodon* HAECKEL 1879.—Type species: *L. tetraphylla* (CHAMISSO & EYSENHARDT).

Liriope tetraphylla (CHAMISSO & EYSENHARDT 1821). 10—30 mm. wide, almost hemispherical, jelly thick. Stomach small, on peduncle of varying length; mouth with four simple lips. Four broad radial canals; 1—3 (or more) centripetal canals in each quadrant. Gonads of very variable shape and size. 4 long, hollow perradial

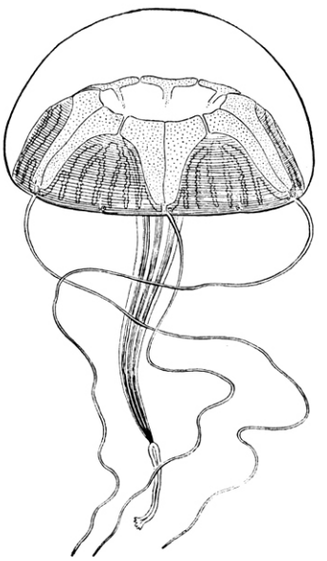


Fig. 292. *Geryonia proboscidalis* (after MAYER).

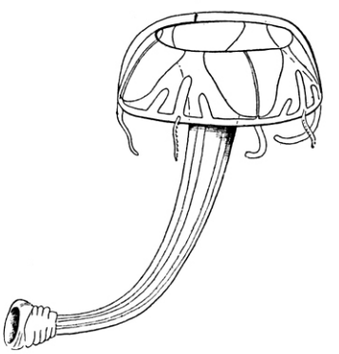


Fig. 293. *Liriope tetraphylla* (after VANHÖFFEN, from MAYER).

tentacles with nematocyst rings, and 4 small, solid interradial tentacles with adaxial nematocyst clusters. 8 statocysts.—Generally distributed and very common in the varm parts off all the oceans. (MAYER 1910 p. 413—424, Pl. 50 fig. 1—10, Pl. 51 fig. 1—4, Pl. 52 fig. 1—4, Pl. 53 fig. 4; text-fig. 263—281; RUSSELL 1953 p. 419, Pl. 24 fig. 2, text-fig. 275—282).—Synonyms: It is now generally accepted that the numerous forms of *Liriope*, which have been described as independent species, all belong to one species, *L. tetraphylla*.

V. Order **Narcomedusae.**

Hydromedusae with sides of umbrella divided by peronial grooves so that umbrella margin may be lobed; with broad stomach with entire circular periphery or with rectangular peripheral pouches; without radial canals, and with or without a peripheral canal system; with gonads on stomach walls; with solid tentacles leaving umbrella some distance above margin, and sometimes small secondary tentacles on margin itself; with sense organs in form of free sensory clubs with endodermal axis.

Key to the families of Narcomedusae.

1. Umbrella completely reduced; demersal habitat ..... *Halammohydridae.*
   Umbrella well developed ..... 2.

2. Without stomach pouches ..... *Solmaridae.*
   With stomach pouches ..... 3.
3. Pouches perradial ..... *Cuninidae.*
   Pouches interradial ..... *Aeginidae.*

Family **Aeginidae.**

Narcomedusae with interradial, divided stomach pouches; with or without peripheral canal system; with primary perradial tentacles leaving umbrella between marginal pouches; pouches extending beyond points of origin of primary tentacles; with or without secondary tentacles on umbrella margin; with or without otoporpae.

Key to the genera of Aeginidae.

1. With only two tentacles ..... *Solmundella.*
   With four or more tentacles ..... 2.
2. With 8 (or more) tentacles and twice as many stomach pouches; with secondary marginal tentacles ..... *Aeginura.*
   With 4—6 tentacles; without secondary tentacles ..... 3.
3. With 4 tentacles, 8 peronia and 16 stomach pouches ..... *Aeginopsis.*
   With 4—6 tentacles, 4—6 peronia and 8—12 stomach pouches ..... *Aegina.*

Aegina ESCHSCHOLTZ 1829. Aeginidae with typically 8, occasionally 10 or 12, stomach pouches; with gonads in the stomach pouches; with peripheral canal system; with typically 4, occasionally 5 or 6, primary tentacles and same number of peronia; without secondary tentacles; without otoporpae.—Type species: *Ae. citrea* ESCHSCHOLTZ.

Aegina citrea ESCHSCHOLTZ 1829. Up to 50 mm. wide, hemispherical, jelly thick at apex. Stomach large, circular; typically 8 rectangular stomach pouches, sometimes with a small median notch. Typically 4 tentacles issuing about midway between apex and margin, a peronial strand from each tentacle base to margin of umbrella, dividing the margin into four lappets. Peripheral canal system present. Numerous marginal statocysts; no otoporpae. 5- or 6-rayed specimens occur rather frequently.—Widely distributed in the warm and temperate parts of all the oceans; in cold areas it is restricted to deep water, but in warm areas it may occur at all depths. (MAYER 1910 p. 451—454, Pl. 52 fig. 5, Pl. 54 fig. 11, text-fig. 299, 300; RUSSELL 1953 p. 467, Pl. 28 fig. 1, text-fig. 308—310; see also the present paper p. 61). Synonyms: *A. rosea* ESCHSCHOLTZ, *rhodina* HAECKEL, *lactea* + *brunnea* VANHÖFFEN, *alternans* BIGELOW, *pentanema* KISHINOUYE.

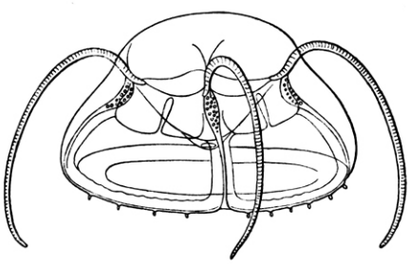


Fig. 294. *Aegina citrea* (after MAYER, from BROCH).

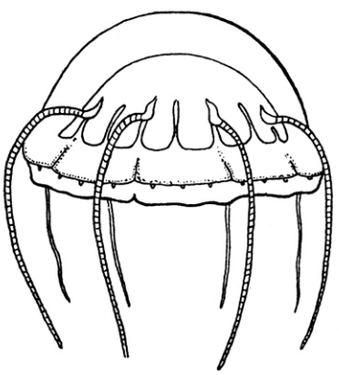


Fig. 295. *Aeginura grimaldii* (after MAAS, from MAYER).

Aeginura HAECKEL 1879. Aeginidae with 16 stomach pouches; peripheral canal system degenerate or absent; with 8 primary tentacles and same number of peronia; with secondary tentacles on umbrella margin; without otoporpae. Type species: *Ae. grimaldii* MAAS.

Aeginura grimaldii MAAS 1904. Up to 45 mm. wide, hemispherical, central part thick. Stomach large, circular; 16 rectangular stomach pouches with indications of slight median clefts. 8 large primary tentacles at level of top of stomach, a peronial strand from each tentacle base to margin of umbrella. 3—5 small secondary tentacles on umbrella margin in each octant. One or two statocysts between adjacent secondary tentacles. Colour of stomach and its pouches deep chocolate or purplish black.—Widely distributed in the oceans except in the Mediterranean and in arctic and antarctic seas; bathypelagic. (MAYER 1910 p. 470, fig. 309; RUSSELL 1953 p. 472, text-fig. 311, 312). Synonym: *A. weberi* MAAS 1905. Doubtful synonyms: *A. myosura*, *Cunoctona lanzerotae* and *C. nausithoë* HAECKEL 1879.

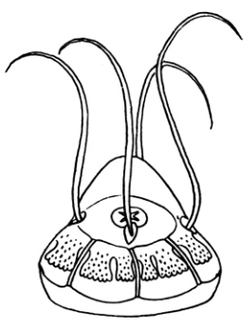


Fig. 296. *Aeginopsis laurentii* (after BRANDT, from MAYER).

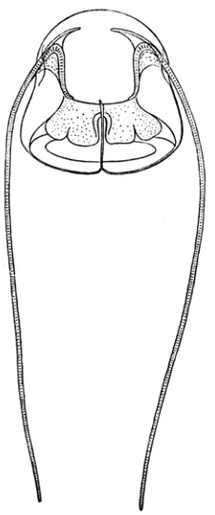


Fig. 297. *Solmundella bitentaculata* (after MAYER).

Aeginopsis BRANDT 1835. Aeginidae with 16 stomach pouches; peripheral canal system absent; with 4 primary tentacles and twice as many peronia; without secondary tentacles; without otoporpae.—Type species: *Ae. laurentii* BRANDT.

Aeginopsis laurentii BRANDT 1838. Up to 25 mm. wide, hemispherical or somewhat conical, apex thick, lateral walls very thin. Stomach broad, lenticular; 16 rectangular stomach pouches (eight primary pouches deeply cleft). 4 large primary tentacles issuing at a very high level; 4 perradial and 4 interradial peronia. No peripheral canal system; 2—3 statocysts in each octant.—High-arctic, circumpolar, from surface to deep water. (BIGELOW 1909*b* p. 314, Pl. 32 fig. 2—6; MAYER 1910 pp. 472, 498, text-fig. 309*a*; KRAMP 1942 p. 97).

Solmundella HAECKEL 1879. Aeginidae with 8 stomach pouches; without peripheral canal system; with 4 peronia, but only 2 tentacles; without secondary tentacles; without otoporpae.—Type species: *S. bitentaculata* (QUOY & GAIMARD).

Solmundella bitentaculata (QUOY & GAIMARD 1833). Up to 12 mm. wide, usually much smaller, higher than wide, apical part very thick. Stomach broad, lenticular; 8 rectangular stomach pouches. 2 opposite very long tentacles issuing from umbrella near apex, which is keeled along the axis leading to the tentacles; the two tentacular peronia are deposited in deep grooves. Usually 8—16 statocysts, but sometimes up to 32.—Widely distributed in the oceans, including the Mediterranean, but rare in the northern parts of the Atlantic and Pacific Oceans; circumpolar in antarctic seas; from surface to fairly deep water. (MAYER 1910 pp. 455, 456, Pl. 54 fig. 1—3, Pl. 55 fig. 4, text-fig. 301, 302). Synonym: *S. mediterranea* (J. MÜLLER 1851).

Family **Solmaridae.**

Narcomedusae without stomach pouches, the genital products being developed either as thickenings or diverticula in the oral wall of the central stomach; with or without peripheral canal system; with or without otoporpae.

Key to the genera of Solmaridae.

Without peripheral canal system and without otoporpae ..... *Solmaris.*
With peripheral canal system and with otoporpae ..... *Pegantha.*

Solmaris HAECKEL 1879. Solmaridae with simple annular gonad; without peripheral canal system; without otoporpae.—The species of this genus need a revision.—Type species: *S. rhodoloma* (BRANDT).

Key to the species of Solmaris.

1. With 6—8 statocysts in each marginal lappet; up to 35 mm. wide, with 18—20 tentacles and lappets *solmaris.*
   With 1—3 statocysts in each marginal lappet ..... 2.
2. Less than 3 mm. wide when adult, with 12—26 tentacles and lappets; usually only one statocyst in each lappet ..... *leucostyla.*
   More than 12 mm. wide when adult; usually two statocysts in each lappet ..... 3.
3. 12—15 mm. wide with 30—36 or more tentacles and lappets ..... *corona.*
   15—23 mm. wide with 12—17 tentacles and lappets ..... *flavescens.*

Solmaris leucostyla (WILL 1844). 3 mm. wide, flat to hemispherical. 12—26 tentacles and marginal lappets; the lappets are quadratic, each with usually one statocyst.—Mediterranean. (METSCHNIKOFF 1886 p. 254, Pl. 23 fig. 29; MAYER 1910 p. 433).

Solmaris flavescens (KÖLLIKER 1853). 15—23 mm. wide, flat and lens-shaped, thick. 12—17 (usually 13—15) tentacles; marginal lappets thin, quadratic, each with usually two statocysts.—Mediterranean and adjacent parts of the Atlantic Ocean; records from other parts of the Atlantic are unreliable. (MAYER 1910 p. 434, text-fig. 284—286). Synonym: *Solmoneta flavescens* HAECKEL.

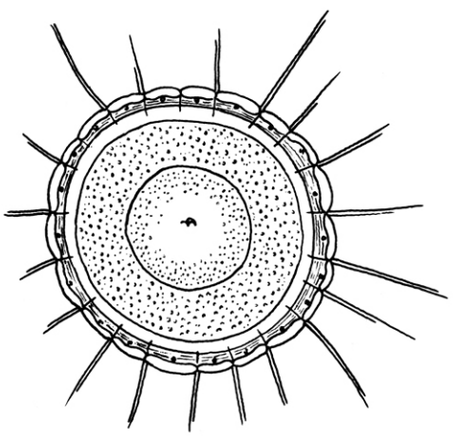


Fig. 298. *Solmaris leucostyla* (after METSCHNIKOFF, redrawn by P.W.).

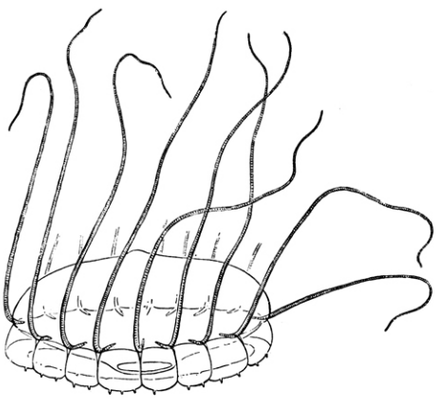


Fig. 299. *Solmaris flavescens* (after MAYER).

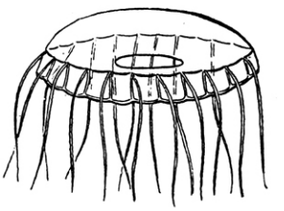


Fig. 300. *Solmaris solmaris* (after GEGENBAUR, from MAYER).

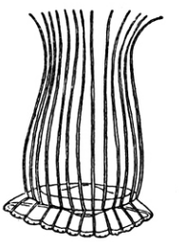


Fig. 301. *Solmaris corona* (after KEFERSTEIN & EHLERS).

Solmaris solmaris (GEGENBAUR 1856). Up to 35 mm. wide, flat, concavo-convex. 18—20 tentacles; marginal lappets quadratic, each with 6—8 statocysts.—Mediterranean. (MAYER 1910 p. 437, text-fig. 287). Synonym: *Solmaris gegenbauri* HAECKEL 1879.

Solmaris corona (KEFERSTEIN & EHLERS 1861). 12—15 mm. wide, flat, lens shaped. Up to 36 long tentacles. Lappets rectangular, about twice as long as broad, usually with two statocysts mounted on a large cushion with long bristles.—Mediterranean; Atlantic Ocean from Norway to the Cape of Good Hope, common in British waters; off Durban in South-East Africa. (MAYER 1910 p. 437, text-fig. 288; RUSSELL 1953 p. 476, Pl. 28 fig. 2, text-fig. 313, 314).

Solmaris multilobata MAAS 1893, with 64 or more tentacles and lappets, may be a multitentacular form of *S. corona*; it was abundant around Scotland in 1889 but has not been found later on.

Solmaris vanhoeffeni NEPPI & STIASNY 1911. 0.5 mm. high, 1 mm. wide, almost hemispherical. 6—16 tentacles, very long. Lappets twice as broad as long, each with 1—3 statocysts.—Adriatic Sea. (NEPPI & STIASNY 1913 p. 60, Pl. 4 fig. 40). This may be the young of one of the other species, though it is stated that its gonads are well developed even in specimens with only 6 tentacles.

Pegantha HAECKEL 1879. Solmaridae with gonads forming diverticula of the margin of the oral wall of the stomach; with peripheral canal system; with otoporpae.—Synonyms: *Polyxenia* + *Pegasia* + *Solmoneta* HAECKEL 1879; *Cunina* ESCHSCHOLTZ 1829 in part; ? *Polycolpa* HAECKEL 1879.—Type species: *P. martagon* HAECKEL.

Key to the species of Pegantha.

1. Exumbrella with deep radiating furrows and elevated ridges; 12—16 tentacles; otoporpae long *triloba.*
   Exumbrella smooth ..... 2.
2. Some or all otoporpae long; peripheriral canals narrow throughout their length ..... 3.
   All otoporpae short; peripheral canals broad, at least in their lateral portions ..... 4.
3. With 12—16 marginal lappets, each with usually 4 or 6 otoporpae, the two middle ones long; canals very narrow ..... *rubiginosa.*
   With about 20—40 marginal lappets, each with usually 3 or 5 long otoporpae; canals fairly narrow *clara.*
4. Umbrella highly vaulted, thick; about 16 marginal lappets; lateral portions of peripheral canals broad at base, tapering outwards ..... *martagon.*
   Umbrella flat, lenticular; 16—26 marginal lappets; peripheral canals very broad throughout.. *laevis.*

Pegantha martagon HAECKEL 1879. Up to 30 mm. wide, usually about 20 mm., hemispherical or higher, thick, smooth. About 16 marginal lappets about as long as broad, square or evenly rounded, each with 5—7 (or 9) statocysts. Otoporpae short and narrow, about twice as long as the width of the transverse portion of the peripheral canals. Canals: transverse portion fairly narrow, lateral portions broad proximally, tapering

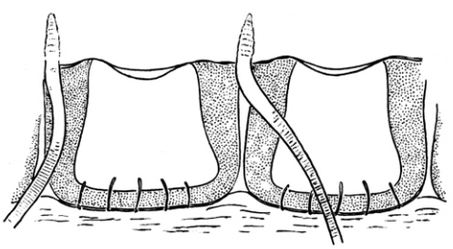


Fig. 302. *Pegantha martagon*, marginal lappets (after KRAMP, redrawn by P. W.).

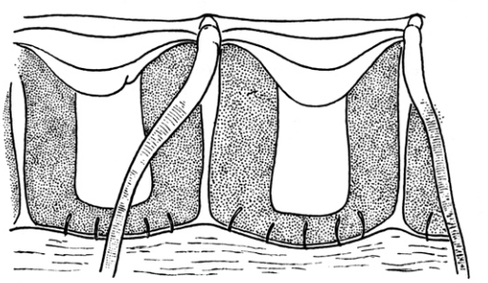


Fig. 303. *Pegantha laevis*, marginal lappets (after KRAMP, redrawn by P. W.).

distally. Gonads simple or irregularly lobed sacs.—Widely distributed in the tropical and subtropical parts of the three great oceans; circumpolar in subantarctic waters; mainly in the upper water layers. (H. B. BIGELOW 1909*a* p. 83, Pl. 18 fig. 1—8; MAYER 1910 p. 443, text-fig. 295, 296; KRAMP 1957 p. 67, Pl. 6 fig. 1; see also the present paper p. 64). Synonym: *P. simplex* BIGELOW 1904.

Pegantha laevis H. B. Bigelow 1909. Up to about 40 mm. wide, flat, lenticular, smooth. 16—22 (up to 26) marginal lappets, about as long as broad with rounded corners, each with 5—7 statocysts; otoporpae shorter or slightly longer than the width of the transverse portion of the peripheral canals. Canals very broad, especially in their lateral regions, of nearly the same width from their base to the outer edge of the lappet. Gonads when fully developed sac-shaped with oval or papilliform processes.—Atlantic Ocean from the Bay of Biscay southwards to Patagonia and South Africa; south-east of Africa; eastern tropical Pacific; mainly in the upper water layers. (H. B. Bigelow 1909*a* p. 97, Pl. 16 fig. 1, Pl. 20 fig. 4—6, Pl. 27 fig. 1—7; Mayer 1910 p. 444; Kramp 1957 p. 70, Pl. 6 fig. 2; see also the present paper p. 66).

Pegantha clara R. P. Bigelow 1909. Up to 50 mm. wide and 20 mm. high, thick, lenticular, smooth. Up to 40 marginal lappets, continuously increasing in number during growth of the individual, quadrate or

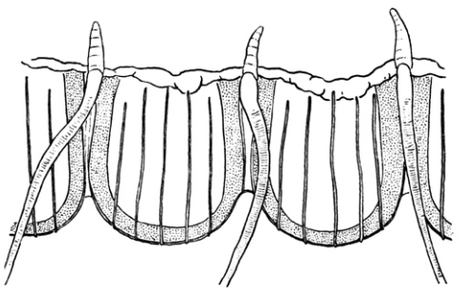


Fig. 304. *Pegantha clara*, marginal lappets (after Kramp, redrawn by P. W.).

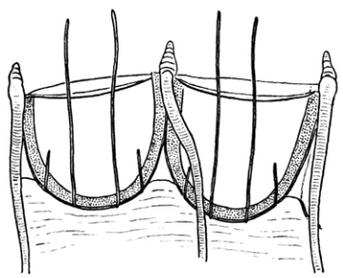


Fig. 305. *Pegantha rubiginosa*, marginal lappets (after Kramp, redrawn by P. W.).

Fig. 306. *Pegantha triloba* (after Bigelow, redrawn by P. W.).

somewhat longer than broad, usually tongue-shaped, each with 3—5 statocysts and long, linear otoporpae, usually as long as the lappets. Peripheral canals fairly narrow, of almost equal width throughout their length. Gonads a simple, smooth or somewhat crenulated pouch in each lappet radius.—Widely distributed in the Atlantic Ocean between about 50° N. and 40° S.; western part of Indian Ocean; tropical Pacific; mainly in the upper water layers. (Mayer 1910 p. 445, text-fig. 298 A; Kramp 1957 p. 73, Pl. 6 fig. 3, text-fig. 13, see also the present paper p. 66). Synonym: *P. smaragdina* H. B. Bigelow 1909*a* p. 90, Pl. 14 fig. 1—2, Pl. 19 fig. 1—9, Pl. 22—26.

Pegantha rubiginosa (Kölliker 1853). Up to about 16 mm. wide, dome-shaped, jelly very thick, smooth. 12—16 marginal lappets, rectangular with rounded corners, each with 4 or 6 statocysts; the two middle otoporpae long and narrow, frequently longer than the lappet, the lateral ones shorter. Peripheral canals very narrow throughout their length. Gonads without diverticula.—Common in the Mediterranean; tropical Atlantic, penetrating northwards to the Azores and the Bay of Biscay. (Mayer 1910 p. 480, text-fig. 319—321, as *Cunina prolifera*; Kramp 1957 p. 76, Pl. 6 fig. 4; see also the present paper p. 67).

Pegantha triloba Haeckel 1879. Up to 30 mm. wide, hemispherical or somewhat flatter, jelly very rigid, exumbrella with deep radiating furrows from tentacle bases nearly to apex surrounded by ribs and supplementary ridges. 12—16 tentacles and 12—16 marginal lappets, ovate, pointed, each with up to 20 statocysts; otoporpae long, tapering upwards. Gonads with 2—4 lobes projecting into the lappet cavities.—Tropical parts of the three great oceans, in the Atlantic penetrating southwards to about 48° S., northwards to about 32° N.; mainly in the upper water layers. (H. B. Bigelow 1909*a* p. 87, Pl. 14 fig. 3, Pl. 16 fig. 3, Pl. 20 fig. 1—3, Pl. 45 fig. 1—2; Mayer 1910 p. 443, text-fig. 293, 294, 297; Kramp 1957 p. 77; see also the present paper p. 68). The following species are probably synonyms of *P. triloba*: *Pegantha biloba* + *quadriloba* + *pantheon* + *sieboldi* Haeckel 1879; *P. dactyletra* Maas 1893; *Solmaris insculpta* Mayer 1906.

Family **Cuninidae.**

Narcomedusae with perradial and undivided stomach pouches; with or without peripheral canal system; with tentacles leaving umbrella opposite centre of each stomach pouch, equal in number to that of pouches; pouches not extending beyond points of origin of tentacles; without secondary tentacles on umbrella margin; with or without otoporpae.

Key to the genera of Cuninidae.

With otoporpae ..... *Cunina.*
Without otoporpae ..... *Solmissus.*

Cunina ESCHSCHOLTZ 1829. Cuninidae with otoporpae; with or without peripheral canal system. Synonym: *Cunoctantha* HAECKEL 1879.—Type species: *C. globosa* ESCHSCHOLTZ.

Key to the species of Cunina.

1. With peripheral canals ..... 2.
   Without peripheral canals ..... 4.
2. Stomach pouches tapering from broad base, separated by wide triangular spaces; 7—9 tentacles *frugifera.*
   Stomach pouches with nearly parallel sides ..... 3.
3. Stomach pouches quadratic, more than twice as wide as septa between them; peripheral canals narrow; 10—14 tentacles ..... *globosa.*
   Stomach pouches elongated rectangular, hardly broader than spaces between them; lateral portions of peripheral canals very broad; numerous tentacles ..... *duplicata.*
4. Stomach pouches spindle-shaped; 8 tentacles ..... *fowleri.*
   Stomach pouches broad, with parallel sides ..... 5.
5. Stomach on a broad conical peduncle; 9—14 stomach pouches; up to 57 mm. wide ... *proboscidea.*
   No peduncle ..... 6.
6. Usually 8 stomach pouches, square; about 5 mm. wide ..... *octonaria.*
   Usually about 12 stomach pouches, square or somewhat rounded distally; about 14 mm. wide *peregrina.*

Cunina octonaria MCCRADY 1857. 5—7 mm. wide, somewhat flatter than a hemisphere. 7—9, usually 8 stomach pouches, broad, square, very close together; tentacles project about midway between margin and apex; a thick and broad pad of ectoderm below the base of each tentacle. 2—5, usually 3 statocysts on each marginal lappet, otoporpae small. No peripheral canals. Larvae developed in stomach pouches or attached to other medusae.—Widely distributed in the warm parts of all oceans, including the Mediterranean. (MAYER 1910 p. 461, Pl. 55 fig. 1, 2, text-fig. 304, 305, as *Cunoctantha octonaria*; p. 464, Pl. 54 fig. 4—9, as *Cunoctantha octonaria* var. *köllikeri*; p. 465, as *Cunoctantha parasitica*; KRAMP 1957 p. 82, synonymy).

Cunina fowleri (BROWNE 1906). 4 mm. wide, watchglass-shaped; 8 stomach pouches, spindle-shaped; 8 marginal lappets, rounded, each with 5 statocysts and long, narrow otoporpae. No peripheral canals. Medusa buds developed from stomach pouches projecting into the bell cavity.—Bay of Biscay. (MAYER 1910 p. 466 text-fig. 306, as *Cunoctantha fowleri*; KRAMP 1957 p. 82).

Cunina peregrina BIGELOW 1909. Up to 14 mm. wide, highly arched, jelly thick; 8—14 (usually 12) stomach pouches, increasing in number with age, in adult specimens square or a little longer than wide, with narrow clefts between them; in younger specimens, with few antimeres, the stomach pouches are well separated and more or less rounded distally (in contradistinction to *C. octonaria*); ectodermal pad below base of tentacles small; marginal lappets short and broad, each with 4—10 statocysts, otoporpae narrow, linear. No peripheral

canals. Stolonial larvae, probably of this species, on the subumbrella of *Rhopalonema velatum*.—Tropical parts of the Pacific and Atlantic Oceans and in the western part of the Indian Ocean. (BIGELOW 1909*a* p. 59, Pl. 1 fig. 6, Pl. 15 fig. 1, 2, Pl. 28 fig. 1—7, Pl. 45 fig. 8; KRAMP 1957 p. 84).

Cunina proboscidea METSCHNIKOFF 1871. Up to 57 mm. wide, pear-shaped or somewhat conical; stomach long, conical, on a large conical gelatinous peduncle; 9—14 stomach pouches, long, rectangular, separated by narrow spaces; tentacles very short; marginal lappets bluntly rounded, each with 3—4 statocysts; otoporpae

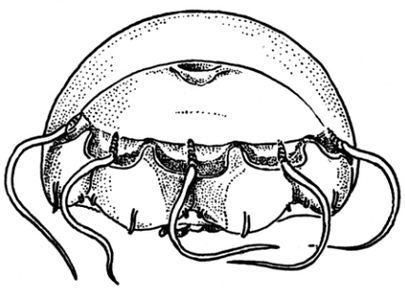


Fig. 307. *Cunina octonaria*
(after MAYER, redrawn by P. W.).

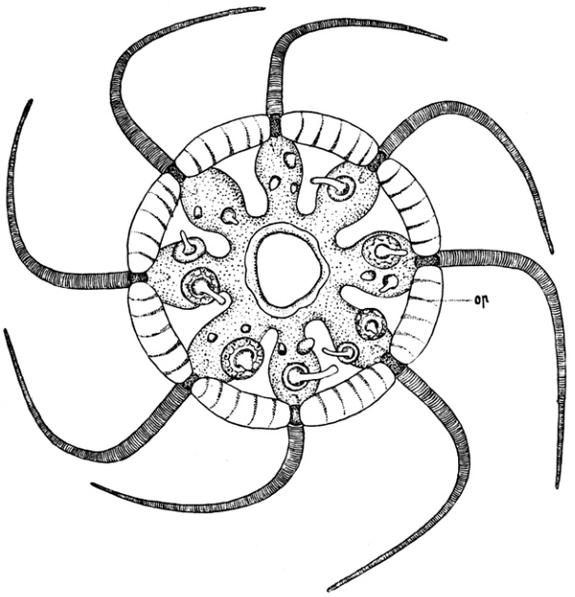


Fig. 308. *Cunina fowleri*
(after BROWNE, from BROCH).

short, club-shaped; peripheral canals degenerate. Medusoid larvae in stomach of the medusa, parasitic larvae developing in *Geryonia*.—Mediterranean. (MAYER 1910 p. 476, text-fig. 316, 317). Synonym: ? *C. vitrea* GEGENBAUR 1856.

Cunina frugifera KRAMP 1948. About 8 mm. wide, dome-shaped, apical jelly very thick; 6—9 stomach pouches, narrowing in width from base outwards, separated by wide triangular spaces; tentacles rather short; no ectodermal pads below base of tentacles; marginal lappets almost square, about as long as broad,

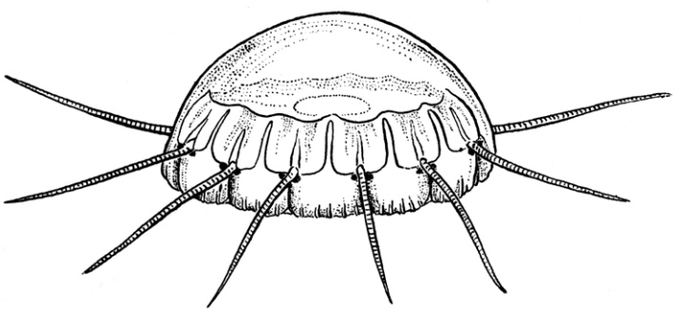


Fig. 309. *Cunina peregrina*
(after BIGELOW, redrawn by P. W.).

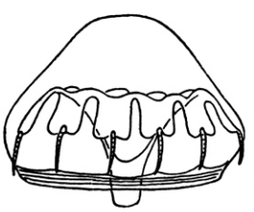


Fig. 310. *Cunina proboscidea*
(after METSCHNIKOFF, from MAYER).

each with 4 statocysts, otoporpae linear; peripheral canals broad and flat. Medusa-buds developing on subumbrellar side of stomach pouches.—Warm parts of Atlantic Ocean, northwards to the Azores, southwards to Uruguay and South-Africa; east coast of Africa. (KRAMP 1948*b* p. 18, Pl. fig. 1—6; see also the present paper p. 69).

Cunina globosa ESCHSCHOLTZ 1829. Up to 18 mm. wide, conical or almost globular, jelly thick; stomach on a broad gelatinous peduncle; 10—14 stomach pouches, wide, quadratic with rounded angles, more than twice as wide as septa between them; the tentacles arise a short distance only above the margin; no ectodermal pad below bases of tentacles; marginal lappets short and broad, each with 3 statocysts; otoporpae short and

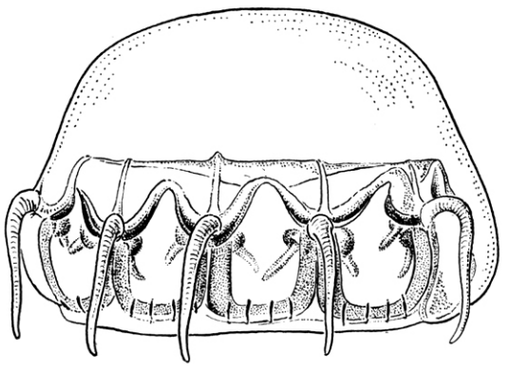


Fig. 311. *Cunina frugifera* (after KRAMP, redrawn by P. W.).

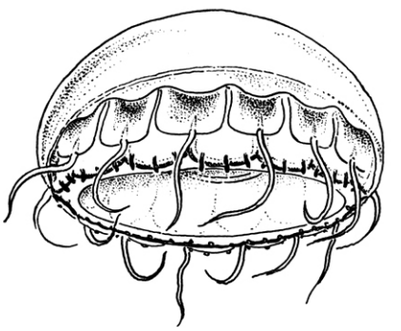


Fig. 312. *Cunina globosa* (after BIGELOW, redrawn by P. W.).

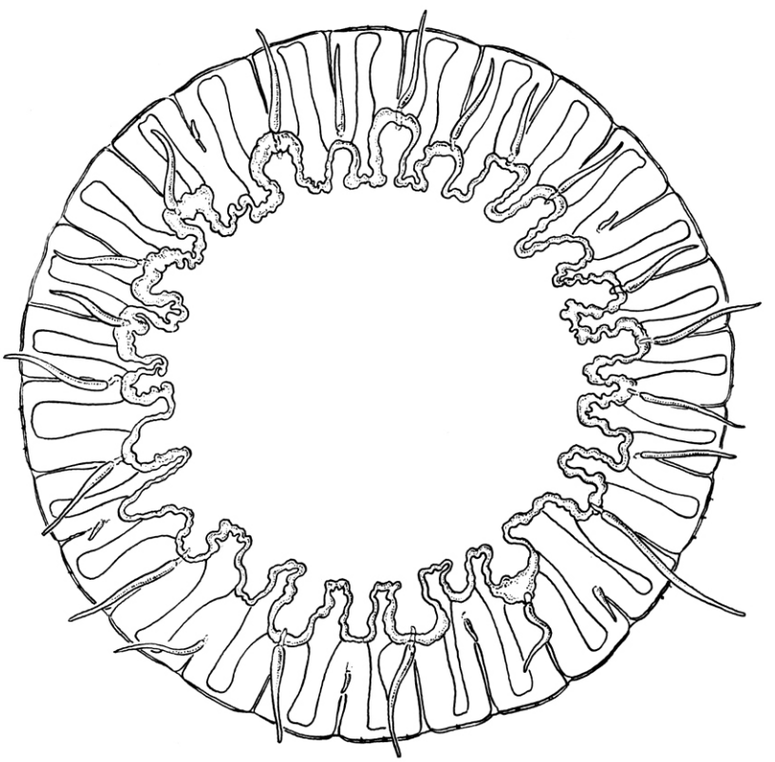


Fig. 313. *Cunina duplicata* (after KRAMP, redrawn by P. W.).

oval; peripheral canals well developed.—Tropical Pacific; Atlantic Ocean near the Cape of Good Hope and off the English Channel. (BIGELOW 1909*a* p. 57, Pl. 15 fig. 3, Pl. 17 fig. 3, 8; MAYER 1910 p. 476, text-fig. 311, 312; KRAMP 1957 p. 83). Synonym: *C. lativentris* GEGENBAUR 1856, which occurs in the Mediterranean and adjacent parts of the Atlantic Ocean, probably belongs to *C. globosa* (MAYER 1910 p. 476, fig. 315; KRAMP 1957 p. 83).

Cunina duplicata MAAS 1893. Up to 58 mm. wide, rather flat; up to 29 stomach pouches, increasing in number with age from 9 in juvenile specimens, tongue-shaped or rectangular, somewhat longer than broad, with parallel sides, separated by spaces of about the same width or somewhat broader; the gonads form a

continuous, folded band following the edge of the stomach with its pouches uninterruptedly; the stomach pouches are of unequal length and width, sometimes large and smaller ones alternating; marginal lappets rectangular, each with 2 or 3 statocysts, otoporpae very small; lateral portions of the peripheral canals remarkably broad, transverse portion narrow.—Central and southern parts of the Atlantic Ocean; off the east coast of Africa. (MAYER 1910 p. 481, text-fig. 323; KRAMP 1957 p. 86, Pl. 6 fig. 5, Pl. 7 fig. 1, 2; see also the present paper p. 70).

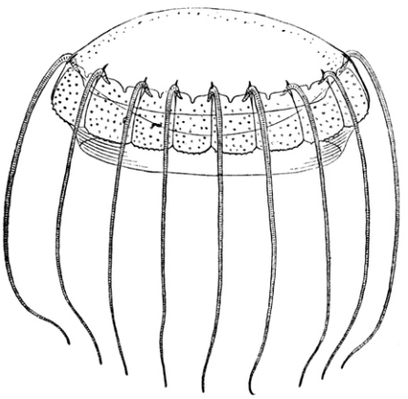


Fig. 314. *Solmissus albescens* (after MAYER).

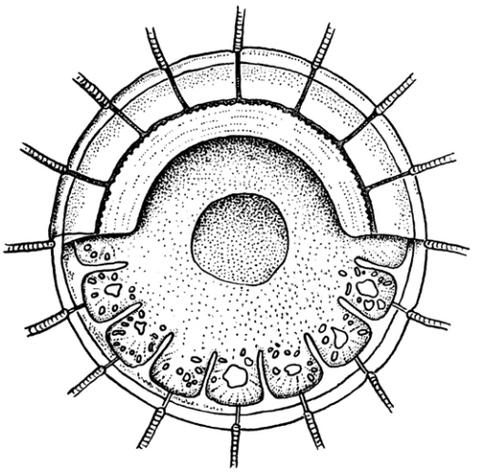


Fig. 315. *Solmissus marshalli* (after BIGELOW, redrawn by P. W.).

Doubtful species: *Cunina polygonia* (HAECKEL 1879), Mediterranean. (MAYER 1910 p. 465, as *Cunoctantha polygonia*). *Cunina oligotis* HAECKEL 1879, South Africa. (MAYER 1910 p. 475).

Solmissus HAECKEL 1879. Cuninidae without otoporpae; without peripheral canal system.—Type species: *S. albescens* (GEGENBAUR).

Key to the species of Solmissus.

1. Exumbrella with numerous small but distinct warts ..... *albescens.*
   Exumbrella smooth ..... 2.
2. With about 16 stomach pouches, rectangular, close together; disk rigid ..... *marshalli.*
   With 20—40 stomach pouches, oval in outline; disk soft and fragile ..... *incisa.*

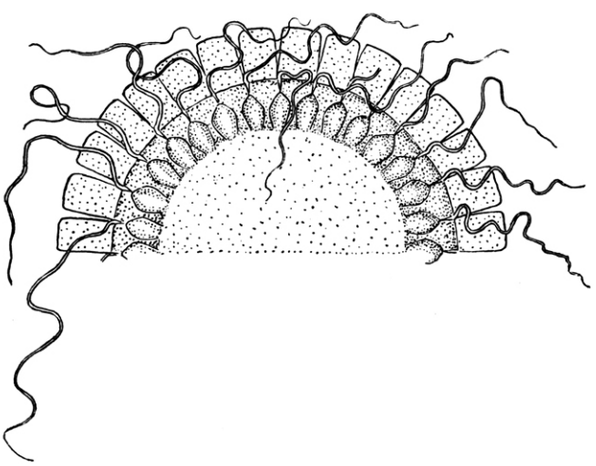


Fig. 316. *Solmissus incisa* (after FEWKES, from BROCH).

Solmissus albescens (GEGENBAUR 1856). 25—30 mm. wide, flat, lenticular, jelly quite thick at centre, thin at margin, exumbrella with scattered small but distinct gelatinous warts; 14—16 stomach pouches, somewhat wider than long, frequently pentagonal; marginal lappets almost rectangular with rounded angles, each with 5—8 statocysts.—Mediterranean, mainly in deep water. (MAYER 1910 p. 482, text-fig. 324—326). Synonyms: *S. ambiguus* NEPPI 1915 and probably *S. ephesius* HAECKEL 1879.

Solmissus marshalli AGASSIZ & MAYER 1902. Up to 62 mm. wide, flat, gelatinous disk thick and rigid, lappet zone very thin, exumbrella smooth; 8—20, usually about 16 stomach pouches, rectangular, about as long as wide or slightly longer; tentacles long; marginal lappets square, as broad

as long, margin hardly, if at all, incised in the peronial radii, each with up to 15 statocysts.—Atlantic Ocean from Bay of Biscay to South Africa; tropical parts of Indian and Pacific Oceans; mainly in deep water but occasionally near the surface. (BIGELOW 1909*a* p. 64, Pl. 16 fig. 5, 6, Pl. 21 fig. 4, 6—8; KRAMP 1957 p. 79; see also the present paper p. 71).

Solmissus incisa (FEWKES 1886). Up to 100 mm. wide, flat, jelly soft and particularly fragile, exumbrella smooth; 20—40 stomach pouches, oval in outline, usually somewhat longer than wide; marginal lappets rectangular, about as long as broad, each with 2—5 statocysts.—Atlantic Ocean from South Africa to Scotland and Nova Scotia; tropical and northern Pacific. (BIGELOW 1909*a* p. 67, Pl. 21 fig. 1—3, 5; MAYER 1910 p. 483; RUSSELL 1953 p. 464, text-fig. 305—307; see also the present paper p. 72).

Doubtful species: *S. bleekii* + *faberi* HAECKEL 1879 (MAYER 1910 pp. 482, 483).

Family **Halammohydridae.**

Narcomedusae with completely reduced umbrella.

Halammohydra REMANE 1927. Halammohydridae with elongated stomach terminating in a simple mouth-opening; umbrella represented by a tiny knob carrying two whorls of very long fimbriated tentacles and one whorl of statocysts. Demersal habitat.

Halammohydra octopodides REMANE 1927. Body 0.4 mm. long; with up to 14 tentacles and 7 statocysts; tentacles without a basal thickening.—Helgoland and Kiel Bay; Kattegat; Roscoff in France; in sand and gravel at low water. (REMANE 1927 p. 643—677, fig. 1—3, 6—9, 14—16, 17 D, 18—21).

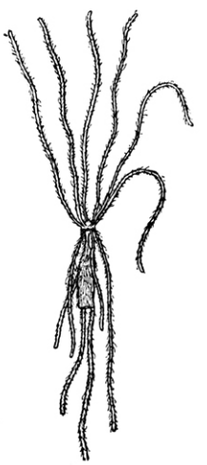


Fig. 317. *Halammohydra octopodides* (after REMANE).

Halammohydra schulzei REMANE 1927. Body 0.4 mm. long; with about 20 tentacles and more than 10 statocysts; each tentacle of one of the two whorls with a large basal thickening.—Helgoland; Roscoff; in sand and gravel. (REMANE 1927 pp. 643—677, fig. 4, 5, 10—13).

Halammohydra vermiformis SWEDMARK & TEISSIER 1957. Body 1.3 mm. long; with 3 or 4 tentacles in the most aboral whorl; the other whorl with 4 tentacles, one of which is much longer than the others; normally 4 (rarely 3) statocysts; tentacles without a basal thickening.—Roscoff, France. (SWEDMARK & TEISSIER 1957 pp. 38—49, Pl. 1, 2, text-fig. 1—5).

C. ZOOGEOGRAPHY

In this section I shall try to give an account of the distribution of the Atlantic hydromedusae from zoogeographical points of view. There are medusae everywhere in the seas, from the cold polar regions to the tropics, from the sun-lit surface far down into the dark deep-sea. They live under a multitude of different conditions, and one of my aims is to find the natural connection between the physical conditions and the composition of the fauna in the different waters. But I shall try to go beyond the mere faunistical descriptions and look for explanations. The faunistical descriptions are the necessary foundations of an understanding of the facts, as we see them in nature, and the first chapters will mainly comprise such descriptions of the faunas in the various zoogeographical regions into which the Atlantic Ocean and its adjacent waters may be divided. The distribution of the species, however, is not merely dependent on the physical conditions in the regions, but also on the ecological habits of the animals; they must be divided into ecological groups. For the medusae it is of fundamental importance whether they spend the whole of their lifetime in the free water-masses, such as the holopelagic Trachylina (Trachy- and Narcomedusae), or whether their development comprises stages which are attached to objects on the bottom of the sea. This applies to the Leptolina (Antho-, Lepto- and Limnomedusae) which are meropelagic, the free-swimming medusae being derived from fixed hydroids. Unfortunetaly the hydroids of numerous species are unknown. We presume that all the Leptolina actually have a hydroid stage, but when we see that some of their medusae have a truly oceanic distribution, we must consider the possibility that the corresponding hydroids also live a pelagic life, perhaps attached to floating objects, of which we actually known a few cases.

In the following account the species are divided into four ecological groups: I, neritic species, dependent on the bottom within the neritic region above the continental shelves; II, slope species, the hydroids of which presumably live on the bottom of the continental slopes outside the neritic region; III, oceanic species, which are divided into two groups, *a*, epipelagic and *b*, bathypelagic, according to the depths in which they mainly occur. These divisions will be further justified under each of the particular chapters.

The faunas of the various regions will be compared with each other, and the interchange between neighbouring regions will be discussed, and in a concluding chapter I shall try to elucidate certain cases of apparently discontinuous distribution and the interchange of species between the Atlantic and the other oceans, partly from the historical point of view. We must bear in mind, however, that within several extensive geographical areas our knowledge of the fauna is still very imperfect and prevents us from drawing sure conclusions.

The divisions into zoogeographical regions are mainly based on the distribution of the water-masses and their movements and interchanges, and they are different for the neritic, the epipelagic-oceanic, and the bathypelagic-oceanic species.

1. Neritic species.

The neritic region is the pelagic region above the shelf, and pelagic animals which, by their nature, are dependent on the neritic region are termed neritic species. The outer limit of the neritic region is, of course, variable but may generally be estimated at depths of about 200 m. As far as the hydromedusae are concerned

The figures 320, 321 and 330 are derived from SVERDRUP, JOHNSON and FLEMING: The Oceans.

the dependance on the neritic region is generally due to the corresponding hydroids being attached to objects on the bottom within the coastal regions. The neritic fauna of hydromedusae, therefore, mainly consists of meropelagic Leptolina. In the majority of these species the hydroid is unknown, but when the medusae are seen to have their principal occurrence along the coasts, we may presume that they are derived from hydroids belonging to the coastal areas. Two species of Trachylina, the Trachymedusae *Ptychogastria polaris* and *P. asteroides*, may, however, be reckoned among the neritic forms, because they spend part of their

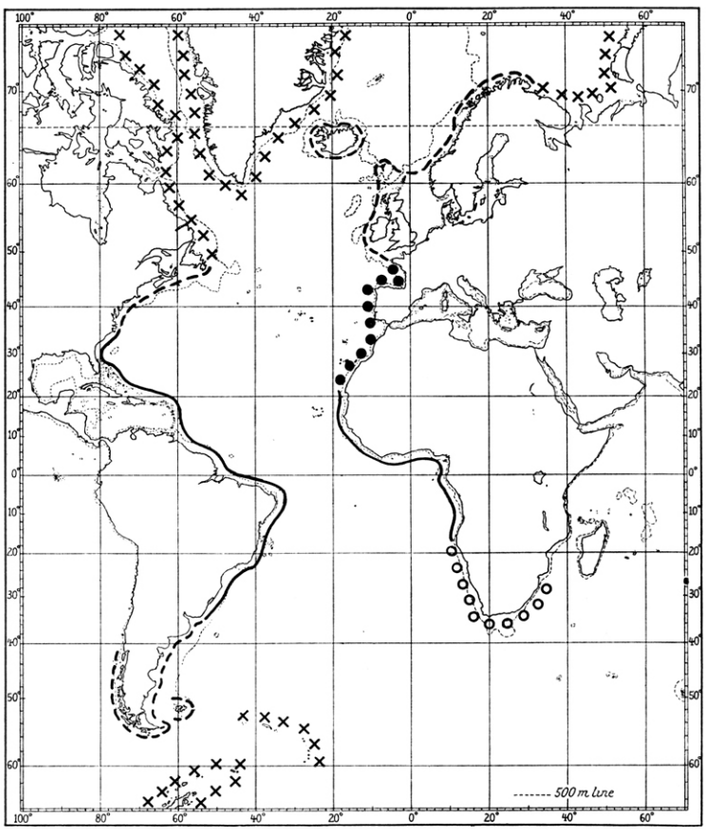


Fig. 318. Neritic zoogeographical regions.

× × × Arctic and Antarctic — — — Boreal and Antiboreal ——— Tropical
● ● ● Mediterranean-Atlantic ○ ○ ○ South-African

time attached to the bottom by means of the adhesive disks on their tentacles, occasionally swimming upwards towards the surface of the water.

How far away from their place of origin the neritic medusae may be carried along with the currents depends on the velocity and direction of the currents and the duration of life of the medusae. The distribution may, however, be limited by unfavourable conditions in the areas to which the medusae are conveyed, and the conditions within a certain area may change from one year or season to another; an isolated occurrence may therefore be due to exceptional conditions, and the species must be designated as a stray visitor in such a remote area. It is often difficult, however, to decide whether a species is a stray visitor in a certain locality, particularly if the locality is within an area which is deficiently investigated. We must also bear in mind that the geographical distribution of a medusa does not necessarily coincide with its native habitat, because it may have been carried to an area where it may continue its swimming existence and take nourishment for its own maintenance, but is unable to propagate.

In the following discussion some species, which probably are of neritic origin, will also be dealt with among the oceanic forms, because for various reasons they are able to spread over the oceans, either because

their hydroids may be attached to floating objects (seeweed, pteropods etc.), or because the medusae may propagate by asexual budding, or else for unknown reasons.

Meropelagic species predominantly occurring in deep water but occasionally met with at high levels are not dealt with among the neritic species.

The medusae of the cosmopolitan genus *Obelia* are entirely omittet from the discussion, because we are unable to determine the species.

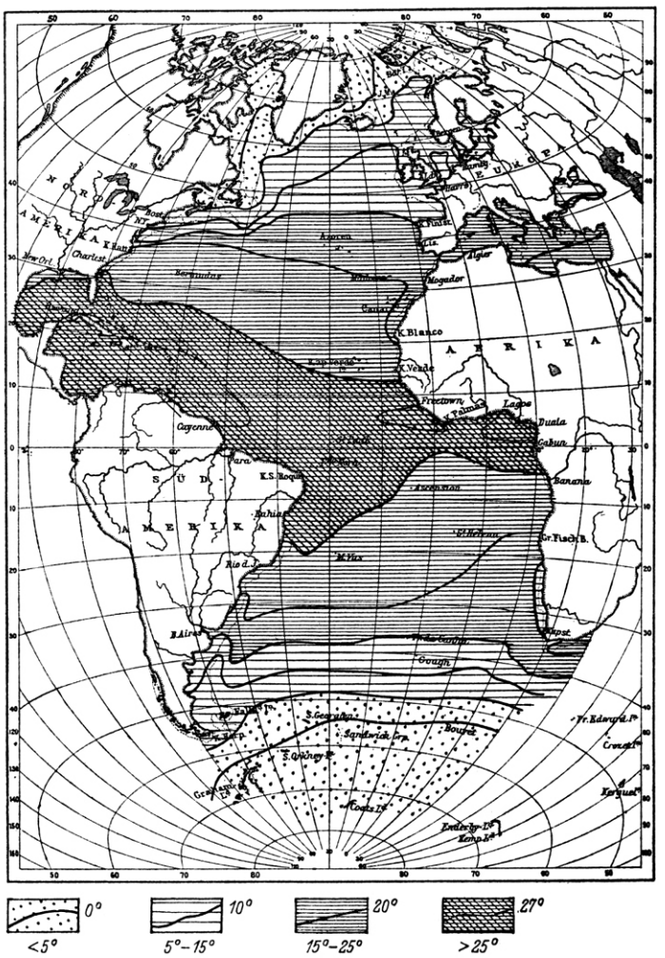


Fig. 319. Mean annual temperature of the surface water of the Atlantic Ocean (after SCHOTT, from EKMAN).

In the division of the neritic zone into zoogeographical regions I mainly follow the proposals put forward by EKMAN (1953), though with slight alterations in the names of the regions. EKMAN's division is mainly based on the composition of the benthal faunas of the continental shelves in relation to the origin and characters of the water-masses. It must be emphasized, however, that as far as the pelagic faunas are concerned the limits between the regions are much less distinct, because the frequent variations of the currents have a much more immediate and instantaneous influence on the distribution of the pelagic animals than on the slowly moving or stationary bottom animals. Nevertheless, each region is inhabited by a pelagic fauna which may be described as characteristic to it, and the indistinctness of the limits makes the study of the interchange between the faunas of neighbouring regions the more interesting.

In the present paper the Atlantic Ocean and adjacent waters are divided into the following regions: I, *The arctic region.* II, *The West-Atlantic boreal region.* III, *The East-Atlantic boreal region.* IV, *The Medi-*

terranean-Atlantic region. V, *The East-Atlantic tropical region.* VI, *The South-West-African region.* VII, *The West-Atlantic tropical region.* VIII, *The antarctic and antiboreal regions.*

The extension of the regions is illustrated in the map, fig. 318, their subdivision into provinces are stated in each of the chapters. The oceanic regions do not coincide with the neritic.

For orientation I also refer to the maps, fig. 319 and 320, showing temperatures and currents at the surface of the Atlantic Ocean.

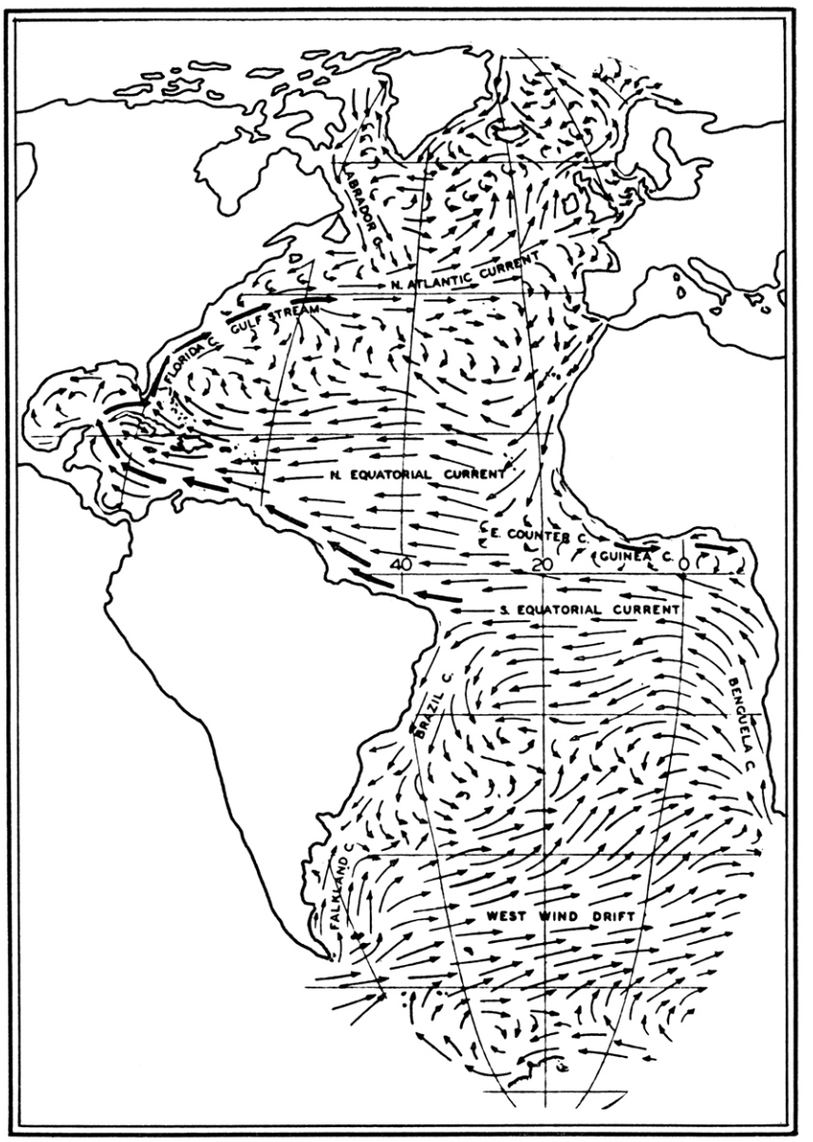


Fig. 320. Surface currents of the Atlantic Ocean (after The Oceans).

I. The Arctic Region.

Among the 29 neritic species recorded from the arctic region *Eumedusa birulai,* which is generally distributed from the Kara Sea to Alaska, and the three more or less doubtful species *Plotocnide incerta* in the White Sea, *Sarsia barentsi* in the Barents Sea, and *Sarsia brachygaster* at Nova Zembla and Spitzbergen, are the only species the distribution of which seems to be restricted to the Eurasian parts of the arctic region. All the other species known from these waters also occur in west-arctic seas, especially all of them have been found off the west coast of Greenland.

In Table I the species occurring within each of the arctic provinces are enumerated.

1. The fauna west of the northernmost part of Greenland is imperfectly known, but it is certainly not accidental that all the species found there are such which have a predominantly arctic distribution. The only exception seems to be *Sarsia tubulosa* which is recorded by DUNBAR (1942) from two localities on the northern part of Baffin Land. Altogether 8 neritic species are recorded from this province (see the table).

Table I. Neritic species in the Arctic Region.

	Arctic provinces									
	Baffin Bay and adjacent waters	Disko Bay to Cape Farewell	Labrador and adjacent waters	East-Greenland	Barents Sea and White Sea	Siberian Polar Sea	West-Atlantic boreal	East-Atlantic boreal	Mediterranean-Atlantic	North-Pacific
Eumedusa birulai	..	..	..	..	..	×	..	..	..	..
Plotocnide incerta	..	..	..	..	×	..	..	..	..	..
Sarsia barentsi	..	..	..	..	×	..	..	..	..	..
Sarsia brachygaster	..	..	..	..	×	..	..	..	..	..
Ptychogastria polaris	×	×	×	×	×	×	×	×	..	×
Catablema multicirrata	×	×	..	..	..	..	..	..	..	×
Halitholus pauper	..	×	×	×	..	..	..	(×)	..	×
Plotocnide borealis	..	×	..	..	×	×	..	×	..	..
Euphysa tentaculata	..	×	..	..	×	..	..	×	..	..
Halitholus cirratus	×	×	×	×	×	×	(×)	×	..	..
Sarsia princeps	×	×	×	×	×	×	(×)	..	..	×
Euphysa flammea	..	×	×	..	×	×	(×)	..	..	×
Ptychogena lactea	×	×	×	..	×	×	×	..	..	×
Catablema vesicarium	×	×	×	×	×	×	×	×	..	×
Bougainvillia superciliaris	×	×	×	..	×	×	×	×	..	×
Staurophora mertensi	..	×	×	..	×	×	×	×	..	×
Bougainvillia principis	..	×	..	..	×	..	..	×	..	..
Leuckartiara breviconis	..	×	×	..	..	..	..	×	..	×
Halopsis ocellata	..	×	..	×	×	..	×	×	..	..
Hybocodon prolifer	..	×	×	..	×	..	×	×	..	×
Mitrocomella polydiademata	..	×	..	..	×	×	×	×	..	..
Tiaropsis multicirrata	..	×	..	×	×	×	×	×	(×)	×
Sarsia tubulosa	×	×	×	..	×	..	×	×	..	×
Melicertum octocostatum	..	×	..	..	×	..	×	×	..	×
Rathkea octopunctata	..	×	×	..	×	×	×	×	×	×
Euphysa aurata	..	×	..	..	×	..	×	×	×	..
Paratiara digitalis	..	..	..	..	×	..	..	×	..	..
Leuckartiara octona	..	..	(×)	..	..	..	×	×	×	×
Eucheilota ventricularis	..	(×)	..	..	..	..	×	..	..	..
Number of species	8	23	14	7	23	13	18	20	4	16

2. West coast of Greenland from Cape Farewell to Disko Bay, 23 species. One of them, *Eucheilota ventricularis*, must be considered a stray visitor; it is an inhabitant of the American coast from Vineyard Sound to Florida, and only a single specimen has been found near Godthaab on the coast of Greenland. The 12 first species in Table I have a predominantly arctic distribution, but only one of them, *Catablema multicirrata*, has never been found in boreal parts of the Atlantic area. *Halitholus pauper* is likewise a well-marked arctic species, but it is recorded from north-western Iceland, and both species occur in the northern Pacific as far south as Hokkaido in northern Japan under the influence of the cold Oyashio Current. They are not known from the Russian and Siberian Polar Sea, so that their occurrence in the Pacific indicates a connection through the arctic Canadian waters. All the other predominantly arctic species on the west coast of Greenland penetrate more or less into the Atlantic-boreal regions (see below); 5 of them are also known from East Greenland, 10 from the Barents Sea or further east in the Polar Sea, and 7 of these proceed into the northern Pacific.

The remaining 10 West-Greenland species have their principal occurrence in boreal waters, whence they penetrate more or less into the arctic region, into the Barents Sea as well as along the west coast of Greenland. It is characteristic that almost all the neritic medusae in the West Greenland fauna, also those with a predominantly boreal distribution, occur all along the coast from Cape Farewell to Disko Bay. This is due to the north-going current, which is a continuation of the East-Greenland Polar Current; it carries great quantities of ice northwards along the coast, but during the summer the ice is melted away under the influence of the sun which is above the horizon during the greater part of the 24 hours, so that in the end the upper layers of the water attain about the same temperature in the northern as in the southern tracts, until the current is deflected westwards and leaves the coast a little south of the mouth of Disko Bay. This accounts for the uniformity of the fauna from Cape Farewell to Disko Bay and the sudden disappearance of most of the species further north. A detailed account of the West-Greenland fauna of medusae was given by me in 1942.

3. Labrador and adjacent waters. The 14 species recorded up to now from the coasts of Labrador and the southern part of Baffin Land also occur on the west coast of Greenland, except *Leuckartiara octona* which, if the identification is correct, has been found as a stray visitor on the north-east coast of Labrador, the only locality within the arctic region from which this widely distributed species is recorded. Among the other 13 species 9 have a predominantly arctic distribution, which is quite natural, since the cold Labrador Current runs southwards along these coasts. The predominantly boreal species *Hybocodon prolifer, Rathkea octopunctata* and *Leuckartiara breviconis* are recorded from the Hudson Strait, but not further north in these tracts, whereas according to DUNBAR *Sarsia tubulosa* occurs on the northern coasts of Baffin Land.

4. East Greenland. The Irminger Current, running westwards off the south coast of Iceland, proceeds towards the southern part of the east coast of Greenland where it is mixed with the East-Greenland Polar Current. Seven species of neritic hydromedusae are known from south-eastern Greenland; the occurrence there of some of these species is probably due to transportation by the Irminger Current, and other species might likewise be expected to turn up, but the pelagic fauna along this inhospitable coast is very deficiently known, and we do not know how many species are indigenous there. This applies still more to the fauna further north; the only species hitherto known from the coast north of Angmagssalik are the well-marked arctic species *Sarsia princeps* and *Ptychogastria polaris.*

5. The pelagic fauna in the Barents Sea and White Sea is a mixed fauna of arctic and boreal species. The arctic seas north of Russia receive a certain amount of Gulf-Stream water from the Norwegian Sea, and it is no wonder, therefore, that among the neritic medusae found there 10 species are predominantly boreal and 10 other species (apart from the three uncertain species mentioned above) are predominantly arctic. Owing to the various eddies in the Barents Sea the distribution of some species may be extended to Spitzbergen, but so far only 6 species have been found there: *Sarsia princeps, Euphysa flammea, Halitholus cirratus, Catablema vesicarium, Bougainvillia superciliaris,* and the Trachymedusa *Ptychogastria polaris,* all of them predominantly arctic species. 12 of the species found in the Barents Sea are distributed further east in the Polar Sea, and 9 of these species proceed into the northern Pacific. The 3 species *Hybocodon prolifer, Sarsia tubulosa* and *Melicertum octocostatum,* which are common to the Barents Sea and the northern Pacific, probably also occur in the Siberian Polar Sea, though they have not yet been found there. As mentioned above, *Eumedusa birulai* is distributed from the Kara Sea to the north coast of Alaska.

General remarks on the arctic fauna of neritic hydromedusae. Endemic arctic species of medusae are evidently very few; this also applies to other pelagic animals (cfr. EKMAN 1953 p. 301). *Catablema multicirrata* and *Halitholus pauper* occur only in the western parts of the arctic region, the former on the west coast of Greenland, the latter also on the east coast and in north-western Iceland, and both of them penetrate into the northern Pacific. On the other hand, *Eumedusa birulai* and the three uncertain species: *Plotocnide incerta, Sarsia barentsi* and *Sarsia brachygaster,* are restricted to the Eurasian Polar Sea. All the other arctic species penetrate more or less into boreal waters.

Of considerable interest is the distribution of *Euphysa tentaculata* and *Halitholus cirratus* which are inhabitants of arctic waters, West Greenland as well as the Barents Sea or the White Sea, but they also occur in the Baltic area, where they may be designated as arctic survivors.

Three of the predominantly arctic species, *Sarsia princeps, Euphysa flammea* and *Ptychogena lactea,* are entirely lacking in the East-Atlantic boreal region, whereas they occur in the surroundings of Newfoundland, the latter also in the Gulf of Maine. *Catablema vesicarium* and *Ptychogastria polaris* have a similar distribution but have also been found on the northern and eastern coasts of Iceland and more or less southwards on the Norwegian coast. *Bougainvillia superciliaris* and *Staurophora mertensi* penetrate southwards along the American coast into the Gulf of Maine (rarely as far as Woods Hole south of Cape Cod), and they also occur along the west coast of Norway and in the North Sea, but not further south in European waters. The distribution of this group of species is in good accordance with the prevailing currents; all of them occur off the American coast as far as the cooling effect of the Labrador Current is discernible. No such cold currents wash the coasts of the north-western Europe, because the effects of the south-going East-Iceland Polar Current are effaced above the Wyville Thompson Ridge, where it meets with the North-Atlantic Current forming complicated eddies. The occurrence of *Bougainvillia superciliaris* and *Staurophora mertensi* in the North Sea and adjacent waters indicate that these two species may tolerate a somewhat higher temperature than the others of the predominantly arctic species; their distribution in the arctic seas is almost the same as that of the five other species, but they are evidently more eurythermic, especially *Bougainvillia superciliaris* which occurs regularly in the North Sea, whereas *Staurophora mertensi* is met with there only occasionally. Their penetration from the arctic seas into the North Sea may originally have been due to the East-Iceland Polar Current which may have carried them across the channels between Iceland and Scotland into a boreal area where, in contradistinction to the other arctic species, they have been able to settle.

Among the species with a predominantly boreal distribution but penetrating into arctic waters we must regard *Leuckartiara octona* and *Eucheilota ventricularis* as stray visitors in the arctic region (see above). The zoogeographical character of *Paratiara digitalis* is uncertain; it was previously known from only three localities: Murman Coast, south of Iceland, and east of the Shetland Islands, but in the present paper it is also recorded from the Sargasso Sea. The 11 other species of this group enumerated in Table I are inhabitants of the East-Atlantic boreal region, and with two exceptions (*Bougainvillia principis* and *Leuckartiara breviconis*) they also occur in the West-Atlantic boreal region, mainly in the Gulf of Maine. In the eastern waters the distribution of *Euphysa aurata* and *Rathkea octopunctata* is extended into the Mediterranean, whereas none of the others occur further south in European waters than in the English Channel. All of them also occur along the west coast of Greenland between Cape Farewell and Disko Bay, but not further north, and with the exception of *Leuckartiara breviconis* they also occur in the Barents Sea.

It is interesting to see that, whereas the southward penetration of arctic species into boreal regions mainly takes place in the western Atlantic, following the Labrador Current and its offshoots, the northward penetration of boreal species into arctic regions mainly follows the Gulf Stream system, partly along the Norwegian coast to the Barents Sea, partly to southern Iceland and with the Irminger Current to South Greenland and further northwards along the west coast of Greenland to Disko Bay, where the slightly heating effect of the West-Greenland coastal current finally terminates.

The bipolarity of *Ptychogastria polaris, Staurophora mertensi, Halopsis ocellata* and *Euphysa aurata* will be mentioned later.

II. The West-Atlantic Boreal Region.

This region may be divided into three provinces according to the prevailing water-masses: 1. The surroundings of Newfoundland and the south coast of Nova Scotia which are exposed to very cold currents from the Labrador Sea and the Gulf of St. Lawrence. 2. The Gulf of Maine, into which a certain influx of outside water takes place, but in which the temperature of the water is chiefly determined by local in-

Table II. Neritic species in the West-Atlantic boreal region.

	West-Atlantic boreal												
	Newfoundland to Nova Scotia	Gulf of Maine (occasionally to Newport)	Cape Cod to Cape Hatteras	Cape Hatteras to West Indies	South Atlantic	West-Arctic	East-Arctic	East-Atlantic boreal	Mediterranean	West Africa	Indo-West-Pacific	East-Pacific tropical	North Pacific
Ptychogastria polaris	×	..	..	..	×	×	×	(×)	..	..	..	..	×
Sarsia princeps	×	..	..	..	..	×	×	..	..	..	..	..	×
Euphysa flammea	×	..	..	..	..	×	×	..	..	..	..	..	×
Halitholus cirratus	×	..	..	..	..	×	×	×	..	..	..	..	..
Leuckartiara nobilis	×	..	..	..	..	..	..	×	×	..	..	..	..
Dipleurosoma typicum	×	..	..	..	..	..	..	×	..	..	..	..	..
Catablema vesicarium	×	×	..	..	..	×	×	×	..	..	..	..	×
Ptychogena lactea	×	×	..	..	..	×	×	..	..	..	..	..	×
Hybocodon pendula	..	×	..	..	..	..	..	..	..	..	..	..	..
Aequorea albida	..	×	..	..	..	..	..	..	..	..	..	..	..
Bougainvillia superciliaris	×	×	..	..	..	×	×	×	..	..	..	..	×
Staurophora mertensi	×	×	..	..	×	×	×	×	..	..	..	..	×
Sarsia tubulosa	×	×	..	..	..	×	×	×	..	..	..	..	×
Hybocodon prolifer	×	×	..	..	..	×	×	×	..	..	..	..	×
Melicertum octocostatum	×	×	..	..	..	×	×	×	..	..	..	..	×
Rathkea octopunctata	×	×	..	(×)	..	×	×	×	×	..	..	..	×
Tiaropsis multicirrata	×	×	..	..	..	×	×	×	..	(×)	..	..	×
Mitrocomella polydiademata	..	×	..	..	..	×	×	×	..	..	..	..	..
Halopsis ocellata	..	×	..	..	×	×	×	×	..	..	..	..	..
Euphysa aurata	..	×	..	..	×	×	×	×	×	..	..	..	..
Bougainvillia britannica	..	×	..	..	..	..	..	×	..	..	..	..	..
Podocoryne borealis	..	×	..	..	..	..	..	×	..	..	..	..	..
Podocoryne carnea	..	×	..	..	..	..	..	×	×	(×)	..	(×)	..
Bougainvillia ramosa	..	×	..	..	..	..	..	×	×	×	..	..	..
Leuckartiara octona	..	×	..	..	..	(×)	..	×	×	×	×	×	×
Euphysora gracilis	..	..	×	×	×	..	..	..	..	..	..	..	..
Tima formosa	..	×	×	..	..	..	..	..	..	..	..	..	..
Phialidium bicophorum	..	×	×	×	..	..	..	..	..	..	..	..	×
Toxorchis kellneri	..	×	(×)	×	..	..	..	..	..	..	..	..	..
Phialidium languidum	..	×	×	×	..	..	..	..	..	..	..	..	..
Rhacostoma atlanticum	..	×	×	×	..	..	..	..	..	×	..	..	..
Stomotoca pterophylla	..	×	×	×	..	..	..	..	..	×	..	×	×
Laodicea undulata	..	×	×	×	×	..	..	×	×	×	..	..	..
Zanclea costata	..	×	×	×	..	..	..	×	×	×	×	×	..
Sarsia hargitti	..	..	×	..	..	..	..	..	..	..	..	..	..
Orchistoma tentaculata	..	..	×	..	..	..	..	..	..	..	..	..	..
Phialidium singularis	..	..	×	..	..	..	..	..	..	..	..	..	..
Aequorea tenuis	..	..	×	..	..	..	..	..	..	..	..	..	..
Lizzia fulgurans	..	..	×	..	..	..	..	..	..	..	..	..	..
Calycopsis typa	..	..	×	..	..	..	..	..	..	×	..	..	..
Nemopsis bachei	..	..	×	×	..	..	..	×	..	..	..	..	..
Amphinema rugosum	..	..	×	×	..	..	..	×	×	..	×	..	..
Amphinema dinema	..	..	×	×	..	..	..	×	×	×	×	..	..
Linvillea agassizi	..	..	×	×	..	..	..	..	..	..	..	..	..
Phialidium folleatum	..	..	×	×	..	..	..	..	..	..	..	..	..
Eucheilota ventricularis	..	..	×	×	..	(×)	..	..	..	×	..	..	..
Eucheilota duodecimalis	..	..	×	×	..	..	..	..	..	..	..	×	..
Eutima mira	..	..	×	×	..	..	..	..	..	..	(×)	..	..
Niobia dendrotentaculata	..	..	×	×	..	..	..	..	..	..	×	..	..
Dipurena strangulata	..	..	×	×	..	..	..	..	..	×	..	..	..
Bougainvillia carolinensis	..	..	×	×	..	..	..	..	..	×	..	..	..
Turritopsis nutricula	..	..	×	×	..	..	..	×	×	×	×	..	..
Ectopleura dumortieri	..	..	×	×	..	..	..	×	×	×	×	×	..
Aequorea aequorea	..	..	×	×	×	..	..	×	×	×	(×)	..	..
Proboscidactyla ornata	..	..	(×)	×	..	..	..	..	..	×	×	×	..
Gonionemus vertens	..	×	×	..	..	..	..	×	×	..	(×)	..	×
Blackfordia manhattensis	..	..	×	..	..	..	..	..	..	..	..	..	..
Blackfordia virginica	..	..	×	..	..	..	..	..	..	..	(×)	..	..
Pennaria tiarella	..	..	×	×	..	..	..	..	..	..	..	..	..
Number of species	15	28	34	25	7	18	16	29	14	17	12	7	16
		59											

fluences and is subject to considerable variations. 3. The coastal area between Cape Cod and Cape Hatteras which is influenced by the anti-clockwise circulation of the so-called slope water on the coastal side of the Gulf Stream.

1. Newfoundland to Nova Scotia. The first 4 species in Table II are decidedly arctic species which do not occur further south on the American coast. *Leuckartiara nobilis* and *Dipleurosoma typicum*, on the other hand, are East-Atlantic boreal species and have never been found in the boreal tracts of the American coast; their occurrence off the east coast of Newfoundland is presumably due to transportation from the east. The other 9 species found in this province also occur in the Gulf of Maine as well as along the west coast of Greenland, so that their presence at Newfoundland was to be expected; none of them occur south of Cape Cod except as occasional visitors to the Woods Hole region.

2. The Gulf of Maine, with depths of up to 250 m., is an almost enclosed area, separated from the open ocean by Nova Scotia to the north and by the extensive shallow-water banks Georges Bank to the south and south-east and Brown Bank to the east, being connected with the ocean only through two passages on both sides of Brown Bank. Bigelow (1922 p. 163) has clearly summarized the temperature conditions in the Gulf as follows: "In the Gulf of Maine the temperature of the upper 100 meters or so of water is governed chiefly by the chilling caused by rigorous winter climate and by the influx of cold water from the Cabot Current balanced against local solar heating in spring and summer and the warming influence of the influx of off-shore water into its eastern side". Also other local forces are responsible for the great fluctuations of the temperature in the Gulf, especially in its western parts, such as melting of ice, tidal stirring, local upwelling of cool water etc. The influx of cold water from the east is not directly derived from the Labrador Current, but mainly indirectly via the Gulf of St. Lawrence. Neither does the Gulf-Stream water directly enter the Gulf, but slope water is carried along the south-eastern face of Georges Bank and further through the channel south of Brown Bank into the Gulf of Maine. The combined inflowing water-masses circulate anti-clockwise along the coast line of the Gulf and undergo considerable changes because of the influence of local circumstances, parts of them being discharged again from the Gulf near the surface.

28 species of neritic hydromedusae are recorded from the Gulf of Maine (see Table II). The majority of them are undoubtedly indigenous in the Gulf, though the local stock of some of them may also be supplemented by influx from outside waters. The occurrence of *Catablema vesicarium* and *Ptychogena lactea* is probably exclusively due to influx with the arctic water. The next 17 species in the table do not occur south of Cape Cod, except when they occasionally escape from the Gulf and are observed at Woods Hole or Newport. The further distribution of *Hybocodon pendula* and *Aequorea albida* is unknown, all the others occur in the East-Atlantic boreal region, 10 of them also in arctic waters. We know from Bigelow's papers that most of these are indigenous in the Gulf of Maine, and it probably holds good for all of them and also for *Tima formosa* which penetrates somewhat further south, but not beyond Cape Hatteras.

Besides this only 8 species are common to the Gulf of Maine and the coast down to Cape Hatteras, and all these also occur further south towards Florida or the West Indies. Among them *Laodicea undulata* and *Zanclea costata* are widely distributed in the Atlantic from the boreal to the tropical regions and probably belong to the indigenous fauna of the Gulf of Maine. *Phialidium languidum* is certainly indigenous in the Gulf, where it is frequently seen in great swarms. The 6 others evidently have a predominantly southern distribution; they do not occur in European waters, but two of them, *Rhacostoma atlanticum* and *Stomotoca pterophylla*, have been found in the tropical part of the west coast of Africa. Bigelow designates *Rhacostoma atlanticum* as a northern species, evidently owing to the mistake by Agassiz (1862) that it should be identical with the obsolete species *Aequorea groenlandica* Péron & Lesueur (= *Medusa aequorea* Fabricius 1780). It seems more likely that its occurrence in the Gulf of Maine is due to influx from the south.

Thus it seems probable that among the 28 species of neritic hydromedusae recorded from the Gulf of Maine only 6 may be regarded as visitors from outside waters, *viz.* the arctic *Catablema vesicarium* and *Ptychogena lactea*, and the southern species *Phialidium bicophorum*, *Toxorchis kellneri*, *Stomotoca pterophylla* and *Rhacostoma atlanticum*. On the other hand, several of the indigenous species are sometimes met with on the south coast of the Cape Cod peninsula, near Woods Hole, or slightly further west at Newhaven; some

of them may even be indigenous there, but zoogeographically they belong to the water-masses of the Gulf of Maine province.

3. Cape Cod to Cape Hatteras. The Florida Current follows the coast from Florida to Cape Hatteras, where it is deflected eastwards as the Gulf Stream at a considerable distance from the coast. Between the coastal water, which generally moves slowly southwards, and the inner border of the Gulf Stream a water-mass with essentially the same character as the Gulf-Stream water, the so-called slope water, forms an elongated eddy with an anti-clockwise circulation (see the map, fig. 321). Pelagic animals from the Florida Current, therefore, have the possibility of approaching the coast of this province, and this accounts for the many species which are common to the coasts north and south of Cape Hatteras.

Among the 34 species occurring between Cape Cod and Cape Hatteras (apart from those belonging to the Gulf of Maine province, see above) *Sarsia hargitti*, *"Orchistoma" tentaculata*, *Phialidium singularis* and *Aequorea tenuis* have been taken only in the northernmost part of the province (and nowhere else in the world) and might possibly better be classified among the Gulf of Maine species. *Lizzia fulgurans*, which occurs all along the coast from Cape Cod to Cape Hatteras, is likewise endemic in this province, whereas *Calycopsis typa* has also been found on the west coast of Africa.

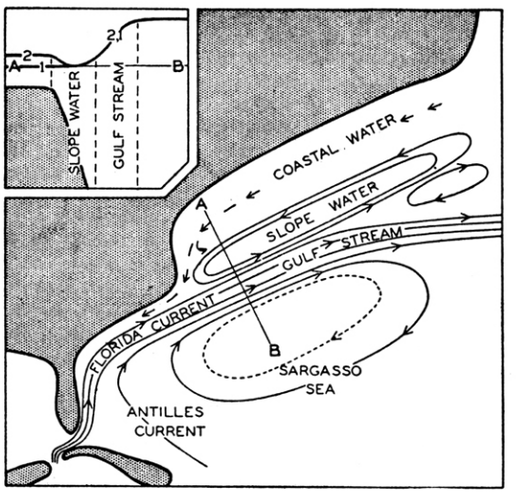


Fig. 321. Schematic representation of the character of the Gulf Stream (after The Oceans).

As mentioned above only some few species are common to this province and the Gulf of Maine procince, whereas no less than 22 of the species also occur further south, most of them to the southern point of Florida or even into the Caribbean Sea. Of course there are many more species in the water of the Florida Current which do not pass northwards beyond Cape Hatteras, and this will be discussed in a later chapter.

The temperature of the coastal water decreases rapidly from Cape Hatteras towards the north; in winter and spring the temperatures in the province are similar to those in the boreal waters of north-western Europe, whereas in summer and autumn the range of temperature is about the same as in the Mauretanian and Lusitanian provinces, from Cape Blanco in Africa to the Bay of Biscay. The seasonal variations in the province are thus very considerable. Neritic species of different zoogeographical characters might therefore be expected to find the conditions in these waters suitable for temporary existence, though perhaps not for propagation.

As seen from Table II the majority of the species between Cape Cod and Cape Hatteras have a predominantly southern distribution off the American coast. Besides the two particularly widely distributed *Laodicea undulata* and *Zanclea costata* only 8 species also occur in the Gulf of Maine, and only 9 occur in the East-Atlantic boreal region. The southern character of the fauna thus seems to be established.

Many of the species presumably belong to the local fauna, so that the effect of the Florida Current and the circulation of the slope water mainly consists in their influence on the hydrographical conditions of the coastal water more than in a supply of specimens of southern origin, though such a supply certainly does take place. Detailed investigations of the life history and seasonal occurrence of each species is necessary to decide, which of the species are indigenous in the province and which occur only as visitors from the south.

The four last species in Table II need special consideration. *Pennaria tiarella* is a hydroid occurring from the West Indies to the Gulf of Maine; its medusa probably survives only for a few hours after its liberation. *Gonionemus vertens* is restricted to the eulittoral zone; it is probably the same species which is described under different names from the northern Pacific, and which in recent years has been found in an increasing number of localities from the Mediterranean to the British and Scandinavian coasts, probably owing to transportation by ships. *Blackfordia manhattensis* and *B. virginica* are brackish-water medusae, both originally described from New England; the former has not been found anywhere else, whereas the latter is very

abundant in the Black Sea and has recently been recorded from the Ganges estuary in India (KRAMP, in press), a distribution which is probably due to transportation with ships from the Black Sea.

Comparison of the fauna of neritic hydromedusae in the West-Atlantic boreal region with those in other zoogeographical regions.—The total number of species found between Cape Hatteras and Newfoundland is 59. Sixteen of them occur in the arctic region, East-Arctic as well as West-Arctic, and none of these occur on the American coast south of Cape Cod (*Eucheilota ventricularis* is a southern species once taken as a stray visitor on the west coast of Greenland). Among the 28 species from the Gulf of Maine province 19 are constant inhabitants of the East-Atlantic boreal region; two of the remaining 10 species are purely arctic, 8 species are purely American, with the exception that *Rhacostoma atlanticum* and *Stomotoca pterophylla* have also been found at West Africa. Among the 34 species in the province between Cape Cod and Cape Hatteras only 9 occur in the East-Atlantic region; one of them is *Gonionemus vertens* which probably has been brought to Europe by ships, 5 species (*Laodicea undulata, Zanclea costata, Turritopsis nutricula, Ectopleura dumortieri,* and *Aequorea aequorea*) are almost generally distributed in the Atlantic, so that their simultaneous occurrence in the western and eastern parts of the ocean presents nothing of particular interest. Apart from these only 3 species (*Nemopsis bachei, Amphinema rugosum* and *Amphinema dinema*) are common to the East-Atlantic boreal region and the southern province of the West-Atlantic boreal region, which is in striking contradistinction to the great similarity between the faunas of the former and the Gulf of Maine province. All the species which are common to the coast between Cape Cod and Cape Hatteras and north-western Europe, also occur in the Mediterranean, except *Nemopsis bachei* which, from the North Sea, penetrates only as far south as the Bay of Biscay. Altogether 14 American species are recorded from the Mediterranean and 17 from the west coast of Africa.

Thirteen of the species in the Gulf of Maine have been found in the northern Pacific, 2 of these also occur in the province south of Cape Cod; no others among the species from this province are known from the northern Pacific, whereas 8 have a more or less scattered distribution in the Indo-West-Pacific.

These enumerations show that the considerable difference between the faunas of the northern and the southern parts of the American coast does not merely comprise the local waters, but also involves the distribution of these faunas in other more or less remote zoogeographical regions.

III. The East-Atlantic Boreal Region.

The whole of the East-Atlantic boreal region is under the influence of the various terminal branches of the Gulf Stream. It is an extensive area with complicated coastal lines and therefore also with complicated current systems. Hydrographically it is characterized by great seasonal variations in the temperature of the coastal waters, whereas for considerable distances the mean temperatures do not show very conspicuous differences; only in very few places, such as the east coast of Iceland, the isotherms may be rather close together. In this regard the European coasts are in striking contradistinction to the boreal parts of the American coast.

The region may conveniently be divided into six provinces, mainly for geographical reasons. The faunas are not fundamentally different in the different provinces, except that the number of species generally somewhat decreases with decreasing temperatures and salinities. It seems advisable to commence the treatment of the region with the Atlantic coasts of the British Isles, whence currents enter the North Sea, partly through the English Channel and further into the Baltic area, partly north of Scotland into the northern part of the North Sea, both influxes being counterbalanced by the outflowing Baltic Current which proceeds northwards along the Norwegian coast. It will also be practical to finish with Iceland which receives the north- and west-going Irminger Current.

1. Atlantic coasts of the British Isles. The hydrographical conditions are not very different in the different parts of this province, except in small areas exposed to local circumstances. From a zoogeographical point of view, however, it is not a homogeneous area. Among the 56 species of neritic hydromedusae recorded from the province some are found only in the southern part of the area, including the Irish Sea and the west coast of Ireland and others occur only in the northern part west of Scotland.

Table III. Neritic species in the East-Atlantic boreal region.

	East-Atlantic boreal															
	British Isles Atlantic	English Channel	North Sea	Baltic province	Norway north of Bergen	Iceland	East-Arctic	West-Arctic	West-Atlantic boreal	West-Atlantic tropical	Lusitanian	Mediterranean	West Africa	Indo-West-Pacific	East-Pacific tropical	North Pacific
Bougainvillia pyramidata	×	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Phialopsis diegensis	×	..	..	..	..	..	..	..	..	×	..	..	×	×	×	×
Podocoryne hartlaubi	×	×	..	..	..	..	..	..	..	..	..	×	..	..	..	..
Mitrocomella brownei	×	×	×	..	..	..	..	..	..	..	..	×	..	..	..	..
Gossea corynetes	×	×	×	..	..	..	..	..	..	..	×	..	..	..	..	..
Amphinema dinema	×	×	×	..	..	..	..	..	×	×	..	×	×	×	..	..
Turritopsis nutricula	×	×	×	..	..	..	..	..	×	×	..	×	×	×	..	..
Lovenella clausa	×	×	×	..	..	..	..	..	..	..	..	..	..	..	..	..
Agastra mira	×	×	×	..	..	..	..	..	..	..	..	..	..	..	..	..
Helgicirrha schulzei	×	×	×	..	..	..	..	..	..	..	..	×	×	..	..	..
Eirene viridula	×	×	×	..	..	..	..	..	..	..	..	×	×	×	..	..
Aequorea vitrina	×	×	×	..	..	..	..	..	..	..	..	..	..	..	..	..
Dipurena ophiogaster	×	×	×	..	..	..	..	..	..	..	..	×	..	×	..	..
Aequorea aequorea	×	×	×	..	×	..	..	..	×	×	×	×	×	(×)	..	..
Proboscidactyla stellata	×	×	×	..	..	..	..	..	..	..	×	..	..	×	..	×
Zanclea costata	×	×	×	..	×	..	..	..	×	×	..	×	×	×	×	..
Podocoryne borealis	×	×	×	×	×	×	..	..	×	..	..	..	..	..	..	..
Eutima gegenbauri	×	×	×	×	..	..	..	..	..	..	..	×	..	..	..	..
Stauridiosarsia producta	×	×	×	×	..	..	..	..	..	×	..	..	..	..	..	..
Cladonema radiatum	×	×	×	×	..	..	..	..	..	×	..	×	..	×	..	×
Bougainvillia ramosa	×	×	×	×	..	×	..	..	×	..	×	×	×	..	..	..
Gonionemus vertens	×	×	×	×	..	..	..	..	×	..	..	×	..	(×)	..	×
Pochella polynema	×	×	×	..	..	..	..	..	..	..	..	..	..	..	..	×
Dipleurosoma typicum	×	×	×	..	..	..	..	..	×	..	..	..	..	..	..	..
Amphinema rugosum	×	×	×	..	..	..	..	..	×	×	..	×	..	×	..	..
Dipurena halterata	×	×	×	..	..	..	..	..	..	×	..	×	×	..	..	..
Phialella quadrata	×	×	×	..	..	..	..	..	..	..	..	..	×	×	..	..
Sarsia prolifera	×	×	×	..	..	..	..	..	..	..	..	×	..	..	..	..
Eleutheria dichotoma	×	×	×	..	..	..	..	..	..	..	..	×	..	..	..	..
Sarsia eximia	×	×	×	..	×	..	..	..	..	..	..	×	..	..	×	×
Cosmetira pilosella	×	×	×	×	..	..	..	..	..	..	×	..	..	..	..	..
Eutima gracilis	×	×	×	×	..	..	..	..	..	..	×	×	×	..	..	..
Lizzia blondina	×	×	×	×	..	×	..	..	..	..	×	×	..	..	..	..
Sarsia gemmifera	×	×	×	×	×	..	..	..	..	..	×	×	..	..	..	..
Bougainvillia britannica	×	×	×	×	×	×	..	..	×	..	..	..	..	..	..	..
Neoturris pileata	×	×	×	×	×	×	..	..	..	..	×	×	×	..	..	..
Leuckartiara octona	×	×	×	×	×	×	..	(×)	×	..	..	×	×	×	×	×
Phialidium hemisphaericum	×	×	×	×	×	×	..	..	..	..	×	×	×	×	..	..
Steenstrupia nutans	×	×	×	×	×	×	..	..	..	..	..	×	..	..	..	..
Laodicea undulata	×	×	×	×	×	×	..	..	×	×	×	×	×	..	..	..
Podocoryne carnea	×	×	×	×	×	×	..	..	×	..	..	×	..	..	..	..
Hybocodon prolifer	×	×	×	×	×	×	×	×	×	..	..	..	..	..	..	×
Sarsia tubulosa	×	×	×	×	×	×	×	×	×	..	..	..	..	..	..	×
Rathkea octopunctata	×	×	×	×	×	×	×	×	×	(×)	..	×	..	..	..	×
Euphysa aurata	×	×	×	×	×	..	×	×	×	..	..	×	..	..	..	..
Tiaropsis multicirrata	×	×	×	×	×	×	×	×	×	..	..	..	(×)	..	..	×
Melicertum octocostatum	×	×	×	×	×	×	×	×	×	..	..	..	..	..	..	×
Mitrocomella polydiademata	×	..	×	×	×	..	×	×	×	..	..	..	..	..	..	..
Leuckartiara nobilis	×	..	..	(×)	..	×	..	..	×	..	..	×	..	..	..	..
Bougainvillia principis	×	×	×	×	×	×	×	×	..	..	..	..	..	..	..	..
Halopsis ocellata	×	..	×	..	×	×	×	×	×	..	..	..	..	..	..	..
Eutonina indicans	×	..	×	×	×	×	..	..	..	..	..	..	..	..	..	×
Leuckartiara breviconis	×	..	×	..	×	×	..	×	..	..	..	..	..	..	..	×
Bougainvillia nordgaardi	×	..	×	×	×	..	..	..	..	..	..	..	..	..	..	×
Staurophora mertensi	×	..	×	×	×	×	×	×	×	..	..	..	..	..	..	×
Aequorea macrodactyla	×	×	..	..	..	..	..	..	..	×	..	..	×	×	×	..
Podocoryne minima	..	×	..	..	..	..	..	..	..	..	..	×	..	..	..	..
Eleutheria claparedei	..	×	..	..	..	..	..	..	..	..	..	×	..	..	..	..
Ectopleura dumortieri	..	×	×	..	..	..	..	..	×	×	×	×	×	×	×	..
Eucodonium brownei	..	×	..	×	..	..	..	..	..	..	..	×	..	..	..	..
Gonionemus vindobonensis	..	..	×	..	..	..	..	..	..	..	..	×	..	..	..	..
Eucheilota flevensis	..	..	×	..	..	..	..	..	..	..	..	..	..	..	..	..
Bougainvillia macloviana	..	..	×	..	..	..	..	..	..	..	..	..	..	..	..	..
Margelopsis haeckeli	..	..	×	..	..	..	..	..	..	..	..	..	..	..	..	..
Nemopsis bachei	..	..	×	..	..	..	..	..	×	×	×	..	..	..	..	..
Eucheilota maculata	..	..	×	×	..	..	..	..	..	..	..	..	..	..	..	..
Tima bairdi	..	..	×	×	×	..	..	..	..	..	..	..	..	..	..	..
Bougainvillia superciliaris	..	..	×	×	×	×	×	×	×	..	..	..	..	..	..	×
Paratiara digitalis	..	..	×	..	..	×	×	..	..	×	..	..	..	..	..	..
Phialidium islandicum	..	..	×	..	..	×	..	..	..	..	..	..	..	..	..	..
Euphysa tentaculata	..	..	..	×	..	..	×	×	..	..	..	..	..	..	..	..
Halitholus cirratus	..	..	..	×	..	..	×	×	×	..	..	..	..	..	..	..
Plotocnide borealis	..	..	..	×	..	..	×	×	..	..	..	..	..	..	..	?
Thamnostoma russelli	..	..	×	..	..	..	..	..	..	..	..	..	..	..	..	..
Margelopsis hartlaubi	..	..	×	..	..	..	..	..	..	..	..	..	..	..	..	..
Ptychogastria polaris	..	..	..	..	×	×	×	×	(×)	..	..	..	..	..	..	×
Catablema vesicarium	..	..	..	..	×	×	×	×	×	..	..	..	..	..	..	×
Halitholus pauper	..	..	..	..	..	×	..	×	..	..	..	..	..	..	..	×
Number of species	56	51	64	36	29	27	17	19	29	15	13	35	18	16	6	20
							20									

The first two species in Table III have not been found in British waters other than off the Atlantic coasts. *Bougainvillia pyramidata* has not been observed anywhere else; the distribution of *Phialopsis diegensis* is partly oceanic and it is recorded only once from an off-shore locality south-west of Ireland.

The occurrence of the next 20 species is restricted to the southern parts of the province, whence they penetrate through the English Channel into the North Sea (*Podocoryne hartlaubi* only to the western entrance of the Channel); 6 of them are distributed further into the Baltic province. None of these species occur in arctic waters, 3 are recorded from the west coast of Norway, but only in its southern part, 13 species occur in the Mediterranean.

The next 24 species are more or less generally distributed along the British Atlantic coasts. All of them occur in the English Channel as well as in the northern part of the North Sea; 16 species proceed into the Baltic province, 17 to the Norwegian coast south of Lofoten, but only 6 are found north of Lofoten and 5 in arctic waters, whereas 12 are recorded from Iceland.

The penetration into the North Sea of the next 9 species apparently takes place only north of Scotland. They do not occur in the English Channel, except *Melicertum octocostatum* which is recorded from Falmouth just inside the mouth of the Channel, and *Bougainvillia principis* which has been observed near Plymouth. Five of the species occur in the southern as well as in the northern parts of the Atlantic province, whereas 4 have been found only in the northern section. The waters around Scotland are at least as well investigated as the southern British waters, so that the absence of a number of species in the Scottish area is not likely to be due to lack of investigations. Among the 9 species under consideration 7 proceed into the Baltic province, 8 to the west coast of Norway, 4 or 5 to northern Norway, 7 to Iceland, and 6 of them occur in arctic waters. *Melicertum octocostatum, Mitrocomella polydiademata, Leuckartiara nobilis* and *Bougainvillia principis* are presumably indigenous in the West British waters, whereas it seems probable that the occurrence west of Scotland of *Eutonina indicans, Leuckartiara breviconis, Bougainvillia nordgaardi* and *Staurophora mertensi* is due to occasional influx from northern waters. *Staurophora mertensi* is a predominantly arctic species which occasionally is met with in the North Sea and only quite recently is recorded from the Clyde area (GAULD 1952). *Eutonina indicans* is generally distributed and very common in the North Sea and the Danish waters and at the southern part of the Norwegian coast, but only once has it been recorded from western Scotland (Firth of Clyde, VANNUCCI 1956). It is also possible that *Halopsis ocellata,* when it occurs in the waters west of the British Isles, has been carried southwards by currents from the north; it is only met with in off-shore localities, occasionally as far as south and south-west of Ireland.

We may state that the Atlantic coasts of the British Isles are inhabited by a rich indigenous fauna of neritic hydromedusae; it is not very likely that immigration of neritic species takes place from southern areas, whereas some few species occur as northern visitors and may be valuable indicators of influx of water from northern regions.

2. The English Channel. The Channel is a transitional province; it has a rich fauna of its own, but it also receives visitors from the Atlantic, partly belonging to the same species which are indigenous. According to RUSSELL (1936 and 1938) there are three types of water in the Channel: "Channel" water, "swirl" water, and "oceanic" water; only oceanic species are carried in with the last.

The total number of species of neritic hydromedusae recorded from the province is 51. *Podocoryne minima* and *Eleutheria claparedei* have not been found in any other boreal localities, *Ectopleura dumortieri* proceeds into the North Sea and *Eucodonium brownei* to the Kattegat; these four species also occur in the Mediterranean. All the other species found in the Channel also occur on the Atlantic coasts. *Podocoryne hartlaubi, Pochella polynema, Melicertum octocostatum, Bougainvillia principis* and *Tiaropsis multicirrata,* which have been found only in the westernmost part of the Channel and which do not occur in the south-western part of the North Sea, are probably only visitors carried in by the "swirl" water derived from the cyclonic swirl south of Ireland (RUSSELL 1938). Among visitors to the Plymouth area with the swirl water RUSSELL also mentions *Aequorea vitrina* and *aequorea, Dipurena ophiogaster* (as *Purena strangulata*), *Podocoryne borealis* (as *P. areolata*), *Dipurena halterata, Amphinema rugosum, Cosmetira pilosella, Laodicea undulata* and *Euphysa aurata.* It seems probable, however, that these species are indigenous in other parts of the Channel. 46 of the

species found in the Channel occur in the North Sea, 25 in the Baltic province, 22 on the west coast of Norway, 33 in the Mediterranean, 16 at Iceland, but only 7 in arctic waters. The fauna in the Channel thus has a predominantly southern character.

3. The North Sea receives influx of water from three different sources: through the English Channel, from the straits between Scotland and the Orkney and Shetland Islands, and from the Skagerrak. The Channel water proceeds along the continental coasts and across the southern part of the North Sea over the Dogger Bank to the west coast of Jutland, whereas under normal conditions it flows for only a short distance northwards along the coast of England. The water entering north of Scotland is mainly derived from the Irish Sea and the coastal water west of Scotland, and mixed with Atlantic water it moves southwards off the east coast of Scotland and northern England until it meets the Channel water; the combined water-masses then proceed eastwards and enter the Skagerrak under the name of the Jutland Current. The Baltic Current, issuing from the Skagerrak, mainly follows the Norwegian coast northwards. Local eddies, weather conditions, tidal currents etc. may have disturbing influences upon this schematic plan, but the resulting currents are generally as here described. During their circulation in the North Sea the inflowing water-masses are gradually diluted by fresh water from many rivers, but within the North Sea proper the salinity remains high enough for most of the medusae, and within the boreal region the North Sea is the province which contains the greatest number of species (64). In the Skagerrak, however, the influence of the Baltic Current puts a stop to the further penetration of several species. A comparatively slight influx of oceanic water takes place from the Atlantic into the deep strata of the Norwegian Channel.

A somewhat arbitrary northern boundary of the North Sea may be drawn from the Shetland Islands to Bergen in Norway, approximately along lat. 61° N; some species occurring near Bergen but not further north on the Norwegian coast, are therefore mentioned in the following as belonging to the fauna of the North Sea.

Among the 64 species recorded from the North Sea the following need special consideration: *Gonionemus vindobonensis*, originally described from aquaria at Triest in the Adriatic Sea, has been observed in an aquarium at Cullercoats in Northumberland; *Eucheilota flevensis* was described from the Zuiderzee in Holland, but disappeared when this enclosed basin was barred from the open sea; *Bougainvillia macloviana* is circumpolar in subantarctic waters and has been introduced to the south-eastern part of the North Sea, probably by ships; *Nemopsis bachei* is an American species found in only two European localities, Zuiderzee in Holland and in the estuary of the river Gironde in France; the other species will be mentioned according to the water masses to which they mainly belong.

The fauna in the south-western part of the North Sea was dealt with by me in a previous paper (1930) to which I refer. By means of the occurrence of the medusae in the coastal waters on both sides compared with the composition of the fauna in the mid-water regions west and east of the Dover Strait I came to the conclusion that though powerful tidal currents are rushing forwards and backwards through the strait, they cause only a slight horizontal displacement of water towards the coasts; the volume of water carried into the North Sea by the tidal wave does only to a slight degree approach the coast. I also found that the majority of the water which is carried in with the rising tide recedes again through the Dover Strait, so that in the end the resulting influx of water from the Channel to the North Sea is rather inconsiderable; a fairly slight influx of salt water is sufficient to increase to a considerable extent the distribution of the 35 $^0/_{00}$ isohaline in the North Sea.

Almost all the species of hydromedusae occurring in this part of the North Sea are indigenous there, though a fresh supply of specimens may occasionally be received from the Channel. Only three species may be regarded as mere visitors: *Dipurena halterata*, *Amphinema dinema* and *Gossea corynetes*; they were found in the North Sea sections only when the 35 $^0/_{00}$ isohaline had a particularly extensive distribution. *Bougainvillia superciliaris*, on the other hand, which is a northern species and which was observed only once, near Deal on the English coast, was supposed to be a visitor from the northern part of the North Sea, and the same probably applies to *Mitrocomella polydiademata*, though on one occasion it was rather abundant near the Belgian coast.

Altogether 40 species have been found in the south-western part of the North Sea; 19 of these are almost generally distributed in the province. Among the remaining 21 species the following 8 have only been found immediately east of the Dover Strait: *Mitrocomella brownei, Gossea corynetes, Aequorea aequorea, Proboscidactyla stellata, Zanclea costata, Amphinema rugosum, Dipurena halterata,* and *Phialella quadrata,* whereas the following 13 species also occur further east, in the Helgoland Bight or in the Jutland Current, but are lacking or scarce in the northern parts of the North Sea: *Amphinema dinema, Turritopsis nutricula, Agastra mira, Eirene viridula, Aequorea vitrina, Eutima gegenbauri, Stauridiosarsia producta, Cladonema radiatum, Bougainvillia ramosa, Gonionemus vertens, Ectopleura dumortieri, Margelopsis haeckeli* and *Eucheilota maculata*; to these may be added *Lovenella clausa, Helgicirrha schulzei* and *Dipurena ophiogaster,* which have not yet been found in the south-western North Sea but are recorded from Helgoland or off the west coast of Jutland. Thus 24 species may be designated as characteristic of that part of the North Sea which is influenced by the Channel water and its continuations towards the west coast of Jutland. A detailed account of the fauna off the coast of Jutland has previously been given by me (1927).

There are 15 species which have their principal or only occurrence in the northern part of the North Sea. *Margelopsis hartlaubi* and *Thamnostoma russelli* are known only from around Bergen in Norway. *Tiaropsis multicirrata, Melicertum octocostatum, Bougainvillia principis* and *Bougainvillia superciliaris* are indigenous in the northern part of the North Sea and penetrate southwards to Helgoland and into the Baltic province. The occurrence of *Bougainvillia nordgaardi, Dipleurosoma typicum, Leuckartiara breviconis, Sarsia prolifera, Pochella polynema, Halopsis ocellata, Paratiara digitalis, Phialidium islandicum* and *Staurophora mertensi* is restricted to the northernmost tracts. The three first may be indigenous at the Shetland Islands and southern Norway, whereas the others are probably only visitors in the North Sea. *Sarsia prolifera* follows the British coast as far south as Northumberland but has not been found further south or east in the North Sea. *Paratiara digitalis, Phialidium islandicum* and *Pochella polynema* are recorded only once between the Shetland Islands and southern Norway; *Halopsis ocellata* is fairly common in these same tracts. *Staurophora mertensi* is decidedly a stray visitor from the north, but on a few occasions it was observed rather plentifully off the Scottish and Jutland coasts. All these species, except the two which are known only from Bergen, are characteristic of the North Water and may be regarded as indicators of penetration of these water masses into other parts of the North Sea.

The 21 species which are included in Table III as occurring in the North Sea but are not enumerated above as southern or northern forms are more or less generally distributed in the North Sea. Most of them have a wide distribution also in other waters, but *Tima bairdi* has never been found anywhere outside the North Sea and the Danish waters, where it is very common, and *Eutonina indicans,* likewise very common in the same waters, also has a narrow distribution in the Atlantic area; it is known from north-western Iceland and has once been observed in the Firth of Clyde on the west coast of Scotland; it also occurs, however, in the northern Pacific.

The Baltic Current does not provide the North Sea with any species which are not indigenous there.

Among the 64 species of neritic hydromedusae recorded from the North Sea, 27 occur off the west coast of Norway north of Bergen, 31 in the Baltic province, 23 at Iceland, 12 in arctic waters, and 30 in the Mediterranean. The fauna in the North Sea is thus a mixed fauna consisting of species belonging to northern as well as southern waters, though with a predominance of southern species.

4. The Baltic province is characterized by the decrease of the salinity of the water from the mouth of the Skagerrak towards the Baltic Sea and by the corresponding changes in the composition of the fauna. Geographically the boundary between the North Sea and the Skagerrak is the line from Hanstholm in Jutland to Lindesnes in Norway, but from a biological point of view the greater part of the north-west coast of Jutland belongs to the North Sea. The Jutland Current proceeds along this coast running close inshore at the two prominent points Hanstholm and Hirtshals; in winter and spring it consists mainly of cold "northern bank water" derived from the northern part of the North Sea; in summer and autumn the warm "southern bank water" is dominating. From the Skaw the Jutland Current continues over to the Swedish coast, where it divides, part of it uniting with the Baltic Current and flowing northwards, another part flowing south as an

undercurrent in the deep channels of the eastern Kattegat, with depths up to 100 m., and further through the Belts into the western part of the Baltic. During this progress the salt water is gradually diluted by the overlayering Baltic water, though at the entrance to the Baltic proper the salinity of the bottom water may still be about 20 $^0/_{00}$ or more, and in the deep basins (80—100 m.) west and east of the island Bornholm salinities of up to 23 $^0/_{00}$ may ocasionally, though rarely, be observed; at the surface in this part of the Baltic it is only 8 $^0/_{00}$. The Baltic Current moving northwards through the Kattegat attains its greatest volume off the Swedish coast; in the eastern Skagerrak it carries part of the "bank water" from the Jutland Current with it out along the south coast of Norway.

The Hydromedusae of the Danish waters were thoroughly dealt with by me in 1927; in that paper I emphasized the importance of plankton organisms, especially the medusae, as hydrographical aids, but I also pointed out that, for such utilisation of the organisms, knowledge of the distribution and biology of the different species is necessary and must constantly be applied. In the present paper I must confine myself to giving a very brief characterization of the fauna in these interesting waters.

Two species belonging to the southern bank water, *Helgicirrha schulzei* and *Eirene viridula*, have better be omitted from the list of species belonging to the Baltic province; up to now they have been found only in the westernmost part of the Skagerrak. Apart from them, 36 species of neritic hydromedusae are enumerated in Table III as occurring in this province. *Cladonema radiatum* and *Gonionemus vertens* are strictly littoral species with a scattered occurrence in shallow water; both have been found on the Swedish coast of the Skagerrak, the former also in the Limfjord.

29 species are recorded from the Skagerrak, but only 6 of these do not penetrate into the Kattegat. *Podocoryne borealis* and *Ectopleura dumortieri* have been found on a few occasions in the Skagerrak; in both instances the specimens were evidently liberated from hydroids growing in the immediate neighbourhood, but their occurrence as indigenous in these waters is probably an exception. *Eutima gegenbauri* occurs as a visitor with the southern bank water, and *Bougainvillia principis, B. nordgaardi* and *Staurophora mertensi* are occasionally carried into the Skagerrak with northern bank water. *Plotocnide borealis* has recently been recorded from Oslo Fjord, where it occurs in great abundance.

The number of species recorded from the Kattegat amounts to 28. A single specimen of *Eucodonium brownei* has been found in the Kattegat evidently derived from a local stock of hydroids, but its occurrence in these waters must be regarded as exceptional; it has not been observed in the North Sea. *Stauridiosarsia producta* is probably also an occasional inhabitant in the Kattegat, where some specimens of its hydroid have been found. *Cosmetira pilosella, Eutima gracilis, Bougainvillia superciliaris, Laodicea undulata, Melicertum octocostatum* and *Mitrocomella polydiademata* are more or less regular visitors in the Kattegat, all the other species are indigenous.

The transitional area between the Kattegat and the Baltic proper is called the Belt Sea; besides the Sound and the Belts it comprises the complicated channels between the many islands and peninsulas in the south-western part of the Kattegat (the Samsö Bay) and also the waters south of the Danish islands, the so-called "Western Baltic", in contradistinction to the Baltic proper east of the Gedser-Darsserort line. With only one exception all of the 20 species which have been found in the Belt Sea also occur in the Kattegat; the exception is *Leuckartiara nobilis*, of which a single specimen has been taken in the Great Belt, widely separated from its further distribution west of the British Isles. Among the other 19 species 13 are undoubtedly indigenous in the Belt Sea, and only 6 may be designated as visitors from the Kattegat. One of these, *Melicertum octocostatum*, is presumably derived from as far away as in the Skagerrak, whereas *Bougainvillia britannica, Lizzia blondina, Sarsia gemmifera, Tiaropsis multicirrata* and *Tima bairdi* are indigenous in parts of the Kattegat. The admission from the Kattegat to the western Baltic takes place almost exclusively through the Great Belt which has an uninterrupted channel with depths of more than 40 m. Almost all the species found in the Samsö Bay also occur in the Great Belt, but the salinity in the western Baltic, up to about 20 $^0/_{00}$ in the lower layers, is too low for 7 of the species.

The Baltic proper is separated from the Sound by a shallow-water sill less than 7 m. deep; the channel between Gedser on the Danish island Falster and Darsseort on the German coast is somewhat deeper, 21 m.,

and *Euphysa tentaculata, Hybocodon prolifer, Rathkea octopunctata* and *Eutonina indicans* may occasionally be carried this way for a short distance into the Baltic proper. On a quite exceptional occasion these same species and also *Tiaropsis multicirrata* were found immediately south of the sill in the Sound. Specimens of *Sarsia tubulosa* are rather frequently carried in across the two sills, and it is probably also indigenous in the westernmost part of the Baltic proper. *Halitholus cirratus,* on the other hand, is a true inhabitant of the Baltic; it is very abundant in its deeper parts right up to the entrance of the Gulf of Botnia, and its hydroid has been found on the isopod *Mesidothea entomon*; it is also indigenous in the Belt Sea and the Kattegat. The further distribution of this species and of *Euphysa tentaculata,* which is common in the Kattegat, is purely arctic, and these two species must be regarded as arctic survivors in the Baltic province.

It appears from the above statements that the number of species is gradually decreasing from the Skagerrak towards the Baltic, undoubtedly owing to the decrease of the salinity of the water; but there are only two remarkably sharp limits to the penetration of these animals, *viz* the two entrances to the Baltic proper. As a matter of fact, among the 29 species known from the Skagerrak no less than 23 occur in the Kattegat and 17 in the Belt Sea, whereas under normal conditions only two species occur in the Baltic proper.

Among the 36 species of neritic hydromedusae recorded from the Baltic province 31 occur in the North Sea, 22 off the Norwegian coast north of Bergen, 20 at Iceland, 13 in arctic waters, 25 in the English Channel, and 17 in the Mediterranean. In comparison with the North Sea the fauna of the Baltic province thus contains remarkably fewer species having a predominantly southern distribution.

5. Norway north of Bergen.—Many years ago I worked up a large collection of hydromedusae from the west coast of Norway in collaboration with professor D. Damas at Liége, Belgium (Kramp & Damas 1925). They were collected by Damas during his sojourn at Bergen from 1904 to 1909 and were under his charge at Liége until 1920, when, at his request, I went there to work up this valuable collection with him. According to our plan the Scyphomedusae, of which no specimens had been preserved, should be worked up by Damas himself through his considerable amount of notes, and in the end we would collaborate again in a preparation of an account of the general results. Damas was, however, so occupied by other undertakings that our plan was never accomplished. Since then only some few additions have been made to our knowledge of the West-Norwegian fauna of medusae, mainly by Rees (1938, 1941, 1952, 1953).

The medusae found around Bergen were mentioned above under the treatment of the North Sea. Further north, water of the Atlantic Current flows northwards along the entire Norwegian coast right up to the Barents Sea, separated from the coast by coastal water of lower salinity, partly derived from the Baltic Current. The Atlantic water is gradually cooled during its northward progression. As far as the bottom animals are concerned the Lofoten constitutes a fairly sharp faunistic boundary, but the upper water layers with their contents of pelagic animals are not so abruptly cooled at this point. It is true that only some few of the species of medusae known from the southern part of the Norwegian coast are recorded from the tracts north of Lofoten, but this may be due partly to insufficient knowledge of the fauna in this northern area; it seems probable that South-Norwegian species which occur in the Barents Sea might also be found off the northern part of the Norwegian coast. The conditions in the deep fjords are greatly dependent on the presence or absence of a shallow-water sill at their entrances.

29 species of neritic hydromedusae are recorded from the west coast of Norway north of Bergen (see Table III). The northward distribution of the following species is not, or only very slightly, extended beyond Cape Stat (about 62° N.): *Bougainvillia britannica, Sarsia gemmifera, Tima bairdi, Eutonina indicans, Neoturris pileata, Bougainvillia nordgaardi* and *Leuckartiara breviconis*; *Sarsia eximia, Zanclea costata,* and *Podocoryne borealis* proceed up to about 64° N. and *Aequorea aequorea* has been found in an off-shore locality about 66° N., All these species have a predominantly southern distribution in relation to the west coast of Norway. *Leuckartiara octona, Phialidium hemisphaericum, Steenstrupia nutans* and *Laodicea undulata* are recorded as far north as Lofoten. The other species enumerated in Table III occur, or presumably occur, along the entire Norwegian coast, though some of them have not yet been collected there but are recorded from the Barents Sea. All these species (except *Podocoryne carnea*) have a predominantly northern distribution and are common in arctic waters. Only two of the Norwegian species are strictly arctic, *viz. Catablema vesicarium*

and *Ptychogastria polaris*; the former has been found as far south as 66°45′ N., the latter occurs in some of the fjords, where cold water prevails.

All of the 29 species, except the two high-arctic species, occur in the North Sea, 19 in the English Channel, 25 off the Atlantic coasts of the British Isles, 12 in the Mediterranean, 21 at Iceland, and 14 in arctic waters. The fauna off the west coast of Norway north of Bergen may thus be designated as a diminution of the British fauna with addition of two high-arctic species.

6. Iceland.—In hydrographical regard Iceland is characterized by a clockwise circulation of the waters all around the island. The Irminger Current, which is a northern branch of the Gulf Stream, carries warm Atlantic water to the south coast, part of it proceeds towards southern Greenland, another part turns north; it passes the north-western corner of the island, but during its further passage along the north coast it is considerably cooled by the East-Greenland Polar Current, especially in winter and spring; on the east coast the Polar Current is predominating, and on the south-eastern part of the coast, where the Polar Current meets the Irminger Current, a very sharp limit may be observed between the cold and the warm water of these currents.

The occurrence of the medusae in the different parts of the Icelandic coastal waters presents a remarkable agreement with the hydrographical conditions. This was thoroughly dealt with by me in a previous paper (Kramp 1939), which will be summarized briefly here with a few additions. Altogether 27 species of neritic hydromedusae are recorded from the Icelandic waters (see Table III). *Paratiara digitalis*, however, has been found only in deep water in a single locality south of the island, and *Leuckartiara nobilis* has likewise been taken only in some off-shore localities. *Bougainvillia britannica* has recently been recorded from the south coast (Fraser 1952), but I am not sure of the correctness of the identification; it may have been confounded with *B. principis* which is a very similar species. Only 3 species are purely arctic; *Halitholus pauper* has been found in the north-western fjords, *Catablema vesicarium* and *Ptychogastria polaris* on the north and east coast. The specimens of *Halitholus pauper* were probably visitors from East Greenland waters, whereas the two other species may be indigenous in the cold waters in north-eastern Iceland. The following 9 species, which have a predominantly northern-boreal or arctic-boreal distribution, are almost generally distributed around Iceland: *Hybocodon prolifer, Sarsia tubulosa, Rathkea octopunctata, Tiaropsis multicirrata, Melicertum octocostatum, Bougainvillia principis, Staurophora mertensi, Bougainvillia superciliaris* and *Phialidium islandicum*. On the other hand, the remaining 12 species, which mainly occur in more southern areas, have never been found in the cold waters of northern and eastern Iceland; some few of them have been able to penetrate as far as the north-western corner of the island, either because they are large species with a life time long enough to enable them to endure transportation over long distances (*Neoturris pileata, Laodicea undulata, Eutonina indicans*), or owing to continuous propagation by budding and therefore increasing in number while being carried by the currents (*Lizzia blondina*). The latter species, which has been found only once in Iceland waters, is probably not a constant inhabitant there, whereas all the other species with a southern distribution in relation to Iceland, are most probably indigenous on the south coast. The free-swimming medusae of *Bougainvillia ramosa* and *Podocoryne carnea* have not been found at Iceland, but their hydroids occur on the south coast.

With the exception of *Leuckartiara nobilis* and the arctic *Halitholus pauper* all the Icelandic species occur on the west coast of Norway; 23 species occur in the North Sea, 21 in the waters west of the British Isles, 16 in the English Channel, 10 in the Mediterranean, and 13 in arctic waters. Thus the Icelandic fauna of neritic medusae consists mainly of boreal species with a comparatively slight admixture of arctic and southern species.

It should still be mentioned that 17 species have been observed in the immediate neighbourhood of the small islands, the Faroes, between the Shetland Islands and Iceland; all of them occur at the British Isles and in the North Sea and, with two exceptions (*Sarsia gemmifera* and *Mitrocomella polydiademata*), also at Iceland.

Comparison of the fauna of neritic hydromedusae in the East-Atlantic boreal region with those in other zoogeographical regions.—The total number of species (besides the *Obelia*'s)

amounts to 77, of which 11 are "endemic" to the region, and 4 species have not been found in other regions within the Atlantic area but occur in the northern Pacific. Among the endemic species three have been taken only in one locality each: *Eucheilota flevensis* in the Zuiderzee, *Margelopsis hartlaubi* and *Thamnostoma russelli* near Bergen in Norway. The others are more or less common in the areas where they occur. *Bougainvillia pyramidata* is endemic in the waters west of the British Isles, *Margelopsis haeckeli* and *Eucheilota maculata* are restricted to the North Sea, and so is *Tima bairdi* which, however, penetrates into the Baltic province; *Agastra mira, Lovenella clausa* and *Aequorea vitrina* are distributed from the western British coasts to the eastern part of the North Sea; *Phialidium islandicum* occurs around Iceland, whence it extends into the northern part of the North Sea. To the endemic species may also be added *Cosmetira pilosella, Proboscidactyla stellata* and *Gossea corynetes,* which occur in the North Sea and at the British coasts and have also been observed in a few localities in the Bay of Biscay, thus penetrating slightly into the Lusitanian area.

Among the 78 species of the region, 19 occur in arctic waters, but only 5 of these are strictly arctic, three of which penetrate southwards to northern Iceland and Norway, two of which occur as arctic survivors in the Baltic province; the others are boreal species penetrating more or less into arctic regions. 29 species also occur in the West-Atlantic boreal region, but apart from 5 species, which are widely distributed in the Atlantic, only four of these occur south of Cape Cod on the American coast (see above, p. 214). 20 species occur in the northern Pacific. In the Lusitanian area, which is insufficiently investigated, only 13 of the North-European species have been observed, but 35 occur in the Mediterranean and 18 on the west coast of Africa. The medusae thus confirm the statement by Ekman (1953 pp. 106—107) that the European boreal fauna has a large number of species in common with the Mediterranean, the Mediterranean-boreal elements of the fauna being stronger than the arctic-boreal, and also that the boreal fauna occupies a relatively independent position in spite of this mixture of faunas from adjacent regions.

IV. The Mediterranean-Atlantic Region.

This region is divided into three well-separated provinces, the Lusitanian, the Mediterranean and the Mauretanian. The northern limit of the Lusitanian province is at the entrance to the English Channel, and it is a well defined boundary. The coasts from the Channel to the Straits of Gibraltar are exposed to south-going branches of the Gulf Stream, whereas the surface-water currents through the Straits of Gibraltar are generally directed inwards towards the Mediterranean. In the present paper the Azores are regarded as belonging to the Lusitanian province. The Mauretanian coast, from the Straits of Gibraltar to Cape Blanco in Africa, is strongly influenced by upwelling cold water from the deep-sea. Moreover the continental coast as well as the Canary Islands are influenced by the south-going Canary Current which is still perceptible at the Cape Verde Islands; in spite of their southern position these islands are, therefore, included in the treatment of the Mauretanian province. The Mediterranean Sea is an enclosed area with special hydrographical conditions.

1. The Lusitanian province. The fauna of medusae off the Lusitanian coasts is very deficiently known. Only 20 species of neritic hydromedusae are recorded, 12 of which occur in the Mediterranean Sea; 8 of these also occur in the East-Atlantic boreal region. The distribution of the first four species in Table IV, *Nemopsis bachei, Cosmetira pilosella, Proboscidactyla stellata* and *Gossea corynetes,* extends southwards from the boreal region for a short distance into the Bay of Biscay but not further south. *Tima flavilabris* occurs north of the Azores; *Sibogita geometrica* and *Zygocanna vagans* are inhabitants of the Malyan Archipelago, and in the Atlantic they have been found only near the Azores (*Zygocanna* also at South Africa). There are 4 Mediterranean species which do not occur in boreal waters but have been found in the southernmost parts of the Lusitanian region: *Helgicirrha cari* at the southern coasts of Spain and Portugal, *Köllikerina fasciculata, Oceania armata* and *Pandea conica* also at the Azores; the latter has an extensive distribution southwards and westwards in the Atlantic, but not further north than the Azores. The remaining 8 species, which are common to the Mediterranean and the boreal region, are recorded from some scattered localities in the Lusitanian province.

Table IV. Neritic species in the Mediterranean-Atlantic region.

	Mediterranean-Atlantic											
	Lusitanian	Adriatic Sea	Mediterranean	Mauretanian	Tropical West Africa	South Africa	East-Atlantic boreal	Arctic	West-Atlantic boreal	West Atlantic tropical	Indo-West-Pacific	North-Pacific
Nemopsis bachei	×	..	..	..	..	..	×	..	×	×	..	..
Cosmetira pilosella	×	..	..	..	..	..	×	..	..	..	..	..
Proboscidactyla stellata	×	..	..	..	..	..	×	..	..	..	×	×
Gossea corynetes	×	..	..	..	..	..	×	..	..	..	..	..
Sibogita geometrica	×	..	..	..	..	..	..	..	..	..	×	..
Tima flavilabris	×	..	..	..	..	..	..	..	..	..	..	..
Zygocanna vagans	×	..	..	..	..	×	..	..	..	..	×	..
Lizzia blondina	×	×	×	..	..	..	×	..	..	..	..	..
Sarsia gemmifera	×	×	..	..	..	..	×	..	..	..	..	..
Bougainvillia ramosa	×	×	..	×	×	..	×	..	×	..	..	..
Phialidium hemisphaericum	×	×	×	×	×	..	×	..	..	..	×	..
Aequorea aequorea	×	×	×	..	×	×	×	..	×	×	(×)	..
Ectopleura dumortieri	×	×	×	..	×	×	×	..	×	×	×	..
Laodicea undulata	×	×	×	..	×	×	×	..	×	×	..	..
Neoturris pileata	×	×	×	×	×	×	×	..	..	..	..	..
Leuckartiara octona	×	×	×	..	×	..	×	(×)	×	..	×	×
Helgicirrha cari	×	..	×	..	..	..	..	..	..	..	..	..
Köllikerina fasciculata	×	×	×	..	..	..	..	..	..	..	..	..
Oceania armata	×	×	×	×	×	..	..	..	..	×	×	..
Pandea conica	×	..	×	..	×	×	..	..	..	×	×	..
"Dicodonium" adriaticum	..	×	..	..	..	..	..	..	..	..	..	..
Thamnostoma dibalia	..	×	..	..	..	..	..	..	..	..	..	..
Melicertissa adriatica	..	×	..	..	..	..	..	..	..	..	..	..
Orchistoma graeffei	..	×	..	..	..	..	..	..	..	..	..	..
Eucheilota maasi	..	×	..	..	..	..	..	..	..	..	..	..
Eutonina scintillans	..	×	..	..	..	..	..	..	..	..	×	..
Gonionemus vindobonensis	..	×	..	..	..	..	×	..	..	..	..	..
Amphinema rugosum	..	×	..	..	..	..	×	..	×	×	×	..
Amphinema dinema	..	×	..	..	×	..	×	..	×	×	×	..
Dipurena halterata	..	×	..	..	×	..	×	..	..	×	..	..
Merga tergestina	..	×	..	..	×	..	..	..	..	..	..	..
Eutima gracilis	..	×	..	..	×	..	×	..	..	..	..	..
Ptychogastria asteroides	..	×	×	..	..	..	..	..	..	..	..	..
Tima lucullana	..	×	×	..	..	..	..	..	..	..	..	..
Octogonade mediterranea	..	×	×	..	..	..	..	..	..	..	..	..
Euphysa aurata	..	×	×	..	..	..	×	×	×	..	..	..
Steenstrupia nutans	..	×	×	..	..	..	..	..	×	..	..	..
Eucodonium brownei	..	×	×	..	..	..	×	..	..	..	..	..
Cladonema radiatum	..	×	×	..	..	..	×	..	..	×	×	×
Eleutheria dichotoma	..	×	×	..	..	..	×	..	..	..	..	..
Podocoryne hartlaubi	..	×	×	..	..	..	×	..	..	..	..	..
Podocoryne carnea	..	×	×	..	..	×	×	..	×	..	..	..
Rathkea octopunctata	..	×	×	..	..	..	×	×	×	(×)	..	×
Helgicirrha schulzei	..	×	×	..	×	..	×	..	..	..	..	..
Eutima gegenbauri	..	×	×	..	..	..	×	..	..	..	..	..
Zanclea costata	..	×	×	..	×	..	×	..	×	×	×	..
Turritopsis nutricula	..	×	×	..	×	..	×	..	×	×	×	..
Eirene viridula	..	×	×	..	×	..	×	..	..	..	×	..
Odessia maeotica	..	×	×	×	..	..	..	..	..	..	..	..
Olindias phosphorica	..	×	×	..	×	..	..	..	..	×	..	..
Pachycordyle weismanni	..	..	×	..	..	..	..	..	..	..	..	..
Stylactis pruvoti	..	..	×	..	..	..	..	..	..	..	..	..
Thamnostoma cidaritis	..	..	×	..	..	..	..	..	..	..	..	..
Bougainvillia maniculata	..	..	×	..	..	..	..	..	..	..	..	..
Orchistoma agariciforme	..	..	×	..	..	..	..	..	..	..	..	..
Tiaropsidium mediterraneum	..	..	×	..	..	..	..	..	..	..	..	..
Agastra rubra	..	..	×	..	..	..	..	..	..	..	..	..
Eugymnanthea inequilina	..	..	×	..	..	..	..	..	..	..	..	..
Phialidium noliformis	..	..	×	..	..	..	..	..	..	×	..	..
Mitrocoma annae	..	..	×	..	..	..	..	..	..	..	..	..
Sarsia eximia	..	..	×	..	..	..	×	..	..	..	..	×
Sarsia prolifera	..	..	×	..	..	..	×	..	..	..	..	..
Dipurena ophiogaster	..	..	×	..	..	..	×	..	..	..	×	..
Eleutheria claparedei	..	..	×	..	..	..	×	..	..	..	..	..
Podocoryne minima	..	..	×	..	..	..	×	..	..	..	..	..

Table IV. (Continued).

	Mediterranean-Atlantic											
	Lusitanian	Adriatic Sea	Mediterranean	Mauretanian	Tropical West-Africa	South-Africa	East-Atlantic boreal	Arctic	West-Atlantic boreal	West-Atlantic tropical	Indo-West-Pacific	North-Pacific
Leuckartiara nobilis	..	..	×	..	..	..	×	..	×	..	..	..
Mitrocomella brownei	..	..	×	..	..	..	×	..	..	..	..	..
Gonionemus vertens	..	..	×	..	..	..	×	..	×	..	..	×
Merga violacea	..	..	×	..	..	..	..	..	..	×	×	..
Scolionema suvaensis	..	..	×	..	..	..	..	..	..	×	×	..
Podocoryne minuta	..	..	×	..	×	..	..	..	..	×	..	..
Lovenella cirrata	..	..	×	×	×	..	..	..	..	×	..	..
Melicertissa clavigera	..	..	..	×	..	..	..	..	..	..	×	..
Cuvieria carisochroma	..	..	..	×	..	..	..	..	..	..	..	..
Staurodiscus tetrastaurus	..	..	..	×	..	..	..	..	..	×	×	..
Toxorchis arcuatus	..	..	..	×	..	..	..	..	..	..	..	..
Eutima gentiana	..	..	..	×	..	..	..	..	..	..	..	..
Gossea faureae	..	..	..	×	..	..	..	..	..	..	..	..
Irenium quadrigatum	..	..	..	×	..	..	..	..	..	..	..	..
Bougainvillia platygaster	..	..	..	×	..	×	..	..	..	×	×	..
Phialopsis diegensis	..	..	..	×	×	×	×	..	..	×	×	..
Eucheilota ventricularis	..	..	..	×	×	..	..	(×)	×	×	..	..
Tiaropsis multicirrata	..	..	..	(×)	..	..	×	×	×	..	..	..
Number of species	20	41	51	17	22	9	41	5	17	23	23	6
		65										

2. The Mediterranean Sea. In a previous paper (KRAMP 1924) I have given a detailed account of the occurrence of 20 species of hydromedusae and 5 species of scyphomedusae in the Mediterranean. The paper was based on the collections by the Danish research vessel "Thor" in 1908—1910 and gave occasion to a discussion on the distribution of the medusae in different parts of the Mediterranean and their relation to the currents and hydrographical conditions. Since, however, the collections were mainly carried out in offshore localities, the faunistic discussions were primarily restricted to the holopelagic species; only comparatively few neritic forms (14 species) were secured from scattered localities.

In a faunistic discussion the Mediterranean really ought to be treated as consisting of at least three provinces, but our knowledge of the neritic fauna is restricted mainly to the surroundings of some few localities where biological laboratories are situated: the Gulf of Lyon on the south coast of France, the Gulf of Naples, the Straits of Messina, and the Gulf of Venice in the Adriatic Sea. Especially the north coast of Africa and the entire eastern basin of the Mediterranean are very insufficiently investigated. In the following account, therefore, the entire Mediterranean will be treated comprehensively, with only some few remarks on the occurrence of the species in the eastern or the western basin respectively. The Adriatic Sea, on the other hand, will be treated separately, because its fauna of various kinds of animals is asserted by various authors to differ in a characteristic way from that of the Mediterranean proper.

An excellent account of the hydrography of the Mediterranean was given by the Danish hydrographer J. N. NIELSEN (1913). He was a hydrographer with an appreciable understanding of the importance of close collaboration between hydrographers and biologists and with an admirable ability to present hydrographical data and results in such a way that they were immediately accessible and serviceable to biologists. In my paper of 1924, quoted above, I made extensive use of NIELSEN's account which enabled me to explain many of the more or less peculiar observations of the distribution of medusae in the Mediterranean. On the other hand, in some instances the occurrence of the medusae turned out to be of considerable value for procuring supplementary information on the movements of the waters.

Through the narrow Straits of Gibraltar, with depths not exceeding 320 m., a considerable inflow of Atlantic water takes place at the surface, whereas along the bottom there is a slightly less outflow of water derived

from the intermediate and deep strata of the Mediterranean. Accordingly medusae belonging to the upper layers may be carried in from the Atlantic into the Mediterranean, and since some of these species may sometimes descend into the intermediate layers, they may also occasionally be carried the opposite way, which explains the occurrence of certain Mediterranean surface-water medusae in the southern part of the Lusitanian province.

The inflowing Atlantic water proceeds eastwards, mainly along the north coast of Africa but sending branches northwards into the Balearic Sea (west of Sardinia-Corsica) and the Tyrrhenian Sea (west of Italy), producing anti-clockwise circulations in these basins (see the map, fig. 325 p. 244). Also in the Ionian Sea (west of Greece), the Aegean Sea (west of Asia Minor) and in the Levant (the innermost part of the Mediterranean) the circulation of the surface-water takes place mainly in anti-clockwise directions. The Aegean Sea receives some influx of water from the surface of the Black Sea.

During its eastward progression the Atlantic water becomes mixed with Mediterranean water, and its salinity increases, very slightly until it reaches the Pantellaria Channel (between Sicily and Tunis), but rapidly further east. The eastern parts of the Mediterranean, especially the Aegean Sea and the Levant, are characterized by very high salinities in the surface layers (up to 39 $^0/_{00}$ or more), which is due to the strong evaporation in these tracts. The temperatures of the upper layers are not very different in the different parts of the Mediterranean, in August about 20—24° in the Balearic and Tyrrhenian Seas, about 20—26° in the Aegean Sea and the Levant; but the annual variations are considerable. The depths to which vertical circulation takes place are likewise variable. Some few of the neritic species may occasionally descend into the intermediate strata, the movements of which are different from those of the upper layers. On the other hand, a discussion of the relation between the currents in the surface-layers and the occurrence of the neritic medusae cannot be carried through because, as mentioned above, our knowledge of the Mediterranean distribution of these medusae is restricted to rather few localities.

The Adriatic Sea is comparatively well investigated as far as the medusae are concerned. 41 neritic species are recorded (see Table IV); five species are endemic in the Adriatic Sea, all of them probably valid species but observed only on few occasions. 13 species have not been found in the Mediterranean proper, but most of them probably occur there since, apart from the five endemic species and the Indo-Pacific *Eutonina scintillans*, they all occur either in boreal waters or at the west coast of Africa. The neritic medusae, therefore, do not confirm the supposition that the Adriatic Sea should contain a characteristic fauna of its own.

In the Mediterranean proper 51 species have been found. All of them occur in the western basin (west of the Pantellaria Channel), whereas only 12 species are recorded from the eastern basin as well; but 20 more, which occur in the Adriatic Sea, might presumably also be found, at least in the Ionian Sea. The following 5 species have not been found further east than in the Ionian Sea (and only in its northern part, near the entrance to the Adriatic Sea): *Laodicea undulata*, *Helgicirrha cari*, *Euphysa aurata*, *Sarsia prolifera*, and *Lovenella cirrata*. Two species, *Aequorea aequorea*, and *Merga violacea*, are also recorded from the Aegean Sea, *Phialidium hemisphaericum* from the Sea of Marmara.

We cannot state with certainty how many of these species are indigenous in the eastern basin and which of them occur only as visitors from the western basin. *Köllikerina fasciculata*, *Oceania armata* and *Pandea conica* are certainly indigenous, being almost generally distributed over the entire Mediterranean. *Odessia maeotica* must be specially mentioned; it is a constant inhabitant of the Black Sea, where it is very abundant, and its occurrence on the Aegean coast of Bulgaria, at Trieste and Naples, in the Gulf of Lyon, and also on the Atlantic coast of Morocco, is presumably due to emigration from the Black Sea.

The small number of species recorded up to now from the eastern parts of the Mediterranean may be due partly to deficiency of knowledge, but it is also possible that the very high salinity puts a stop to the eastward distributed of a number of species.

The available records of neritic hydromedusae in the western basin are mainly restricted to some few scattered localities which have been particularly well investigated. All the species are probably indigenous in the Mediterranean; if a species had been found only in the Alboran Sea, just inside the Straits of Gibral-

tar, it might be supposed to be a visitor from the Atlantic, but this does not apply to any single species; all the species which have been found in the Alboran Sea also occur in other parts of the Mediterranean.

For a comparison with the faunas in other zoogeographical regions the Mediterranean fauna had better be treated as a unity, including the Adriatic fauna. Altogether 65 species are recorded, of which 17 are endemic. Four of these have been seen only as newly hatched from the hydroids: *Pachycordyle weissmanni, Stylactis pruvoti, Thamnostoma cidaritis* and *Eugymnanthea inequilina*, all of them at Naples. *Bougainvillia maniculata* has been observed only by HAECKEL (at Villefrance-sur-Mer). The semi-benthonic Trachymedusa *Ptychogastria asteroides* was likewise described by HAECKEL (in the Adriatic Sea and the Straits of Gibraltar) and was regarded as more or less doubtful, until it was found again (at Villefranche) by PICARD (1955). All the endemic species have been found in only one or a few localities, except *Mitrocoma annae*; it is rather peculiar that this species, which seems to be fairly common in the western parts of the Mediterranean, has never been found in other waters. When to the 17 species endemic in the Mediterranean we add the 5 species which are known from the Mauretanian province only, and also *Tima flavilabris* which has been found only near the Azores, and *Helgicirrha cari* which has emigrated from the Mediterranean to the southern coasts of Spain and Portugal, the total number of endemic species in the entire Mediterranean-Atlantic region amounts to 24. The neritic hydromedusae thus confirm the statement by EKMAN (1953 p. 84) that the Mediterranean-Atlantic region possesses a considerable number of endemic species.

It is interesting that among the 65 species which have been found in the Mediterranean no less than 35 occur in the East-Atlantic boreal region, whereas only 20 are known from the tropical west coast of Africa, and 14 of these also occur in the boreal region. In the composition of the Mediterranean fauna of neritic hydromedusae the boreal elements distinctly predominate over the tropical. Among the boreal species, however, only three penetrate into arctic waters.

A comparison with the fauna in the western Atlantic shows that 24 of the Mediterranean species occur off the American coasts, 6 in the boreal region only, 10 in the tropical region only, and 8 in boreal as well as tropical American waters.

In the Indo-West Pacific region 16 Mediterranean species occur, 4 of them in Japan and 3 of these only there.

3. The Mauretanian province. This province is insufficiently investigated. Only 17 species of neritic hydromedusae are recorded (including the isolated occurrence of *Tiaropsis multirrata*); 5 of them have been found nowhere else, but four of these "endemic" species have only been observed by HAECKEL: *Cuvieria carisochroma* at the Cape Verde Islands, *Toxorchis arcuatus* and *Eutima gentiana* at the Canary Islands, and *Irenium quadrigatum* at the coast of Morocco. Eight of the Mauretanian species are known to occur further south off the west coast of Africa, 5 in the East-Atlantic boreal region. It is more peculiar that only 6 Mediterranean species have been found in the Mauretanian province; one might expect to find all of the 20 species which are common to the Mediterranean and the tropical African coast but, besides our deficient knowledge of the fauna, we cannot exclude the possibility that the comparatively low temperature, which is due to upwelling of cold water from the Atlantic deep-sea, prevents some of these species from settling down at the Mauretanian coasts.

V. The East-Atlantic Tropical Region.

The northernmost part of the west coast of Africa, the Mauretanian coast, has been dealt with above as a province of the Mediterranean-Atlantic region. The southernmost part, south of Great Fish Bay (about 17° S.) belongs to the South-African region, but for convenience its fauna of neritic hydromedusae is included in Table V.

The tropical part of the African coast may be divided into three provinces which are characterized by the prevailing currents, whereas there is a fairly gradual transition between the faunas of the three provinces.

1. Cape Blanco to Cape Verde, from about 21° N. to 14° N. Outside the comparatively short distance between these two points the North Equatorial Current moves southwards before it continues south of the Cape Verde Islands and westwards across the Atlantic Ocean; it receives parts of the Canary Current, and

Table V. Neritic species in the East-Atlantic tropical region and in the South-West African region.

	Tropical													
	Cape Blanco–Cape Verde	Cape Verde–Cape Lopez	Cape Lopez–Great Fish Bay	S. W. Africa	Mauretanian	Mediterranean	East-Atlantic boreal	West-Atlantic boreal	West-Atlantic tropical	West-Atlantic antiboreal	Antarctic	Indo-West-Pacific	East-Pacific tropical	North-Pacific
Calycopsis typa	×	..	..	..	..	..	..	×	..	..	..	..	..	..
Turritopsis nutricula	×	×	..	..	..	×	×	×	×	..	..	×	..	..
Phialopsis diegensis	×	×	×	×	×	..	×	..	×	..	..	×	×	×
Leuckartiara octona	×	..	×	..	..	×	×	×	..	..	..	×	×	×
Neoturris pileata	×	..	×	×	×	×	×	..	..	..	..	..	..	..
Eirene viridula	×	×	×	..	..	×	×	..	..	..	..	×	..	..
Laodicea undulata	×	×	×	×	..	×	×	×	×	×	..	..	..	..
Aequorea aequorea	×	×	×	×	..	×	×	×	×	×	..	(×)	..	..
Pennaria pauper	..	×	..	..	..	..	..	..	..	..	..	..	..	..
Euphysilla pyramidata	..	×	..	..	..	..	..	..	..	..	..	..	..	..
Rathkea africana	..	×	..	..	..	..	..	..	..	..	..	..	..	..
"Dipleurosoma" gemmifera	..	×	..	..	..	..	..	..	..	..	..	..	..	..
Octophialucium medium	..	×	..	..	..	..	..	..	..	..	..	..	..	..
Aglauropsis jarli	..	×	..	..	..	..	..	..	..	..	..	..	..	..
Pochella oligonema	..	×	..	..	..	..	..	..	..	..	..	..	..	..
Merga tergestina	..	×	..	..	..	×	..	..	..	..	..	..	..	..
Lovenella cirrata	..	×	×	..	×	×	..	..	×	..	..	..	..	..
Olindias phosphorica	..	×	×	..	..	×	..	..	×	..	..	..	..	..
Pandea conica	..	×	×	×	..	×	..	..	×	×	..	×	..	..
Zanclea costata	..	×	..	..	..	×	×	×	×	..	..	×	×	..
Eutima gracilis	..	×	..	..	..	×	×	..	..	..	..	..	..	..
Phialidium hemisphaericum	..	×	..	..	×	×	×	..	..	..	..	×	..	..
Amphinema dinema	..	×	..	..	..	×	×	×	×	..	..	×	..	..
Ectopleura dumortieri	..	×	×	×	..	×	×	×	×	..	..	×	×	..
Phialella quadrata	..	×	..	..	..	..	×	..	..	..	..	×	..	..
Dipurena strangulata	..	×	..	..	..	..	..	×	×	..	..	..	..	..
Bougainvillia carolinensis	..	×	..	..	..	..	..	×	×	..	..	..	..	..
Stomotoca pterophylla	..	×	..	..	..	..	..	×	×	..	..	..	×	..
Rhacostoma atlanticum	..	×	×	..	..	..	..	×	×	..	..	..	..	..
Proboscidactyla ornata	..	×	×	..	..	..	..	(×)	×	..	..	×	×	..
Calycopsis papillata	..	×	×	..	..	..	..	..	×	..	..	..	..	..
Cnidostoma fallax	..	..	×	..	..	..	..	..	..	..	..	..	..	..
Cannota dodecantha	..	..	×	..	..	..	..	..	..	..	..	..	..	..
Podocoryne minuta	..	..	×	..	..	×	..	..	×	..	..	..	..	..
Dipurena halterata	..	..	×	..	..	×	×	..	×	..	..	..	..	..
Bougainvillia ramosa	..	..	×	..	×	×	×	×	..	..	..	..	..	..
Aequorea macrodactyla	..	..	×	×	..	..	×	..	×	×	..	×	×	..
Staurocladia capense	..	..	..	×	..	..	..	..	..	..	..	..	..	..
Podocoryne carnea	..	..	..	×	..	×	×	×	..	..	..	..	×	..
Heterotiara anonyma	..	..	..	×	..	..	..	..	×	..	..	×	×	×
Zygocanna vagans	..	..	..	×	..	..	..	..	..	..	..	×	×	..
Phialidium simplex	..	..	..	×	..	..	..	..	(×)	×	..	×	..	..
Eucheilota ventricularis	..	..	×	..	×	..	..	×	×	..	..	..	..	..
Aequorea coerulescens	..	..	..	×	..	..	..	..	..	×	..	×	×	..
Sarsia gracilis	..	..	..	×	..	..	..	..	..	×	..	..	..	..
Halitholus intermedius	..	..	..	×	..	..	..	..	..	×	..	..	..	..
Cosmetirella davisi	..	..	..	×	..	..	..	..	..	×	×	..	..	..
Mitrocomella frigida	..	..	..	×	..	..	..	..	..	..	×	..	..	..
Number of species	8	28	20	17	6	19	17	16	22	9	2	17	11	3
		38												

owing to the fluctuations of this current the temperatures of the upper water layers are subject to rather considerable seasonal variations, the isotherms being particularly close together at Cape Blanco in summer, at Cape Verde in winter. It may be designated as a transitional area, but the temperature conditions are predominantly tropical (annual mean temperature at the surface 19—25°), and it further differs from the Mauretanian coast in a less pronounced upwelling of cold water from deeper strata.

The fauna of this province is insufficiently known. Only 8 species of neritic hydromedusae have been found, and with the exception of *Calycopsis typa*, which belongs to the West-Atlantic boreal region, all these

species are widely distributed from north-western Europe far southwards off the African coast, four of them even to South Africa. They also occur in the Mediterranean, except *Phialopsis diegensis* which has a partly oceanic distribution. Moreover 5 species occur in Indo-West-Pacific waters.

2. Cape Verde to Cape Lopez, from about 14° N. to 1° S.—The Mid-Atlantic Counter Current between the North and South Equatorial Currents continues eastwards along the northern coast of the Gulf of Guinea under the name of the Guinea Current. Its northern limit is variable, in the northern summer near Cape Verde, in winter deplaced somewhat more to the south. During its eastward progression the Guinea Current keeps close to the coast, forming eddies in the various bights, as a swiftly running, warm current with only slight seasonal variations of the temperature, until in the innermost corner of the Gulf of Guinea it meets the South Equatorial Current, approximately at Cape Lopez. The eddies in the bights may involve some upwelling of cold water from the deeper strata, especially during the northern summer, when the velocity of the main current is particularly high.

From this section of the African coast 28 species of neritic hydromedusae are known, among which 7 species have not been observed elsewhere, each of them being found in only one or two localities. Among the remaining 21 species, 13 occur in the Mediterranean, 11 in the East-Atlantic boreal region. There are also 11 species in common with the West-Atlantic boreal region, and 15 species occur in West-Atlantic tropical waters. On the other hand, only 11 of the species are known from the west coast of Africa south of Cape Lopez.

Apart from the 7 "endemic" species (which may perhaps be found later on in other areas), the fauna of this province, the most distinctly tropical part of the West-African coast, consists mainly of species with an extensive distribution in boreal as well as in tropical waters, and with a considerable admixture of West-Atlantic species, most of which (10 species) occur in boreal as well as in tropical American waters.

3. Cape Lopez to Great Fish Bay, from about 1° S. to about 17° S. The South Equatorial Current originates off this part of the coast, whence it flows westwards across the ocean. The cold Benguela Current leaves the African coast in the surroundings of Great Fish Bay, but its cooling effect is traced in the South Equatorial Current, especially in its intermediate water layers; the warm surface layer, therefore, is particularly thin along the coast of this province, and upwelling of cold water may take place off the southern part of the coast.

The number of species of neritic hydromedusae recorded from this province amounts to only 20, and one of these, *Neoturris pileata*, has been found only in two off-shore localities far from land. The only "endemic" species are *Cnidostoma fallax* and the somewhat doubtful *Cannota dodecantha*. 11 species also occur in the province between Cape Lopez and Cape Verde, and 6 north of Cape Verde. The distribution of 7 species is extended further south into the South-African region, but all of these are widely distributed species which also occur in European waters. 12 species occur in the Mediterranean, 10 in the East-Atlantic boreal region.

Thus also the fauna between Cape Lopez and Great Fish Bay consists mainly of species with an extensive distribution from north to south. Moreover as many as 15 species occur in the western Atlantic, 8 of them being restricted to the tropical region. The 4 species which have been found in the West-Atlantic antiboreal region all have a wide distribution, whereas none of the species which are characteristic inhabitants of antiboreal waters have been found off the African coast north of Great Fish Bay. Six species occur in the Indo-West-Pacific region.

General remarks. As will be demonstrated in the next chapter the fauna of neritic hydromedusae in the West-Atlantic tropical region is not merely much richer (partly due to more intensive collections), but also more characteristic, than the East-Atlantic tropical fauna. The temperatures of the upper water layers may arise to about the same values on both sides of the ocean, but the regions, which may be termed tropical, have a much larger extension along the American than along the African coasts. The mean annual temperature at the surface is above 20° from about 28° S. to about 35° N. in America, but only from about 17° S. to 20° N. in Africa, and above 25° between about 18° S. and 30° N. in the American waters, between about 4° S. and 12° N. on the coast of Africa. Moreover the surface layer of warm water is considerably thinner

along the African than along the American coasts, hardly reaching down to 100 m. below the surface in most parts of the African waters. Since the neritic medusae are generally derived from sessile hydroids, it may also be noticed that the sandy bottom off the open West-African coast, which is directly exposed to the oceanic waves, is not favourable to littoral, fixed polypoid animals. This circumstance may also have a restricting influence on the composition and richness of the fauna.

A general survey of the fauna of neritic hydromedusae found off the tropical west coast of Africa is illustrated in Table VI.

The total number of species is 38, nine of which are "endemic". It will first be noticed that among the other 29 species no less than 18 occur in the Mediterranean and 16 in the East-Atlantic boreal region. All of the 8 species (apart from the "endemic") which do not occur in European waters occur in American-Atlantic waters, 6 of them in the boreal as well as in the tropical region. Altogether 22 of the 29 species have been found in the western Atlantic; only 7 of these are restricted to the tropical parts of the American coasts, and with only one exception (*Calycopsis papillata*) they also occur in the Mediterranean or in north-western Europe.

All this shows that the fauna along the tropical west coast of Africa is not a predominantly tropical fauna. On the other hand, none of the species occur in arctic or antarctic waters.

13 species occur in the Indo-West-Pacific region, and all of them are widely distributed in the Atlantic.

The proportional numbers are not conspicuously different in the different provinces, considering that one of the three provinces (between Cape Verde and Cape Lopez) is much better investigated than the two others. It should be noticed, however, that among the species occurring in American waters, those which are restricted to their tropical parts predominate in the southernmost province, but not in the median, most distinctly tropical African province.

VI. The South-West-African Region.

The Atlantic coast of South Africa is exposed to the cooling influence of the Benguela Current, which is derived from the West Wind Drift in the southern Atlantic and mixed with water of antarctic origin. Moreover a considerable upwelling of cold water from moderate depths takes place along the coast, carrying great amounts of plant nutrients towards the surface and thereby giving favourable conditions for a large population of pelagic organisms. The hydrographical conditions in the South-African region are, however, complicated by admixture of water of other origins, especially from the warm Agulhas Current which from the southern part of the east coast of Africa turns westwards and becomes mixed with the cold water of the West Wind Drift. The complicated conditions are well illustrated in the adjacent map (fig. 322). In accordance herewith the pelagic fauna off the southern and western coasts of South Africa is a mixed fauna. The northern limit of the region is around Great Fish Bay, where the main body of the Benguela Current turns westwards and leaves the African coast.

In this region 17 species of neritic hydromedusae have been found, and several more species may be expected, when the area is better investigated. Among these 17 species, 7 occur further north off the tropical parts of the west coast of Africa, 6 of them even in the East-Atlantic boreal region.

Table VI. Number of species of neritic hydromedusae in the East-Atlantic tropical and the South-West African regions and their further distribution.

	West-African tropical provinces				South-west African region
	1	2	3	total	
Total number of species	8	28	20	38	17
Endemic species	0	7	2	9	1
Mediterranean	6	13	12	18	6
East Atlantic boreal	7	11	10	16	7
West Atlantic boreal	5	11	7	14	4
West Atlantic tropical	4	16	14	20	8
West Atlantic antiboreal	2	3	4	4	9
Eastern Atlantic					
Only further north	0	7	11	14	8
Only further south	0	3	0	0	..
Both north and south	7	8	5	7	..
Western Atlantic					
Only boreal	2	0	2	3	1
Only tropical	1	5	8	8	4
Boreal and tropical	4	11	5	12	3
Indo-West-Pacific	5	11	8	13	9

With the exception of *Podocoryne carnea*, which is a predominantly boreal species, of which an isolated occurrence is recorded from South Africa, none of the remaining species occur in other parts of the eastern Atlantic. One species, *Staurocladia capensis*, is endemic in the region (unless it may turn out to be identical with *S. vallentini* which occurs at the Falkland Islands). *Zygocanna vagans* is an inhabitant of the Malayan Archipelago and eastern Pacific with two isolated records in the Atlantic: South-West Africa and near the Azores. *Heterotiara anonyma* is likewise mainly an Indo-Pacific species, but it also occurs in the warm parts of the western Atlantic. The distribution of *Aequorea coerulescens* is predominantly Pacific, but it is also recorded from the Falkland Islands. Altogether 9 of the South-West African species occur in Indian or Pacific waters.

Of particular interest is the occurrence in the South-West African region of 5 species which belong to antiboreal or even antarctic waters. *Sarsia gracilis* and *Halitholus intermedius* are known only from the Falkland Islands and South Africa. *Phialidium simplex* likewise occurs at the Falkland Islands and South Africa but has also been recorded from a locality further north on the coast of South America (30° N.) and from Australia. *Cosmetirella davisi* has a circumpolar distribution in antarctic and antiboreal waters, and it has been found in some localities from the Cape of Good Hope almost to Great Fish Bay. *Mitrocomella frigida* is recorded from two localities near the Indian and Pacific sectors of the Antarctic Continent and from South Georgia in the southern Atlantic, and also this antarctic species has been found in the South-West African region.

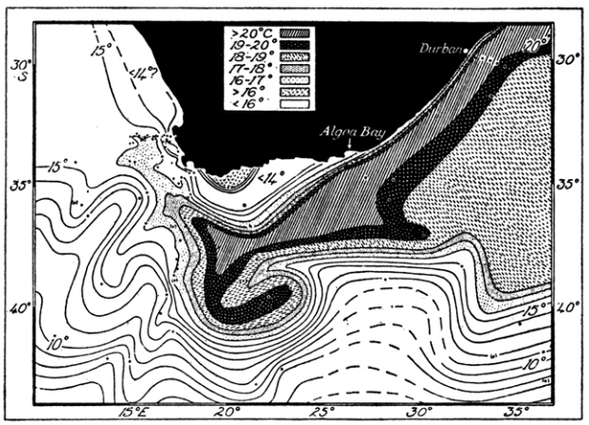


Fig. 322. Distribution of water of different temperatures at a depth of 50 m. in the month of October off the South-African coast (after STEPHENSON, from EKMAN).

The occurrence of these five species in this region has recently been discussed by me (KRAMP 1957 p. 97), as follows: "All these medusae are so small that presumably their pelagic life is of short duration and they have little chance of being carried long distances by the currents. The nearest shallow-water area is the plateau of Bouvet Island, which is about 1300 miles away from South Africa. We must presume, therefore, that there is an indigenous, local population of these species in South African coastal waters . . . . . the occurrence of these southern species must presumably be explained as being due to the cooling influence of the Benguela Current." (See the maps, fig. 333 and 334, p. 267).

The composition of the fauna of neritic hydromedusae in the South-West African region is summarized in conjunction with the survey of the tropical fauna in the table above, p. 227, which gives an impression of the mixed character of the fauna.

VII. The West-Atlantic Tropical Region.

In contradistinction to the boreal region which has a narrow extension in the western Atlantic, compared with the wide extent of the East-Atlantic boreal region, the tropical region comprises a very extensive part of the American coasts, from Cape Hatteras (34° N.) to Montevideo (35° S.). The region may be divided into five provinces, but in one of them, the Gulf of Mexico, the fauna of neritic hydromedusae is almost unknown; the only species recorded up to now is *Gossea brachymera*. This province will, therefore, be entirely disregarded in the following discussion. Geographically the Tortugas at the southern point of Florida might be regarded as belonging to the Gulf of Mexico; but since the whole area from the Tortugas to Cape Hatteras is washed by the Florida Current, and most of the species which are known from the coasts of North and South Carolina and Georgia also occur at the Tortugas, these islands are more properly dealt with as belonging to the first province, Cape Hatteras to Florida. The other provinces, the Caribbean Sea, the north

Table VII. Neritic species in the West-Atlantic tropical region.

	West-Atlantic tropical												
	Cape Hatteras to Florida	Caribbean Sea	Trinidad to Cape San Roque	Cape San Roque to Montevideo	Antiboreal	West-Atlantic boreal	East-Atlantic boreal	Mediterranean-Atlantic	East-Atlantic tropical	South-African	Indo-West-Pacific tropical	East-Pacific tropical	North-Pacific
Rathkea octopunctata	(×)	..	..	..	..	×	×	×	..	..	..	..	×
Paratiara digitalis	×	..	..	..	..	..	×	..	..	..	..	..	..
Pandea conica	×	..	..	..	×	..	..	×	×	×	×	..	..
Cnidotiara gotoi	×	..	..	..	..	..	..	..	..	..	×	..	..
Scolionema suvaensis	×	..	..	..	..	..	..	×	..	..	×	..	..
Linvillea agassizi	×	..	..	..	..	×	..	..	..	..	..	..	..
Ectopleura dumortieri	×	..	..	×	..	×	×	×	×	×	×	×	..
Nemopsis bachei	×	..	..	..	..	×	×	..	..	..	..	..	..
Phialidium bicophorum	×	..	..	..	..	×	..	..	..	..	..	..	×
Margelopsis gibbesi	×	..	..	..	..	..	..	..	..	..	..	..	..
Eirene gibbosa	×	..	..	..	..	..	..	..	..	..	..	..	..
Eutima variabilis	×	..	..	..	..	..	..	..	..	..	..	..	..
Eutima cuculata	×	..	..	..	..	..	..	..	..	..	..	..	..
Turritopsis nutricula	×	..	..	..	..	×	×	×	×	..	×	..	..
Cladonema radiatum	×	..	..	..	..	..	×	×	..	..	×	..	×
Amphinema dinema	×	..	..	..	..	×	×	×	×	..	×	..	..
Aequorea aequorea	×	..	..	..	×	×	×	×	×	×	(×)	..	..
Niobia dendrotentaculata	×	..	..	..	..	×	..	..	..	..	×	..	..
Dipurena strangulata	×	..	..	..	..	×	..	..	×	..	..	..	..
Pennaria tiarella	×	..	..	..	..	×	..	..	..	..	..	..	..
Bougainvillia carolinensis	×	..	..	..	..	×	..	..	×	..	..	..	..
Stomotoca pterophylla	×	..	..	..	..	×	..	..	×	..	..	×	..
Phialidium languidum	×	..	..	..	..	×	..	..	..	..	..	..	..
Phialidium folleatum	×	..	..	..	..	×	..	..	..	..	..	..	..
Eucheilota ventricularis	×	..	..	..	..	×	..	×	×	..	..	..	..
Eucheilota duodecimalis	×	..	..	..	..	×	..	..	..	..	..	×	..
Eutima mira	×	..	..	..	..	×	..	..	..	..	..	..	..
Zancleopsis dichotoma	×	..	..	..	..	..	..	..	..	..	..	..	..
Lovenella bermudensis	×	..	..	..	..	..	..	..	..	..	..	..	..
Aequorea floridana	×	..	..	..	..	..	..	..	..	..	..	..	..
Phialucium carolinae	×	..	..	..	..	..	..	..	..	..	×	..	..
Toxorchis kellneri	×	..	..	..	..	×	..	..	..	..	..	..	..
Dipurena halterata	×	..	..	..	..	..	×	×	×	..	..	..	..
Merga violacea	×	..	..	..	..	..	..	×	..	..	×	×	..
Hybocodon forbesi	×	..	..	..	..	..	..	..	..	..	×	..	..
Lizzia gracilis	×	..	..	..	..	..	..	..	..	..	×	..	..
Köllikerina elegans	×	..	..	..	..	..	..	..	..	..	×	..	..
Staurodiscus tetrastaurus	×	..	..	..	..	..	..	×	..	..	×	..	..
Amphinema turrida	×	..	..	..	..	..	..	..	..	..	×	×	..
Halitiara formosa	×	..	..	..	..	..	..	..	..	..	×	..	..
Ectopleura minerva	×	..	..	..	..	..	..	..	..	..	×	..	..
Eucheilota paradoxica	×	..	..	..	..	..	..	..	..	..	×	..	..
Amphinema australis	×	..	..	..	..	..	..	..	..	..	..	×	..
Dicodonium floridana	×	..	..	..	..	..	..	..	..	..	..	..	..
Podocoryne minuta	×	..	..	..	..	..	..	×	×	..	..	..	..
Podocoryne dubia	×	..	..	..	..	..	..	..	..	..	..	..	..
Bougainvillia frondosa	×	..	..	..	..	..	..	..	..	..	..	..	..
Dipleurosoma ochracea	×	..	..	..	..	..	..	..	..	..	..	..	..
Melicertissa mayeri	×	..	..	..	..	..	..	..	..	..	..	..	..
Phialidium globosum	×	..	..	..	..	..	..	..	..	..	..	..	..
Phialidium gelatinosum	×	..	..	..	..	..	..	..	..	..	..	..	..
Phialella parvigastra	×	..	..	..	..	..	..	..	..	..	..	..	..
Eirene lactea	×	..	..	..	..	..	..	..	..	..	..	..	..
Sarsia angulata	×	..	..	..	..	..	..	..	..	..	..	..	..
Pachycordyle degeneratus	×	..	..	..	..	..	..	..	..	..	..	..	..
"Dipleurosoma" collapsa	×	..	..	..	..	..	..	..	..	..	..	..	..
Netocertoides brachiatum	×	..	..	..	..	..	..	..	..	..	..	..	..
Toxorchis brooksi	×	..	..	..	..	..	..	..	..	..	..	..	..
Phialidium mccradyi	×	..	..	..	..	..	..	..	..	..	..	..	..
Eutima coerulea	×	..	..	..	..	..	..	..	..	..	..	..	..
Cubaia aphrodite	×	..	..	..	..	..	..	..	..	..	..	..	..
Gossea brachymera	(×)	..	..	..	×	..	..	..	..	..	..	×	..
Zanclea costata	×	×	..	..	..	×	×	×	×	..	×	×	..
Amphinema rugosum	×	×	..	..	..	×	×	×	..	..	×	..	..
Rhacostoma atlanticum	×	×	..	..	..	×	..	..	×	..	..	..	..

Table VII. (Continued)

	West-Atlantic tropical				Antiboreal and antarctic	West-Atlantic boreal	East-Atlantic boreal	Mediterranean-Atlantic	East-Atlantic tropical	South-African	Indo-West-Pacific tropical	East-Pacific tropical	North-Pacific
	Cape Hatteras to Florida	Caribbean Sea	Trinidad to Cape San Roque	Cape San Roque to Montevideo									
Dichotomia cannoides	×	×	..	..	..	..	..	..	..	..	..	..	..
Bougainvillia niobe	×	×	..	..	..	..	..	..	..	..	..	..	..
Heterotiara anonyma	×	×	..	..	..	..	..	..	..	×	×	×	×
Eutiara mayeri	×	×	..	..	..	..	..	..	..	..	..	..	..
Dicodonium jeffersoni	×	×	..	..	..	..	..	..	..	..	..	..	..
Orchistoma pileus	×	×	..	..	..	..	..	..	..	..	..	..	..
Eirene pyramidalis	×	×	..	..	..	..	..	..	..	..	..	..	..
Calycopsis papillata	×	×	..	..	..	..	..	..	×	..	..	..	..
Aequorea macrodactyla	×	×	..	..	×	..	×	..	×	×	×	×	..
Laodicea undulata	×	×	..	×	×	×	×	×	×	×	..	..	..
Bougainvillia platygaster	×	×	..	×	..	..	..	×	×	×	×	..	..
Phialidium discoidum	×	×	..	×	..	..	..	..	..	..	..	..	..
Proboscidactyla ornata	×	..	..	×	..	(×)	..	..	×	..	×	×	..
Olindias phosphorica	×	..	..	×	..	..	..	×	×	..	..	..	..
Cirrhitiara superba	×	..	×	..	..	..	..	..	..	..	×	..	..
Euphysora gracilis	×	..	..	×	..	×	..	..	..	..	..	..	..
Phialidium ovalis	×	..	..	×	..	..	..	..	..	..	..	..	..
Vallentinia gabriellae	×	..	..	×	..	..	..	..	..	..	..	..	..
Oceania armata	..	×	..	..	..	..	..	×	×	..	×	..	..
Eucheilota comata	..	×	..	..	..	..	..	..	..	..	..	×	..
Octophialucium sp.	..	×	..	..	..	..	..	..	..	..	..	..	..
Dicodonium punctatum	..	..	×	..	..	..	..	..	..	..	..	..	..
Lovenella cirrata	..	..	×	..	..	..	..	×	×	..	..	..	..
Phialidium brunescens	..	..	×	..	..	..	..	..	..	..	×	..	..
Stauridiosarsia producta	..	..	..	×	..	..	×	..	..	..	..	..	..
Phialopsis diegensis	..	..	..	×	..	..	×	×	×	×	×	×	×
Phialidium noliformis	..	..	..	×	..	..	..	×	..	..	..	..	..
Thamnostoma tetrella	..	..	..	×	..	..	..	..	..	..	..	..	..
Dipurena reesi	..	..	..	×	..	..	..	..	..	..	..	..	..
Phialidium simplex	..	..	..	(×)	×	..	..	..	..	×	×	..	..
Number of species	83	18	4	15	6	25	15	22	22	9	30	13	5
	96												

coast of South America from Trinidad to Cape San Roque, and the east coast down to Montevideo, are characterized by the prevailing water masses. Unfortunately their faunas are insufficiently known.

1. Cape Hatteras to Florida.—The water masses derived from the Equatorial Currents and accumulated in the Carribean Sea and the Gulf of Mexico escape with great velocity through the channel between Florida and Cuba, the Straits of Florida, whence they follow the coast northwards; this is the Florida Current, which at Cape Hatteras leaves the coast and continues eastwards as the Gulf Stream. The coastal waters from the southern point of Florida to Cape Hatteras thus constitute a well characterized province of the tropical region, though in their northern portion they might rather be called subtropical. The passages between the Bahama Islands receive some influx of water from the east, but their fauna of medusae is so closely related to that of southern Florida that it seems natural to regard these faunas as belonging to one and the same province.

No less than 83 species of neritic hydromedusae have been found within this province, some parts of which are particularly well investigated, especially around the Tortugas, Florida, whence A. G. Mayer has described several new species.

The first 13 species in Table VII occur from Cape Hatteras southwards, but do not penetrate as far as Florida. *Rathkea octopunctata* is a northern species which has been found as a stray visitor near the Bermudas but nowhere else south of Cape Hatteras. The predominantly tropical species *Scolionema suvaensis* has likewise been found at the Bermudas only. *Paratiara digitalis, Pandea conica* and *Cnidotiara gotoi* have only

been taken in off-shore localities and not in the coastal area of the province under consideration. The subsequent 8 species belong to the coastal area proper, the first four of them also occur north of Cape Hatteras; *Margelopsis gibbesi, Eirene gibbosa, Eutima variabilis* and "*Eutima*" *cuculata* are endemic in this northern part of the province.

The next 18 species in the table all occur at the Tortugas in southern Florida (four of them also among the Bahamas) as well as further north in the province where, however, *Cladonema radiatum, Zancleopsis dichotoma, Lovenella bermudensis* and *Aequorea floridana* have been recorded only from the Bermudas. The three latter species are endemic in the province. None of these 18 species are known from the tropical American provinces south of Florida-Bahamas, whereas no less than 13 occur in the boreal region. *Toxorchis kellneri* is recorded from the Tortugas and the Gulf of Maine, but not from the intervening part of the American coast.

A very considerable number of species (29) are known from no other American localities than Florida and the Bahamas, and 18 of these from no other places in the world. *Dipurena halterata* and *Merga violacea* occur in European waters, 9 other species in the Indian or Pacific Oceans (see the table). Altogether 25 species may up to now be regarded as "endemic" in the province between Cape Hatteras and Florida-Bahamas.

Gossea brachymera must be specially mentioned. It has a peculiar distribution, being recorded from the coast of Louisiana in the Gulf of Mexico, Acapulco Harbour on the Pacific coast of Mexico, and from the eastern entrance to the Strait of Magellan.

The remaining 22 species occurring in the province from Florida and the Bahamas northwards have also been found in the Caribbean Sea or further south and will be mentioned below.

2. The Caribbean Sea, including also the external coasts of the West-Indian chain of islands.—*Halmomises lacustris,* which was found in fresh water at Trinidad, is omitted from the table.

The Caribbean Sea receives a considerable influx of water from the South Equatorial as well as from the North Equatorial Currents, which continue into the Gulf of Mexico, where complicated swirls are formed, and finally leave the area through the Straits of Florida. From this distinctly tropical province 18 species of neritic hydromedusae are recorded, but many more might probably be found. 15 species also occur at Florida or the Bahamas or further north, 4 of them even in the boreal region. There are only three species which have not been found in the northerly province (Florida to Cape Hatteras); one of these, *Oceania armata,* is an East-Atlantic and Mediterranean species, of which a few specimens were collected by the "Dana" near the Virgin Islands. *Eucheilota comata* has been observed only at Guadeloupe in the West Indies and on the Pacific coast of Mexico; the third is an undetermined species of *Octophialucium* described above (p. 36). Eight of the Caribbean species occur off the west coast of Africa, and 8 in the Indian or Pacific Oceans.

3. Trinidad to Cape San Roque.—The north coast of South America outside the Caribbean Sea is, throughout its length, washed by the South Equatorial Current. The fauna is very deficiently known, only 4 species of neritic hydromedusae have been recorded. *Dicodonium punctatum* has not been found in any other localities; *Lovenella cirrata* occurs in the Mediterranean and on the west coast of Africa, *Phialidium brunescens* is known only from the Nicobar Islands in the Indian Ocean, *Cirrhitiara superba,* which occurs at Florida and the Bahamas, is recorded by THIEL from a locality far outside the north coast of Brazil and has moreover been found in north-eastern Australia. All these species thus occur in distant parts of the world.

4. Cape San Roque to Montevideo.—The South Equatorial Current is divided off Cape San Roque, giving origin to a south-going branch, the Brazil Current, which follows the coast until, in the neighbourhood of Montevideo, it meets the north-going Falkland Current. The prominent point Cape Frio might be supposed to mark a faunistic boundary, but the medusan fauna north of this point is almost unknown, whereas parts of the Brazilian coast further south are fairly well examined in this respect, mainly thanks to the investigations carried on in later years by Mrs. M. VANNUCCI at São Paulo.

Altogether 15 species of neritic hydromedusae are recorded from this province. Two species, *Thamnostoma tetrella* and *Dipurena reesi,* have not been observed anywhere else (besides *Aglauropsis agassizi* of which no

adequate description was given by F. MÜLLER). The following 4 species have an extensive distribution: *Laodicea undulata, Ectopleura dumortieri, Phialopsis diegensis,* and *Proboscidactyla ornata.* The hydroid of *Phialidium noliformis* is widely distributed, but the medusa has been observed (reared in aquaria) only in the Mediterranean and at São Paulo.

Among the remaining 8 species the occurrence of *Stauridiosarsia producta* at Santos in Brazil is peculiar, since this species belongs to the boreal waters in north-western Europe (besides a doubtful record from the Adriatic Sea). *Olindias phosphorica,* which occurs in the Mediterranean and on the west coast of Africa, and also at Florida and the Bahamas and Bermudas (as forma *tenuis*) is represented on the Brazilian coast by a variety with particularly many centripetal canals, forma *sambaquinensis.* Owing to its propagation by budding *Bougainvillia platygaster* has a partially oceanic distribution in the warm parts of the Atlantic Ocean (and off the east coast of Africa), and it has been found in several localities off the Brazilian coast. *Phialidium discoidum, Phialidium ovalis* and *Vallentinia gabriellae* are purely American species, each of them recorded from a single locality on the east coast of Brazil and also found at Florida and in the West Indies.

From a zoogeographical point of view the most interesting among the species recorded from this province is *Phialidium simplex.* It was originally described from the Falkland Islands and most probably belongs to the antiboreal region, whence it has spread to South Africa and to Australia; its occurrence east of Rio Grande do Sul in Brazil (about 30° S.) was probably due to an exceptional northward extension of the Falkland Current.

Among the 15 species recorded from this province 3 have been found in the Caribbean Sea (where several more will probably be collected by future investigations), 9 between Florida and Cape Hatteras, but only 3 in the West-Atlantic boreal region, whereas 4 of the species occur in East-Atlantic boreal waters, all of them species with an extensive distribution.

General remarks.—A general survey of the fauna of neritic hydromedusae in the West-Atlantic tropical region is illustrated in Table VIII.

The bottom conditions in the greater parts of this region are favourable to the settlement of fixed polypoid animals and may contribute to the richness of the fauna of free-swimming neritic medusae, and future investigations in the Carribean Sea and along the South-American coasts will probably increase the number of species to a considerable degree.

Table VIII. Number of species of neritic hydromedusae in the West-Atlantic tropical region and their further distribution.

	West-Atlantic tropical provinces				
	1	2	3	4	total
Total number of species	83	18	4	15	96
Endemic species	24	1	1	2	37
West-Atlantic boreal	25	4	0	3	25
East-Atlantic boreal	13	4	0	4	15
Mediterranean-Atlantic	18	5	1	6	22
East-Atlantic tropical	19	7	1	6	22
South-African	7	4	0	5	9
Indo-Pacific	32	7	2	5	37

In comparing the faunas of the four provinces we must entirely disregard the third province, Trinidad to Cape San Roque, which is particularly deficiently investigated. In spite of the fact that also the faunas of the second and fourth provinces are insufficiently known in comparison with that of the first, northernmost province, the figures in the table give some impression of the difference between the faunas of these three sections of the American tropical waters.

The figures show a considerable decrease from north to south of the number of species which also occur in the American boreal region. In percentage of the total number found in each of the three provinces the number of species in common with the boreal region decreases from 30 % in the northernmost and 22 % in the Caribbean Sea to 20 % in the southernmost province. On the other hand, the number of species, which also occur in the warm parts of the East-Atlantic regions, increases from north to south in the West-Atlantic tropical region, as follows: in common with the Mediterranean-Atlantic region 22—28—40 %, in common with the East-Atlantic tropical region 23—39—40 %.

Among the 96 species found in the entire region 67 are restricted to the tropical parts of the American waters; 24 of these species also occur in other parts of the world and exclusively in warm regions (including

the Mediterranean Sea and the South-African region). This means that the distribution of about 70 % of the species is restricted to warm-water regions. Among the 36 species known from the East-Atlantic tropical region 9 species are purely tropical and 4 occur in the Mediterranean as well as in the tropics. The West-African fauna thus comprises 13 species which occur in warm-water regions only i. e. 36 % in comparison with 70 % in the American tropical region. This confirms the statement above (p. 228) that the fauna in the West-Atlantic tropical region has a much more pronouncedly tropical character than that in the East-Atlantic tropical region.

39 % of the species known from the West-Atlantic tropical region occur in the Indian or Pacific Oceans, *viz* 18 species in the Indian Ocean, 10 in the Malayan Archipelago, 11 in Australian waters, 13 in Japan, 4 in the northern Pacific, and 13 in the eastern tropical Pacific. Details will be discussed in a subsequent chapter (pp. 268—272).

VIII. The Antarctic and Antiboreal Regions.

The limit between the antarctic and the antiboreal regions is the Antarctic Convergence, the mean position of which lies between 50—55° S. all around the polar area, though in certain places its position is related to the bottom configuration. Thus in the Drake Passage between the southern point of South America and Graham Land in the Antarctic Continent the convergence is as far south as at about 60° S., and it makes a sharp bend

Table IX. Neritic species in the antarctic and antiboreal regions.

	Antarctic		Antiboreal										
	Atlantic sector	Indian and Pacific sectors	Atlantic sector	Indian and Pacific sectors	West-Atlantic tropical	West-Atlantic boreal	Arctic	East-Atlantic boreal	Mediterranean-Atlantic	East-Atlantic tropical	South-African	Indo-West-Pacific	East-Pacific
Propachycordyle canalifera	×	..	..	..	..	..	..	..	..	..	..	..	..
Staurocladia hodgsoni	×	×	..	..	..	..	..	..	..	..	..	..	..
Margelopsis australis	×	×	..	..	..	..	..	..	..	..	..	..	..
Köllikerina maasi	×	×	..	..	..	..	..	..	..	..	..	..	..
Zanclonia weldoni	×	×	..	..	..	..	..	..	..	..	..	..	..
Ptychogena antarctica	×	×	..	..	..	..	..	..	..	..	..	..	..
Phialidium iridescens	×	×	..	..	..	..	..	..	..	..	..	..	..
Mitrocomella frigida	×	..	..	..	..	..	..	..	..	..	×	..	..
Tiaricodon coeruleus	×	..	×	..	..	..	..	..	..	..	..	..	×
Staurocladia vallentini	×	..	×	..	..	..	..	..	..	..	..	..	..
Cosmetirella davisi	×	×	×	×	..	..	..	..	..	..	×	..	..
Rathkea formosissima	..	..	×	..	..	..	..	..	..	..	..	..	..
Podocoryne tenuis	..	..	×	..	..	..	..	..	..	..	..	..	..
Aglauropsis conanti	..	..	×	..	..	..	..	..	..	..	..	..	..
Vallentinia falklandica	..	..	×	..	..	..	..	..	..	..	..	..	..
Proboscidactyla mutabilis	..	..	×	..	..	..	..	..	..	..	..	..	..
Bougainvillia macloviana	..	..	×	×	..	..	..	×	..	..	..	..	..
Laodicea pulchra	..	..	×	×	..	..	..	..	..	..	..	..	..
Hybocodon unicus	..	..	×	..	..	..	..	..	..	..	..	×	..
Phialella falklandica	..	..	×	×	..	..	..	..	..	..	..	..	×
Sarsia gracilis	..	..	×	..	..	..	..	..	..	..	×	..	..
Halitholus intermedius	..	..	×	..	..	..	..	..	..	..	×	..	..
Phialidium simplex	..	..	×	..	(×)	..	..	..	..	..	×	×	..
Aequorea coerulescens	..	..	×	..	..	..	..	..	..	..	×	×	×
Gossea brachymera	..	..	×	..	×	..	..	..	..	..	..	..	×
Aequorea macrodactyla	..	..	×	..	×	..	..	×	..	×	×	×	×
Pandea conica	..	..	×	..	×	..	..	..	×	×	×	×	..
Aequorea aequorea	..	..	×	..	×	×	..	×	×	×	×	(×)	..
Laodicea undulata	..	..	×	..	×	×	..	×	×	×	×	..	..
Euphysa aurata	..	..	×	..	..	×	×	×	×	..	..	..	..
Staurophora mertensi	×	..	×	..	..	×	×	×	..	..	..	..	..
Halopsis ocellata	..	..	×	..	..	×	×	×	..	..	..	..	..
Number of species	12	7	24	4	6	5	3	7	4	4	10	6	5

between the Falkland Islands, which belong to the antiboreal region, and South Georgia, which must be considered as belonging to the antarctic region; but its fluctuations according to the seasons as well as from one year to another are remarkably small.

The Antarctic Convergence is marked by a sudden increase of the temperature brought about by sinking down of the cold antarctic surface water below the antiboreal surface water. As a matter of fact, the Antarctic Convergence constitutes a rather effective barrier between the antarctic and the antiboreal faunas of neritic medusae. It will be pointed out later (p. 252) that the difference between the two faunas also comprises the epipelagic oceanic medusae. The features of the deeper layers will likewise be discussed later in connection with the distribution of the oceanic species.

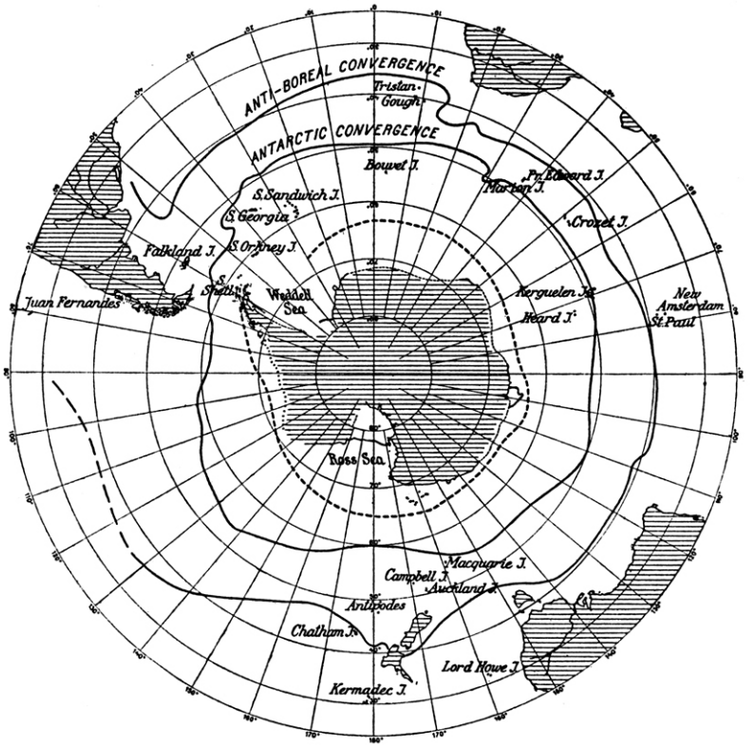


Fig. 323. The South Seas (after EKMAN).

Close to the Antarctic Continent the currents are usually directed from east to west, but the main body of the antarctic surface water moves eastwards, circulating around the continent under the influence of the prevailing westerly winds. Its temperature increases from about — 1° near the continent to 0° or about 1 or 2° at the Antarctic Convergence.

Within the antiboreal (sometimes called the subantarctic) region the current is likewise generally directed from west to east, but in several places it is deflected towards the north; e. g., on the eastern side of South America a branch, the Falkland Current, turns north, until it meets the warm, south-going Brazil Current at about 35° S., near Montevideo (see above, p. 233). The temperature of the antiboreal surface water increases slowly to about 10—12° in winter, about 14—15° in summer at the northern limit of the region, the Antiboreal Convergence, where another sudden increase of temperature takes place. The Antiboreal Convergence approximately follows the latitude of 40° S., but it is less sharply defined than the Antarctic Convergence.

The Antarctic Region.—In the Atlantic sector of this region 12 species of neritic hydromedusae have been collected, and at least 7 of them have a circumpolar distribution (see Table IX). *Propachycordyle canali-*

fera is known only from the Weddell Sea, and 6 other species have likewise never been taken outside the antarctic region, where all of them are circumpolar. *Mitrocomella frigida* is likewise a circumpolar and strictly antarctic species, but it has followed one of the north-going branches of the current and has been found west of the Cape of Good Hope. *Staurophora mertensi* is one of the predominantly boreal species which have a bipolar distribution; it has been found in several localities around the Falkland Islands, whence on a single occasion it has penetrated into the antarctic region and was taken at the South Orkney Islands. Apart from this only 3 of the antarctic species also occur in the antiboreal region.

The Antiboreal Region.—The only coastal areas within this region are South Island of New Zealand, a number of small islands in the Indian and Pacific Oceans, and the southern part of South America with the neighbouring Falkland Islands. The small islands Gough Island and Tristan da Cunha in the South Atlantic are likewise situated between the two convergences, whereas Bouvet Island belongs to the antarctic region, and the Antiboreal Convergence passes at a great distance south of Africa. The following discussion, therefore, will only come to deal with the waters off the South-American coast between Cape Horn and Montevideo, i. e. the water masses of the Falkland Current. Our knowledge of the fauna of medusae in this region is due mainly to the fairly intensive collections which have been carried out at the Falkland Islands, previously dealt with by Browne & Kramp (1939).

The number of species of neritic hydromedusae recorded up to now from these waters amounts to 24. Table IX immediately shows the great difference between this antiboreal fauna and the fauna in the antarctic waters further south. Besides *Staurophora mertensi*, which was mentioned above, only 3 species are common to the two areas. *Staurocladia vallentini* and *Tiaricodon coeruleus* occur in the surroundings of Graham Land and at the Falkland Islands; the latter is also recorded from the Strait of Magellan and from the coast of Peru, where its occurrence may be due to the cooling effect of the Peru Current, which is a branch of the circulating antiboreal West Wind Drift. *Cosmetirella davisi* is circumpolar in the antarctic region, and besides in the Falkland Current it has been found in some localities within the area of the Benguela Current off the southern part of the west coast of Africa between the Cape of Good Hope and Great Fish Bay (see above, p. 230). As previously stated by me (Kramp 1932 and 1949) specimens of this species taken in antiboreal regions generally attain a greater number of tentacles than specimens of corresponding size from antarctic waters.

The next 5 species in Table IX are endemic in the South-West-Atlantic antiboreal region, and the following 7 species likewise seem to be characteristic of the antiboreal region, but are distributed further east. All of them have been collected at the Falkland Islands, *Bougainvillia macloviana* also at Kerguelen Island in the Indian Ocean and the Campbell Island south of New Zealand; its occurrence in the North Sea in the East-Atlantic boreal region is undoubtedly due to transportation by ships. *Laodicea pulchra* occurs at Kerguelen, *Hybocodon unicus* is recorded from southern India, *Phialella falklandica* from the islands south of New Zealand and in the water of the Peru Current on the west coast of South America. *Sarsia gracilis, Halitholus intermedius* and *Phialidium simplex* have been found near the southern coast of Africa together with *Cosmetirella davisi* and *Mitrocomella frigida* (see above, p. 230 and Kramp 1957 p. 96). *Phialidium simplex* is also recorded from north-eastern Australia, and as mentioned above (p. 234) it has been taken as far north as 30° S. on the east coast of South America, probably as a stray visitor.

The distribution of *Aequorea coerulescens*, which likewise occurs at the Falkland Islands, follows the Benguela Current to South-West Africa and the Peru Current along the west coast of South America, but it has also been found in the central part of the North Pacific and at Japan, so that it cannot be reckoned among the characteristic species of the antiboreal region. Still more peculiar is the distribution of *Gossea brachymera*, which is recorded from the eastern entrance to the Strait of Magellan, the Gulf of Mexico, and the Pacific coast of Mexico (see above, p. 233).

The remaining 7 species in Table IX have their further distribution in more northerly waters. *Aequorea macrodactyla, Pandea conica, Aequorea aequorea* and *Laodicea undulata* are widely distributed in the Atlantic

Ocean from boreal or Mediterranean waters to South Africa, and the South-West-Atlantic antiboreal region marks the southern boundary of their distribution. *Euphysa aurata*, *Staurophora mertensi* and *Halopsis ocellata* are bipolar species. They belong to the boreal regions, penetrating more or less into the Arctic, and the former also occurs in the Mediterranean, but none of them have been found south of 40° N. Nevertheless they occur in the antiboreal waters around the Falkland Islands, quite isolated from their principal areas of distribution. The problem of bipolarity will be discussed in the concluding chapter of the present paper.

General remarks.—We see thus that the vast majority of the species occurring in the antarctic and antiboreal regions are characteristic of these regions. In my paper on the hydromedusae of the "Discovery" Expeditions (KRAMP 1957 pp. 96 and 98) I emphasized that in the south-western Atlantic the Antarctic Convergence constitutes a rather distinct barrier between the antarctic and the antiboreal faunas, whereas the antiboreal region receives a considerable admixture of species belonging to tropical waters derived from the Brazil Current, which becomes more or less mixed with the water of the Falkland Current. As seen from the above, apart from the three bipolar species, which presumably are indigenous in the area, there are only 4 neritic species for which the surroundings of the Falkland Islands constitute the southernmost outpost of their distribution, all of them widely distributed in both sides of the ocean and also occurring in boreal or at least in Mediterranean waters. *Pandea conica* has a partially oceanic distribution, the three others are fairly large medusae, presumably with a long duration of pelagic life, which favours their chance of being carried to remote areas from their normal habitats.

2. Slope species.

Before we proceed to the oceanic medusae, whose occurrence is independent of the coasts, it is necessary to mention some species which mainly occur in the deep water layers, but near the coasts. They are presumably all meropelagic, derived from hydroids attached to the bottom of the continental slopes outside the neritic areas. There are other meropelagic medusae which for various reasons are able to spread over the oceans, either in the upper or in the deep layers, and they will be treated in connection with the truly oceanic, holopelagic species. There is also the possibility, of course, that some of the species mentioned in the following as "slope species" may in the future be found in the open sea. On the whole, since most of them have been found only in one or a few localities, their occurrence does not give occasion for thorough zoogeographical discussions; but they must be enumerated, and I will arrange them according to their occurrence from north to south, with a concluding series of four species which seem to have an extensive distribution in the Atlantic, whence two of them have spread to the east coast of Africa, whereas none of the others have been observed outside the Atlantic area.

Greenland.—A single specimen of *Ptychogena hyperborea* was taken in Smith Sound in a haul with 675 m. wire out, at a temperature of — 0.7° (KRAMP 1942). *Paragotoea bathybia* was found in deep water in the southern part of Davis Strait, and in the present paper (p. 5) it is recorded from South Africa (see below).

Norway.—The following four species occur in some of the fjords on the west coast of Norway. The deep interior parts of the Norwegian fjords are separated from the ocean by a sill with more or less shallow water, which prevents the arctic bottom water of the Norwegian Sea from entering the fjord, where the temperature of the deep strata, therefore, is comparatively high, about 6—7° in the fjords south of Cape Stat, somewhat less in some fjords further north. The four species under consideration all occur in the deep strata of the fjords, but have not been found in the open sea off the coast.

Ptychogena crocea was found in Moldefjord (about 63° N.) and in Mangerfjord near Bergen, *Calycopsis simplex* in Hjörundfjord near Bergen. *Cyclocanna welshi* was taken in Mangerfjord near the bottom at about

300 m., and also at the bottom in the deepest part, 650 m., of the Skagerrak; this species also occurs off the east coast of North America, outside Chespeake Bay, where it was taken in the upper layers, 140—0 m., i. e. in the circulating "slope water" (see above, p. 213). *Octophialucium funerarium* occurs in several of the Norwegian fjords between about 60° and $63^1/_2$° N., usually at depths of more than 300 m., but in Trondheim Fjord it has on two occations been observed at the surface, which is explained by the occurrence of local convection currents carrying bathypelagic organisms towards the surface (Dons 1931 p. 25). This medusa is also common in deep and intermediate strata in the Mediterranean Sea; above the threshold at Gibraltar it may ascend towards the surface (see above, p. 36). Two records from deep water in the Atlantic, west of Scotland and in the Bay of Biscay, bridge the gap between the occurrences in Norway and the Mediterranean.

Off the mouth of the English Channel.—From deep water in an interesting locality near the entrance to the Channel, F. S. Russell has recently described three new species, *Amphinema krampi*, *Merga reesi*, and *Tiaropsidium atlanticum*.

Warm parts of the Atlantic Ocean.—Three species, each observed only once: *Leuckartiara grimaldii* was taken near the Azores (Ranson 1936); the actual depth of capture is not stated; the specimen was taken in a haul between 1000 m. and the surface, and we may suggest that it came from the deeper strata. The peculiar little medusa *Oonautes hanseni* was found in Cadiz Bay in a haul with 620 m. wire out (Damas 1936). *Gotoea similis* is described in the present paper (p. 5); it was taken in deep water (1500 m. wire out) near St. Helena in the South Atlantic.

Antarctic.—*Amphinema rubra* is likewise a species of which only one specimen has been observed (Kramp 1957); it was taken near the South Orkney Islands in a vertical haul, 500—250 m.

Species found in some widely separated areas.—*Calycopsis chuni* has been found in deep water in the West Indies, off the Mauretanian coast in north-western Africa, near the south coast of Africa, and on both sides of Cape Gardafui in the northern part of the east coast of Africa; near the island Ascension a specimen was taken in the upper strata, with 300 m. wire out (see above, p. 23). The captures of *Calycopsis bigelowi* are all from deep water, in two localities near the Cape of Good Hope and in one locality in the Gulf af Aden, thus in two widely separated areas. Still more widely separated are the two localities where *Paragotoea bathybia* has been collected, viz. the southern part of Davis Strait west of Greenland and near the Cape of Good Hope, on both occasions in deep water (1900—2000 m. wire out). It is a very small medusa and may live in other localities in the Atlantic, though presumably at no considerable distance from the coasts, being probably derived from hydroids growing on the slope (see above, p. 5). The deep part of Davis Strait is a direct northward continuation of the Atlantic deep-sea and does not constitute a part of the arctic region; the temperature of the water at the depths where this species was taken is nearly the same in the two distant localities, 3—4°.

In contradistinction to the preceeding species *Russellia mirabilis* occurs in two areas, which are not merely widely separated, but also very different in their hydrographical conditions. The medusa was found in a number of localities in purely antarctic waters, near the coasts west and east of Graham Land and near South Georgia (Kramp 1957), partly in very deep water (1450—1000 m.), partly at higher levels (400—120, 165—0, and 100—0 m.), thus at very low temperatures, partly below 0°, and in the present paper (p. 30) it is recorded from the West Indies, thus in a tropical region, though here it avoided the very warm water of the upper layers, but was taken in a haul with 1000 m. wire out, where the temperature was between 8 and 12°.

The group of "slope species" thus comprises 16 species, which have been found in very different parts of the Atlantic and adjacent seas, from high-arctic to antarctic regions (see the map, fig. 324). Only two species, *Octophialucium funerarium* and *Calycopsis chuni*, have been found in any noticeable number of localities, both of them medusae of rather considerable size, not likely to be overlooked in the catches. Most of the other species have been observed only once or twice and may be expected to turn up in new localities. It was a surprise, e. g., when *Paragotoea bathybia*, which I had described from Davis Strait in 1942, was found near the Cape of Good Hope in South Africa, and when the antarctic *Russellia mirabilis* was rediscovered in

West-Indian waters. Any attempts to draw zoogeographical conclusions from the scattered occurrences of these sixteen species would be premature. It should only be noted that, with the exception of the two *Calycopsis* species which have been found at the east coast of Africa, and *Russellia mirabilis* which was taken on both sides of the prominent peninsula Graham Land of the Antarctic Continent, none of the species have been observed outside the Atlantic area.

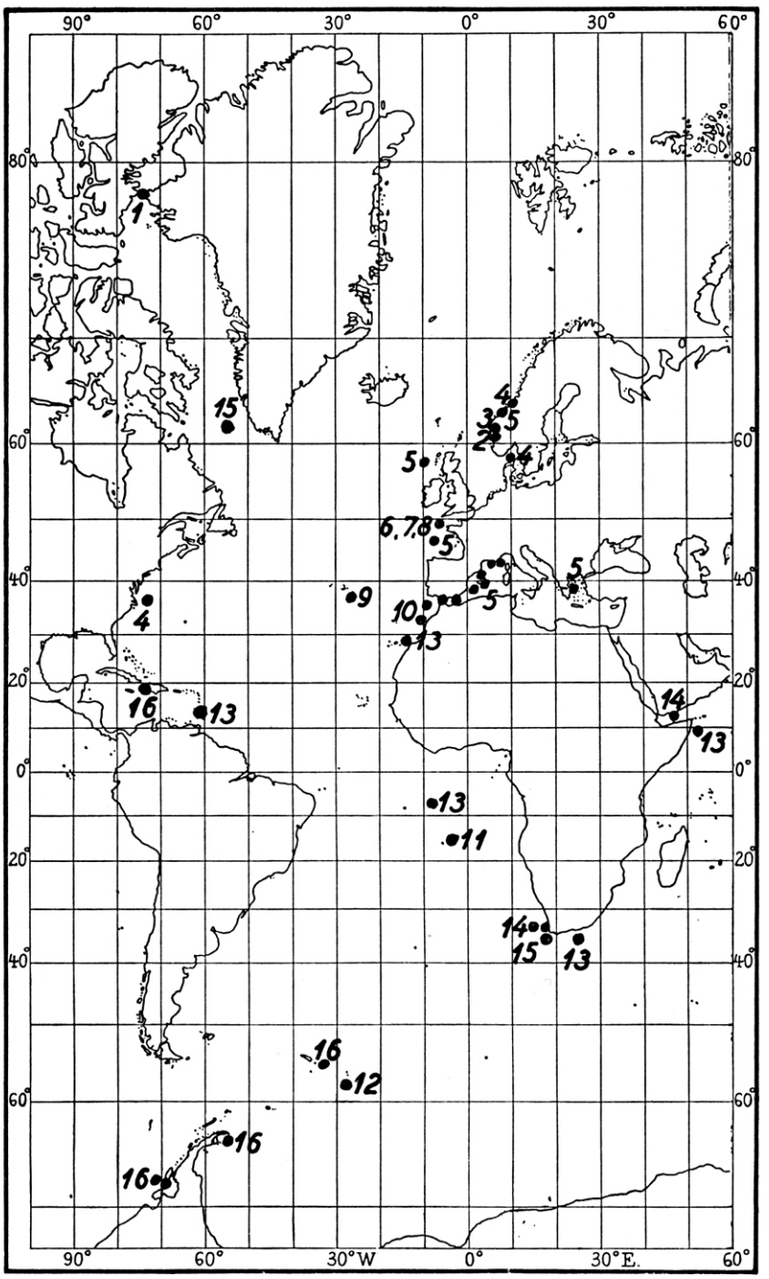


Fig. 324. Distribution of "slope species". 1. Ptychogena hyperborea. 2. Ptychogena crocea. 3. Calycopsis simplex. 4. Cyclocanna welshi. 5. Octophialucium funerarium. 6. Amphinema krampi. 7. Merga reesi. 8. Tiaropsidium atlanticum. 9. Leuckartiara grimaldii. 10. Oonautes hanseni. 11. Gotoea similis. 12. Amphinema rubra. 13. Calycopsis chuni. 14. Calycopsis bigelowi. 15. Paragotoea bathybia. 16. Russellia mirabilis.

3. Oceanic species.

Oceanic species are those which live in the free water-masses of the oceans and are not directly dependent on the coastal shelves. Indirectly their occurrence is influenced by the position and configuration of the continents, in so far as these are responsible for the directions of the sea-currents, which are of decisive importance to the distribution of the pelagic animals. The animals live and propagate where the physical conditions are suitable to them; but the currents may carry them to areas with unfavourable conditions, too low or too high temperature or salinity, lack of oxygen, or insufficiency of reliable food. They may perhaps survive for some time, but are unable to propagate; they have reached an "expatriation area", where they are found only as stray visitors. Medusae do not migrate actively over any considerable distances, but they are more or less capable of ascending or descending to other horizontal levels and may thereby avoid unfavourable conditions to which the currents have conveyed them. As matter of fact, several species are more or less frequently taken at levels to which they do not properly belong, and this may be due to active vertical migration. But it may also be due to passive transportation with descending or upwelling water-masses, of which examples will be mentioned in the following descussion. Medusae may be valuable indicators of displacements of the water layers, either horizontally or vertically.

The majority of the oceanic medusae are holopelagic, no bottom-stages entering into their life-cycle, and this applies to all the Trachymedusae and Narcomedusae. Only the two species of *Ptychogastria* may with some reason be dealt with among the neritic species, because they spend part of their time attached to the bottom by means of their adhesive tentacles (see above, p. 205). There are, however, also a number of meropelagic species (Anthomedusae and Leptomedusae) which, for various reasons, may spread widely over the oceans. Some of them are probably of neritic origin and have already been mentioned among the neritic species; but their oceanic distribution is influenced by the same hydrographical conditions as the holopelagic forms, and they are therefore also included in the present chapter. Other species of Leptolina have a decidedly oceanic distribution, apparently without any connection with the coastal lines or the bottom conformation, and they will be treated on equal terms with the holopelagic species.

Since the currents and other conditions are quite different in the upper and the deep water layers, their faunas must be dealt with separately and, as a matter of fact, there is a conspicuous difference in the composition of the epipelagic and the bathypelagic fauna of medusae. Some few species are eurybathic and will be mentioned under both headings. On the other hand, bathypelagic species which are found only occasionally in the upper layers, and epipelagic species which descend only occasionally into greater depths, are only mentioned as belonging to one or the other of these groups.—Diurnal vertical movements frequently take place but are usually barred by a discontinuity layer which is not surpassed, neither from below nor from above. The diurnal migrations must be studied by observations for prolonged periods within restricted areas and cannot be considered in the present discussion. It should also be remembered that such as the collections are generally carried out by oceanic expeditions, there is a certain amount of uncertainty about the actual depths in which the specimens have been caught by the nets.

3 a. The Epipelagic Zone.

The epipelagic zone comprises the upper water layers. Its lower limit is variable, generally down to 150—250 m. below the surface, dependent on ecological factors, mainly the temperature of the water and the contents of nutritive matter. Medusae are predatory animals, but many of the animals which constitute their prey are plant-eaters; indirectly, therefore, the amount of phytoplankton may be of considerable importance to the occurrence and quantity of the medusae.

The epipelagic species are partly exposed to the same currents as the neritic species. It is natural, therefore, to divide the epipelagic zone into zoogeographical regions in a similar way as the neritic regions, though with certain accommodations, taking into consideration the hydrographical conditions in the open sea. The actual distribution of the epipelagic medusae shows, as will be demonstrated below, that the division into epipelagic

regions may be somewhat simplified in comparison with the neritic. It is sufficient to divide the Atlantic into the following transverse belts; arctic, boreal, warm-water, antiboreal, and antarctic, with addition of the Mediterranean and the South-African regions as areas having special conditions. This is in fairly good accordance with the division proposed by MEISENHEIMER (1905) for the distribution of the epipelagic Pteropoda, though as far as the medusae are concerned, the limits between the regions may be drawn slightly differently. The majority of the Atlantic species are equally distributed in the eastern and western parts of the ocean; the few exceptions are marked by special signatures in the table, and may in some cases be due to insufficient knowledge of the fauna in certain areas, mainly off the South-American coasts.

1. The arctic region.—Among the epipelagic species with an oceanic distribution only three occur in arctic waters, and only one of these, *Aeginopsis laurentii*, is restricted to the arctic region, where its distribution is circumpolar. It is rather eurybathic, ranging from the surface down to 1000 m. or more. An isolated

Table X. Oceanic species in the epipelagic zone.

	Arctic	Atlantic boreal	Mediterranean	Atlantic warm-water	South-African	Atlantic antiboreal	Atlantic antarctic	Indian warm-water	Indian temperate	Indian antarctic	Pacific antarctic	Pacific antiboreal	Pacific warm-water	Pacific boreal	Pacific arctic
*Aeginopsis laurentii	×	..	..	..	..	..	..	..	..	..	..	..	..	..	×
Homoeonema platygonon	×	E	..	..	..	..	..	..	..	..	..	.	..	..	..
*Aglantha digitale	×	×	..	×	..	..	..	..	..	..	..	..	..	×	×
Calycopsis krampi	..	E	..	..	..	..	..	..	..	..	..	..	..	..	..
Calycopsis gara	..	×	..	..	..	..	..	..	..	..	..	..	..	..	..
Cunina globosa	..	E	×	..	×	..	..	..	..	..	..	..	×	..	..
Turritopsis nutricula	..	×	×	×	..	..	..	×	..	..	..	..	×	..	..
Solmaris corona	..	×	×	E	×	..	..	..	..	..	..	..	..	..	..
Rhopalonema velatum	..	×	×	×	×	×	..	×	..	..	..	×	×	..	..
*Aegina citrea	..	E	..	×	×	×	..	×	..	×	..	..	×	×	..
Phialopsis diegensis	..	×	..	E	×	..	..	W	..	..	..	..	E	×	..
Pegantha clara	..	W	..	×	×	..	..	W	..	..	..	..	..	..	..
Aglaura hemistoma	..	×	×	×	×	..	..	×	..	..	..	×	×	..	..
Liriope tetraphylla	..	×	×	×	×	×	..	×	..	..	..	×	×	(×)	..
Solmaris leucostyla	..	..	×	..	..	..	..	..	..	..	..	..	..	..	..
Solmaris solmaris	..	..	×	..	..	..	..	..	..	..	..	..	..	..	..
Cunina proboscidea	..	..	×	..	..	..	..	..	..	..	..	..	..	..	..
Petasus atavus	..	..	×	E	..	..	..	..	..	..	..	..	..	..	..
Solmaris flavescens	..	..	×	E	..	..	..	..	..	..	..	..	..	..	..
Pegantha rubiginosa	..	..	×	×	..	..	..	..	..	..	..	×	..	..	..
*Persa incolorata	..	..	×	×	×	..	..	..	..	..	..	×	..	..	..
Cytaeis tetrastyla	..	..	×	×	..	..	..	×	..	..	..	..	×	..	..
Pandea conica	..	..	×	×	×	(×)	..	..	..	..	..	..	W	..	..
Cunina octonaria	..	..	×	×	×	..	..	×	..	..	..	..	×	..	..
Geryonia proboscidalis	..	..	×	×	×	..	..	×	..	..	..	..	×	..	..
*Sminthea eurygaster	..	..	×	×	×	..	..	×	..	..	..	×	..	..	..
Solmundella bitentaculata	..	..	×	×	×	×	×	×	..	×	×	×	×	..	..
Cunina fowleri	..	..	..	E	..	..	..	..	..	..	..	..	..	..	..
Bougainvillia niobe	..	..	..	W	..	..	..	..	..	..	..	..	..	..	..
Bougainvillia platygaster	..	..	..	×	×	..	..	W	..	..	..	..	..	..	..
*Euphysora furcata	..	..	..	×	×	..	..	W	..	..	..	..	..	..	..
Cunina frugifera	..	..	..	×	×	..	..	W	..	..	..	..	..	..	..
Cunina duplicata	..	..	..	×	×	×	..	W	..	..	..	..	W	..	..
Amphogona apsteini	..	..	..	E	..	..	..	×	..	..	..	..	×	..	..
Heterotiara anonyma	..	..	..	W	×	..	..	E	..	..	..	..	×	×	..
Cunina peregrina	..	..	..	×	×	..	..	W	..	..	..	..	×	..	..
*Solmissus marshalli	..	..	..	×	×	..	..	×	..	..	..	..	×	..	..
Pegantha triloba	..	..	..	×	..	×	..	×	..	..	..	..	×	..	..
Pegantha laevis	..	..	..	×	×	×	..	..	..	..	..	..	×	..	..
Pegantha martagon	..	..	..	×	×	×	×	×	..	..	×	×	×	..	..
*Calycopsis borchgrevinki	..	..	..	..	..	..	×	..	..	×	×	..	..	..	..
Pantachogon scotti	..	..	..	..	..	..	×	..	..	×	×	..	..	..	..
Number of species	3	13	19	32	23	9	4	22	0	4	4	8	20	5	2

* Eurybathic, also included in Table XI. E, W, only in eastern or western parts.

record from the Norwegian Sea is from the body of arctic water which fills up this deep basin, with temperatures below 0° up to about 550—600 below the surface. Records of this species from southern New England and Japan (MAYER 1910 p. 472) are erroneous (see KRAMP 1947 p. 37). *Homoeonema platygonon* has been found only in a few localities (Kara Sea, some Norwegian fjords, and south of Iceland), and its zoogeographical character cannot be determined (KRAMP 1947 p. 17). *Aglantha digitale* is almost generally distributed and very common in boreal and arctic waters; it has an extensive vertical distribution, though it is rare in the uppermost surface layers as well as in very deep water. In the southernmost parts of its area of distribution it occurs only in the intermediate and deep strata; it is an "arctic-bathy-subarctic" species (EKMAN 1953 p. 338).

2. The boreal region.—The hydrographical conditions of the surface waters in this region are mentioned above in connection with the neritic species (pp. 210—222). Its southern limit is determined by the northward penetration of the warm-water species.—Altogether 13 oceanic species are recorded from the epipelagic zone of this region, most of them only as stray visitors from the south, and some of them only from its eastern parts. *Homoeonema platygonon* and *Aglantha digitale* were mentioned above. *Calycopsis krampi* and *C. gara* have only been taken in one locality each. *Cunina globosa* is likewise recorded from only a few localities within this region, *viz.* south-west of Ireland, but it also occurs at South Africa and in the tropical Pacific, and *C. lativentris* in the Mediterranean probably belongs to the same species. The Anthomedusa *Turritopsis nutricula*, which has a predominantly southern distribution, is a regular inhabitant of the waters off the coast of New England, and in the English Channel and the North Sea; it is most probably of neritic origin, but owing to its ability to propagate by budding it may also be found in the open oceans.

Two other species are constant inhabitants of restricted parts of the boreal region, though both of them have their principal occurrence in tropical regions. *Solmaris corona* is an East-Atlantic species occurring from South Africa to the British Isles, including the Mediterranean; in the present paper it is recorded from two localities between Newfoundland and Ireland; it is common in the surface waters west of the British Isles, and it is usually carried to the southern part of the Norwegian coast in the autumn, when the Atlantic Current increases in volume and velocity. *Rhopalonema velatum* is generally distributed and very abundant in the warm parts of all the oceans, and its northward distribution in the Atlantic as an indigenous species is extended as far as to an oblique line from Cape Cod in America to northern Scotland, i. e. along the northern border of the Gulf Stream and the Atlantic Current, but it is not known to enter the North Sea or the Norwegian Sea. *Aegina citrea* is widely distributed in the warm parts of the oceans, where it occurs from the surface downwards to considerable depths; in the northern Atlantic (as well as in the northern Pacific) it is only met with in the deep strata and will, therefore, be further mentioned among the bathypelagic species.

The remaining four species enumerated in Table X as occurring in the North-Atlantic boreal region are found there only as stray visitors from the south. The Leptomedusa *Phialopsis diegensis* is recorded from the Irminger Sea south-west of Iceland, about 60° N., which is evidently an exceptional occurrence, since the only two other records from the boreal region are south of 50° N., south-west of Ireland and east of the Newfoundland Bank; all other records are from the waters west of Africa. *Pegantha clara*, *Aglaura hemistoma* and *Liriope tetraphylla* penetrate very slightly into the boreal region, though the latter rather frequently, though irregularly, is carried into the western part of the English Channel by inflowing Atlantic water, mainly in late autumn.

We see thus that, apart from the two species of *Calycopsis*, the further distribution of which is unknown, not one single species of the epipelagic oceanic hydromedusae is characteristic of the boreal region; two species have their further distribution in arctic waters, all the others mainly belong to tropical seas. EKMAN (1953) has come to the same conclusion: "There are very few, if any, purely boreal epipelagic species" (p. 341), and he rightly designates this as very remarkable.

3. The Mediterranean Sea.—As mentioned above (p. 224) I have previously dealt with the Mediterranean fauna of medusae (KRAMP 1924), though only the species which were collected by the "Thor" in 1908—1910. Their occurrence in the various parts of the Mediterranean was discussed in relation to the hydrographical conditions, and in several instances the occurrence of the medusae gave supplementary information on the currents, especially in the boundary layers between the upper and the intermediate strata. This was possible

because some of the epipelagic species occasionally descend into layers with currents other than those in the surface layers; on the other hand, occasional occurrence of bathypelagic species in the upper layers indicates upwelling of water from the deep-sea.

The conditions of the surface currents are briefly mentioned above (pp. 224 ff.) and may be further illustrated in the adjacent map from NIELSEN's paper on the hydrography of the Mediterranean (1913), showing the main features of the circulation of the water masses. As mentioned above, our knowledge of the occurrence of the neritic medusae is mainly derived from some few scattered localities. As far as the oceanic species are concerned, the epipelagic as well as the bathypelagic, the cruises of the "Thor" gave very comprehensive information on the pelagic fauna in almost all parts of the Mediterranean, except in the Adriatic

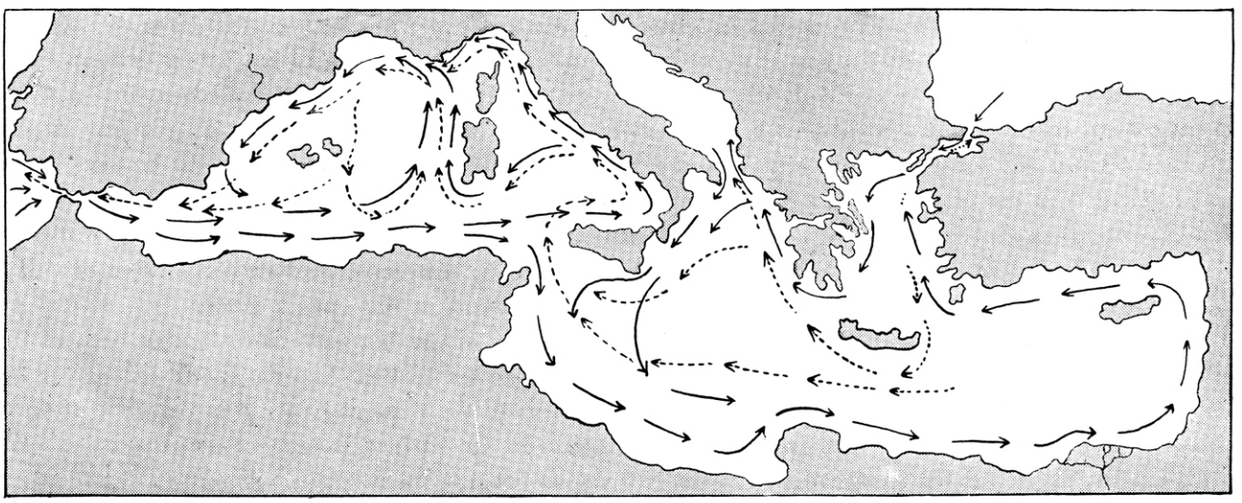


Fig. 325. Direction of the movement of the surface water (full drawn) and of the intermediate water (dotted).

Sea. The most important later additions are given by BABNIK (1948) on the Adriatic Sea and by RANSON (1936) on the western part of the Mediterranean. Unfortunately RANSON's long and interesting paper on the medusae collected during the cruises by the Prince of Monaco in the western Mediterranean and adjacent parts of the Atlantic gives no exact information on the vertical distribution of the animals, except that some of the hauls were taken at the surface; the depths of the other hauls were given as between the surface and a certain, usually considerable depth.

The number of predominantly epipelagic, oceanic species recorded from the Mediterranean amounts to 19. *Solmaris leucostyla, S. solmaris* and *Cunina proboscidea* seem to be endemic in the Mediterranean, where each of them has been found in only one or a few localities. All the other species occur in the Atlantic warm-water region, and it must at once be emphasized that none of them are restricted to the westernmost part of the Mediterranean, just inside the Straits of Gibraltar, but occur at least as far east as to the west coast of Italy. This means that none of them are mere visitors from the Atlantic Ocean; specimens are undoubtedly carried in through the strait, but there is an indigenous stock of each species in the Mediterranean. They are, however, not equally distributed within the area. *Solmaris solmaris, S. corona* and *S. flavescens, Cunina globosa, C. proboscidea* and *C. octonaria* are restricted to the western basin, 12 species penetrate somewhat further, through the Pantellaria Channel (between Sicily and Tunis) or the Straits of Messina into the Ionian or Adriatic Seas, but only 5 species have been found in the Levant, the easternmost basin, east of a line from Cyrenaica to the west point of Crete. One of these, *Pegantha rubiginosa*, has been found there only once, and only as a visitor in the westernmost part of the basin, south of Crete, probably carried in by the currents along the African coast. *Pandea conica, Rhopalonema velatum, Liriope tetraphylla* and *Geryonia proboscidalis* are certainly indigenous in the Levant. It may be the very high salinity (up to 39 $^{0}/_{00}$ or more) at the surface which bars the way for a further penetration of the other Mediterranean species. The Aegean Sea is likewise poorly inhabited by medusae; it contains the same four species which occur in the Levant, and moreover *Petasus*

atavus, a species which has been observed only by HAECKEL; it is probably identical with *P. tetranema* from the Canary Islands (HAECKEL), whereas records from the Red Sea, the Indian Ocean and China Sea are uncertain.

Of particular interest is the exchange of water between the Aegean Sea and the Sea of Marmara, and in this connection two species of medusae tend to illustrate what happens. The salinity of the surface water in the Aegean Sea is very high, about 39 $^0/_{00}$ in its eastern part; a small amount of this water penetrates across the threshold of the Dardanelles into the Sea of Marmara, where it dives down below the outflowing surface-current of water from the Black Sea with a lower salinity, about 22 $^0/_{00}$. *Rhopalonema velatum* usually avoids the uppermost water layers; it is abundant in the Aegean Sea, particularly at depths between 150 and 200 m., but during the investigations by the "Thor" a dense accumulation of this species was found about 40 m. below the surface just outside the mouth of the Dardanelles; nevertheless the medusa was entirely lacking in the Dardanelles and the Sea of Marmara. This indicates that the water masses, by which this species is carried northwards along the west coast of Asia Minor (see the current-map), rise somewhat towards the surface outside the mouth of the Dardanelles, but are not admitted across the threshold, where the greatest depth is about 50 m. *Liriope tetraphylla* is likewise very common in the Aegean Sea, but it was also found in enormous quantities in the Sea of Marmara. This species is a more pronouncedly epipelagic medusa than *Rhopalonema*; it mainly occurs between 15 and 50 m. below the surface, and it is introduced into the Sea of Marmara by the thin layer of water from the Aegean Sea which is admitted across the threshold into the Sea of Marmara as an undercurrent. Here the medusae ascend into the upper layers and are carried backwards again to the Dardanelles. But they avoid the uppermost stratum, and therefore they come once more into the strata which are moving inwards towards the Sea of Marmara, where they take part in the same circulation over and over again, the population increasing in number by propagation. It is not known to proceed into the Black Sea. The Sea of Marmara acts as a trap to these medusae, receiving a moderate but continuous supply from the Aegean Sea, and practically never letting any of them out again (for details, see KRAMP 1924 pp. 56—58).—*Pandea conica* has also been found in the Sea of Marmara, but only occasionally, and must be regarded as a stray visitor in that sea.

Only one species, *Turritopsis nutricula*, is known to have immigrated into the Levant through the Suez canal.

The origin of the Mediterranean fauna has been much discussed; it has been regarded as an impoverished Atlantic fauna, but it has also been emphasized that the fauna has many species in common with Indo-Pacific waters, and various attempts to explain this fact have been advanced.

As far as the epipelagic oceanic hydromedusae are concerned, it was stated above that 3 species are endemic in the Mediterranean, and the other 16 species all occur in the Atlantic warm-water region; 6 of these also penetrate more or less into the boreal region, but only to its southern portions, off the British coasts. Among the 16 Mediterranean species, which occur in the Atlantic warm-water region, 9 are distributed southwards into the South-African region. In contradistinction to the neritic species (see above, p. 226) the epipelagic oceanic species in the Mediterranean are predominantly tropical forms.

It is easily understood that the majority of the epipelagic species in the Mediterranean also occur in the Atlantic, since an exchange of water continually takes place through the Straits of Gibraltar, mainly as an inflow of surface water from the Atlantic. It is more remarkable that 16 of the Atlantic warm-water species have not been found in the Mediterranean. The composition of the fauna of epipelagic oceanic medusae might, therefore, be interpreted as confirming the apprehension of the Mediterranean fauna as an impoverished derivation from the Atlantic; but its simultaneous similarity to the Indo-Pacific fauna calls for further contemplation. No less than 10 of the Mediterranean species occur in the Pacific warm-water region (9 in the Indian Ocean); the distribution of 8 of these is continuous around South Africa. The authors who claim that the Mediterranean fauna is derived from the fauna of the tertiary Tethys Ocean and is not, or only partly, immigrated from the Atlantic, may be right. But it must be admitted that, since all of the species common to the Mediterranean and the Indo-Pacific also occur in the Atlantic Ocean, the epipelagic oceanic medusae do not contribute to the solution of these questions. They will, however, be considered in the concluding chapter of the present paper.

4. The Atlantic warm-water region.—The determination of the northern and southern limits of this region may be based upon the actual distribution of the medusae. The number of epipelagic oceanic species recorded from the region amounts to 32 (see Table X). *Aglantha digitale* is a northern species penetrating slightly into the warm-water region; being a cold-water species, however, it mainly keeps to the deeper strata in the southern part of its area of distribution, though in the Bay of Biscay, and even as far south as east of the Azores, it may occasionally ascend towards the surface. The Anthomedusa *Turritopsis nutricula* mainly occurs near the coasts, but owing to its ability to propagate by budding it may spread rather far out into the open seas; it is mainly a tropical species, but in the Atlantic area its distribution is extended to Cape Cod in the west and the English Channel and North Sea in the east.

All the other species have a predominantly tropical distribution. In the western Atlantic most of them have their northern limit of distribution at Cape Hatteras, only some few (*Rhopalonema velatum, Aglaura hemistoma, Liriope tetraphylla* and *Pegantha clara*) being occasionally found as far north as Cape Cod. In the eastern Atlantic the northern limit is very different for the different species. Besides *Aegina citrea* which in northern waters only occurs in deep water, only two species, *Solmaris corona* and *Rhopalonema velatum,* are regular inhabitants of the waters west of the British Isles. On the other hand, several species occur in the Bay of Biscay. It seems natural, therefore, to draw the northern limit of the warm-water region from Cape Hatteras in America to Bretagne in France, south of the entrance to the English Channel, though with a somewhat sinuous course across the ocean, i. e. approximately along the annual isotherm of 15°. In the east, however, some of the species do not occur further north than Portugal, Gibraltar or Morocco.

In so far as our knowledge permits us to determine the southern limit of the region we will find that, as far as the majority of the species are concerned, it has a rather fixed position off Montevideo in the west and at some distance south of Africa in the east, but apparently very variable in the open sea, perhaps on account of the many swirls in this area. The southern limit, accordingly, mainly follows the Antiboreal Convergence (see above, p. 236), i. e. also the southern limit more or less follows the 15° isotherm. There are, however, some species which penetrate considerably farther south. This applies to *Solmundella bitentaculata* and *Pegantha martagon,* which even reach into the antarctic region, and also to a lesser degree to *Rhopalonema velatum.* Moreover *Pandea conica, Liriope tetraphylla* and *Pegantha laevis* have occasionally been found a little south of the Convergence, and likewise *Aegina citrea, Cunina duplicata* and *Pegantha triloba,* but in deep water only. Records of *Sminthea eurygaster* from two localities in the antiboreal region (Thiel 1936) seem to me open to doubt.

The limits of the Atlantic warm-water region, in north as well as in south, as drawn here by means of the actual distribution of the epipelagic medusae, agree fairly well with the limits stated by Meisenheimer (1905) for the distribution of Pteropoda, except that he does not include the Bay of Biscay in the region. I also agree with Meisenheimer that the South-African region must be treated separately (see below). In the North Atlantic Moser (1915) has found a similar limit between the distribution of warm-water and cold-water species of Siphonophora.

The vertical distribution of several species is somewhat uncertain owing to the methods of collecting employed by most oceanic expeditions. The majority of the species enumerated in Table X are entirely epipelagic, but during the investigations by the "Dana", especially in 1930 off the west coast of Africa, decidedly epipelagic species were frequently taken in hauls with very considerable length of wire out, though they undoubtedly were residing in the upper layers and were caught during the setting out or hauling in of the nets. There is reason to believe (and in some cases we know with certainty) that owing to handling difficulties the trawls sometimes remained hanging outboard for a considerable time. This was the consequence of the simultaneous use of several nets attached to the same wire at different levels; the fastening and unfastening of each net required a certain amount of time, and in the meantime the other nets were slowly towed through the water at unintentional levels.

The following species are presumably really eurybathic and will be mentioned again in connection with the bathypelagic species: *Aegina citrea, Persa incolorata, Euphysora furcata, Sminthea eurygaster, Solmissus marshalli,* and to some degree *Solmundella bitentaculata* and *Rhopalonma velatum,* perhaps also *Cunina duplicata.*

From a zoogeographical point of view the 32 species of epipelagic oceanic hydromedusae belonging to the warm-water region may be divided into the following groups.

Aglantha digitale and *Turritopsis nutricula* have been mentioned above.

Four species occur only in the Atlantic (to some extent also in the Mediterranean) but are unknown in the other oceans. One of them, the Anthomedusa *Bougainvillia niobe*, is restricted to a somewhat narrow area in the western Atlantic; it is probably of neritic origin but is able to spread into the open sea owing to its vivid propagation by budding, and it occupies the area east of the American coast between Cape Hatteras and Florida and north of the West-Indian chain of islands. It may be derived from the coasts of the islands, being carried along with the Florida Current and its derivations into the great swirl of the Sargasso Sea, whence it seems unable to escape (see the map, fig. 326).—*Cunina fowleri* has been found only in one locality

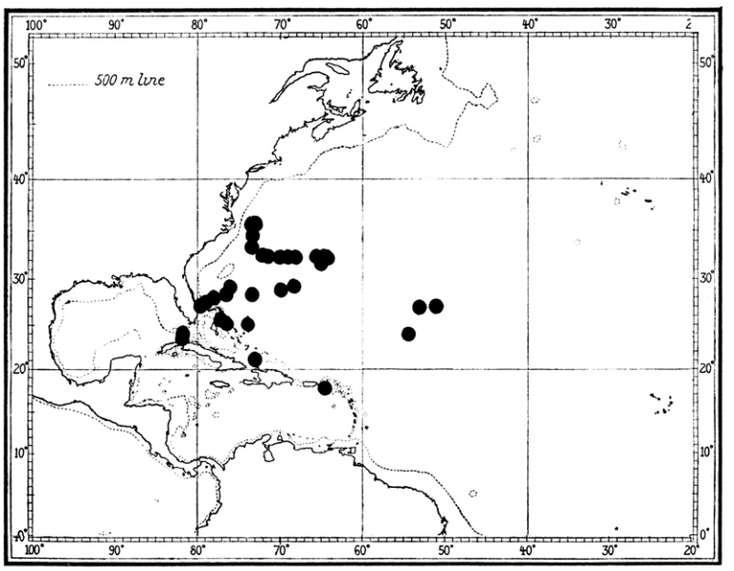


Fig. 326. Distribution of *Bougainvillia niobe*.

in the Bay of Biscay, *Petasus atavus* at the Canary Islands and in the eastern part of the Mediterranean *Solmaris flavescens* occurs mainly in the Mediterranean and in the eastern parts of the Atlantic Ocean; all of them are restricted to the warm-water region, where their occurrence (in so far as it is known up to now) is somewhat scattered and not perceptively connected with the transatlantic currents.

Solmaris corona forms a transition between this and the next group; besides in the Mediterranean and the warm parts of the eastern Atlantic its distribution is extended northwards to Scotland and southern Norway and southwards around the corner of South Africa to the southernmost part of the east coast of Africa.

The next group consists of eight species which have an extensive distribution in the Atlantic warm-water region, whence they have extended their distribution more or less into Indo-Pacific areas. It is possible, of course, that by future investigations they will be found to be more widely distributed in the Indo-Pacific, but provisionally we must regard them as species originating in the Atlantic and immigrating from there into the other oceans. *Bougainvillia platygaster* is an Anthomedusa propagating by budding; it seems to have its principal occurrence in the Sargasso Sea and the West-Indian waters, but in contradistinction to *B. niobe* (see above) its distribution is extended eastwards to the Azores and north-western Africa and southwards to the area east of Brazil; moreover it has been found in several localities off the east coast of Africa (see the map, fig. 327). *Euphysora furcata* is likewise an Anthomedusa; its propagation is unknown, but it has sometimes been found at great distances from the coasts and it seems to have a rather considerable vertical distribution; it has once been found in the Indian Ocean, east of Somaliland. *Cunina frugifera*, which is widely distributed in the Atlantic between 40° N. and 35° S., has likewise been found off Somaliland and also in

two localities south-east of Africa. *Cunina duplicata* has a very similar distribution in the Atlantic and east of Africa, but it is also recorded from the east coast of Australia. None of these species are known from the Mediterranean. *Sminthea eurygaster, Pegantha rubiginosa* and *Persa incolorata,* also have an extensive distribution in the Atlantic and in the Mediterranean; the former has been found in three localities in the Indian Ocean, north of Madagascar, near the Chagos Islands, and near Ceylon; in addition, off south-eastern Australia, where also *Persa incolorata* and *Pegantha rubiginosa* were found. The oceanic distribution of the

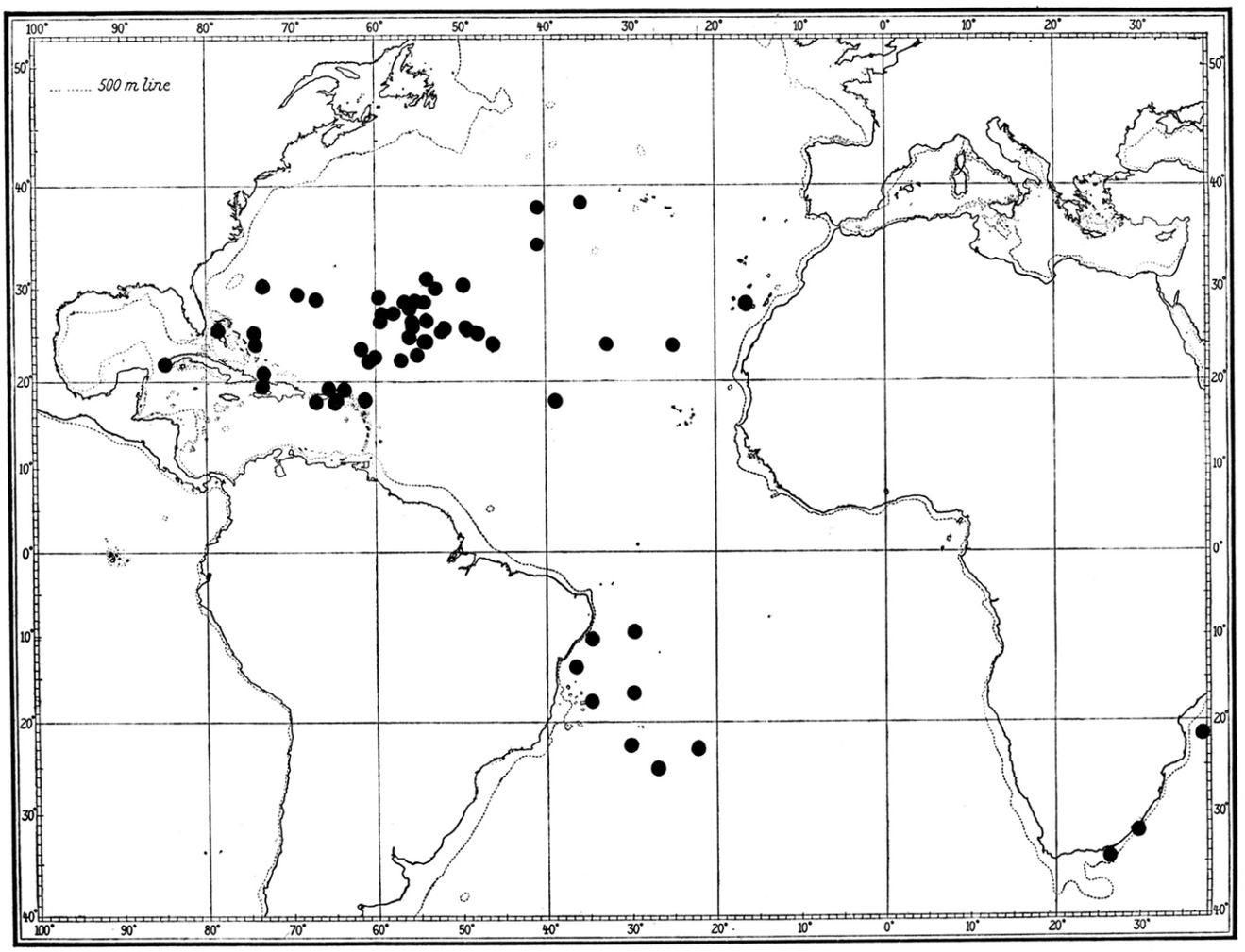


Fig. 327. Distribution of *Bougainvillia platygaster.*

Anthomedusa *Pandea conica* (see the map, fig. 328) is due to the fact that its hydroid is attached to the shell of a Pteropod, *Cleodora cuspidata*; the medusa is widely distributed in the Mediterranean and the warm parts of the Atlantic, but up to now it is recorded only from two localities outside the Atlantic, *viz* at the Philippines and southern Japan, though the Pteropod has a circumglobal distribution. It may seem peculiar that the four first named species of this group, if they have really immigrated from the Atlantic into the Indian Ocean, have been observed along the east coast of Africa, where the main direction of the surface currents is from north to south. Presumably they move slowly northwards, when occasionally the currents follow that direction (tidal currents?), remaining in quiet areas, where eddies are formed, until another northward displacement of the water masses takes place. Once established off the African coast a further distribution towards the east is difficult owing to the west-going Equatorial Currents of the Indian Ocean.

On account of the prevailing currents in the Indian Ocean one might expect a rather considerable immi-

gration of medusae from there to the Atlantic Ocean; as a matter of fact, we know only two species which apparently have their principal areas of distribution in the Indo-Pacific and are recorded from some few localities in the Atlantic. *Cunina globosa* occurs in the eastern and central Pacific and has been found near the Cape of Good Hope, south-west of Ireland, and in the Mediterranean; *Amphogona apsteini* is widely distributed in the Pacific and Indian Oceans; in the Atlantic it has been found only once, in the Gulf of Guinea. Both species belong to the epipelagic zone. There are, however, a considerable number of circumglobal warm-water species equally common in all of the three oceans; they will be discussed below, but it will be convenient first to mention two species having a discontinuous distribution.

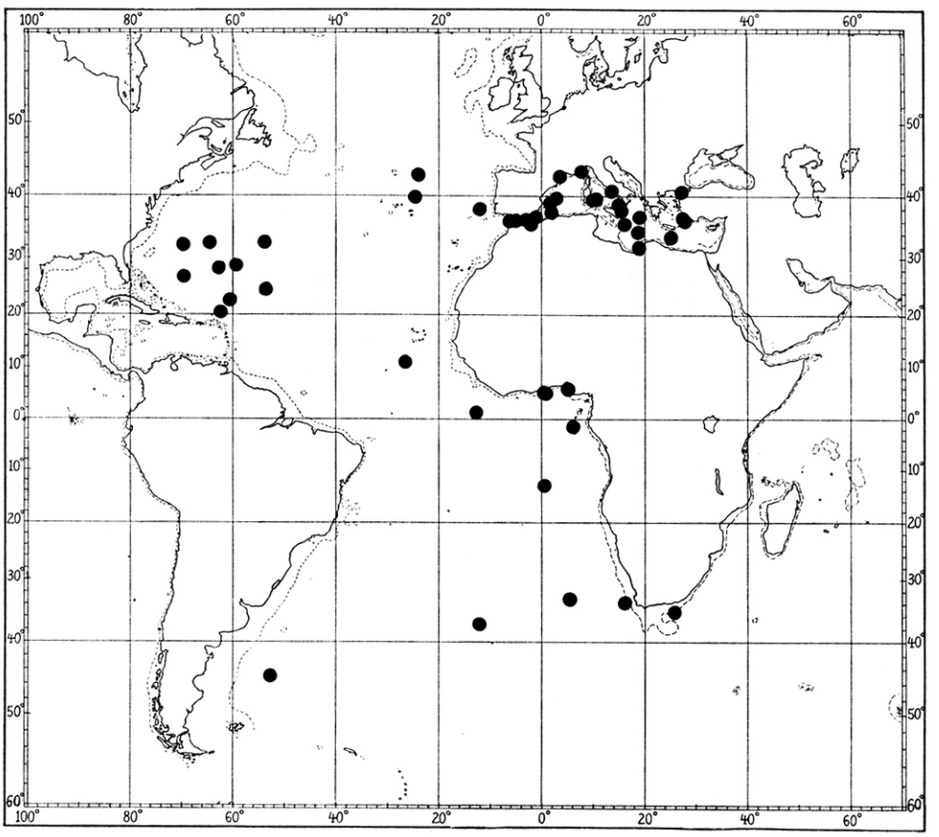


Fig. 328. Distribution in the Atlantic Ocean and the Mediterranean of *Pandea conica*.

The Leptomedusa *Phialopsis diegensis* is particularly common in the waters west of Africa but has also been found in some scattered localities in other parts of the Atlantic and off the east coast of Africa as far north as Somaliland, but not further east in the Indian Ocean, and the only records from the Pacific are from the eastern part of that ocean. *Heterotiara anonyma* is fairly common in the Sargasso Sea and among the West-Indian Islands; in the present paper it is recorded from a locality off the Atlantic coast of South Africa. Moreover it occurs in the Malayan Archipelago, in the northern Pacific between Kamchatka and British Columbia, and off the coast of Peru in South America.

The following 14 species with a circumglobal distribution are all predominantly tropical, and their areas of distribution in the Indian and Atlantic Oceans communicate freely around South Africa. In the Atlantic all of them are generally distributed from east to west within the tropical belt, but their northern and southern limits of distribution are somewhat different, especially as far as their southward penetration is concerned.

The most predominantly tropical species are *Cytaeis tetrastyla* (which is an Anthomedusa propagating by budding), *Geryonia proboscidalis*, *Cunina octonaria*, and *C. peregrina*; they occur approximately between 40° N. and 35° S., and the three first named also occur in the Mediterranean. *Aglaura hemistoma*, *Solmissus*

marshalli and *Pegantha clara* have about the same southern limit of distribution, but they proceed slightly more towards the north. On the other hand, *Pegantha triloba* and *P. laevis* penetrate slightly into the antiboreal region, as far as 48° S. *Liriope tetraphylla* and *Rhopalonema velatum* are particularly abundant, in the Atlantic as well as in the other oceans and in the Mediterranean. Both of them have been found off the American coast as far north as Cape Cod; in the eastern Atlantic they both occur in the Bay of Biscay, whence the former is frequently carried into the western part of the English Channel, and *Rhopalonema velatum* occurs regularly in the waters west of Scotland. They also penetrate somewhat into the antiboreal region, though *Liriope* has been found there only once (see below). *Aegina citrea* must be specially mentioned, because its vertical distribution is very extensive. Its horizontal distribution in the Atlantic reaches from Iceland to South Georgia, but north of about 40° N. and south of about 40° S. it has, with very few exceptions, been taken only in the deep strata, whereas in tropical seas it may be found from the very surface down to considerable depths. It is accordingly a species which may tolerate extremely variable temperatures. Also in the Pacific its distribution is very extensive, ranging from Tasmania to the Aleutian Islands, and in the Indian Ocean it has been found near the Antarctic Continent as well as in the tropics.

One might expect that the species which penetrate far southwards into antarctic waters might also have a corresponding northward distribution into the cold northern regions; but this is not the case. *Pegantha martagon* and *Solmundella bitentaculata* both have their principal occurrence in the tropical parts of all the oceans; but they also occur in the antiboreal belt and have been taken in several localities within the antarctic region. Both are common off the entire west coast of Africa and westwards towards the American coasts, but they have never been found further north than around the Azores, about 40° N. Their northern limit of distribution thus coincides with that of the most distinctly tropical species mentioned above.

Among the 32 species of epipelagic, oceanic hydromedusae occurring in the Atlantic warm-water region no less than 17 are absent from the Mediterranean, *Aglantha digitale* because it is a northern species, *Bougainvillia niobe* and *B. platygaster* because they are predominantly West-Atlantic; *Cunina fowleri* is known from only one locality, *Amphogona apsteini* is probably an immigrant from the Indo-Pacific not yet reaching further north in the Atlantic than the Gulf of Guinea. The other 13 species (see Table X) might seem to have easy access to the Mediterranean with the rapidly inflowing surface-water through the Straits of Gibraltar. Even if some of them usually avoid the uppermost layers, they have all more or less frequently been collected so near the surface that they might easily pass the strait, the more so because upwelling water from the deeper strata frequently joins the inflowing water-masses. The explanation may possibly be that, even if some of these medusae occasionally are carried in from the Atlantic, they do not find the hydrographical conditions in the Mediterranean suitable for permanent establishment in that sea. The higher salinity may be the limiting factor for some species. The great seasonal variations in the temperature of the upper layers may also be taken into consideration, but in the intermediate layers the variations are less conspicuous, so that at least some of the Atlantic species might presumably find some water-levels within the Mediterranean, where they were able to adapt themselves to the conditions and settle down as permanent inhabitants. Some species have succeeded in this regard, others have not, and it is not easy to explain why. Some of the oceanic species in the Mediterranean may be descendants from the Tethys fauna, as supposed by some authors; but the absence of several Atlantic species seems to indicate that a considerable part of the Mediterranean fauna is derived from the Atlantic Ocean by an immigration, which has not been fully accomplished.

Before entering into a comparison between the warm-water faunas of the Atlantic and the Indo-Pacific regions we must consider the fauna of the South-African region.

5. The South-African region.—This region is generally reckoned from Durban on the east coast to Great Fishbay on the west coast. As seen from Table X the 23 species which have been found in the region all occur in other parts of the Atlantic warm-water region; the only exception is *Cunina globosa*, which is probably an immigrant from the Indo-Pacific and is still rare in the Atlantic, being found south-west of Ireland and in the Mediterranean, besides in a locality near the Cape of Good Hope, where it was taken at the surface of the water. On the other hand, 9 Atlantic warm-water species are not recorded from the South-African region, *viz. Bougainvillia niobe* which belongs to the Sargasso Sea, *Cunina fowleri*, *Petasus atavus* and

Solmaris flavescens which are altogether rare in the Atlantic, *Amphogona apsteini* which is probably immigrated from the Indo-Pacific and is still rare in the Atlantic; *Cytaeis tetrastyla* is a distinctly tropical species which may possibly be unable to live in these southern latitudes. *Turritopsis nutricula, Pegantha rubiginosa* and *Pegantha triloba* probably occur in the region, though they have not yet been found there.

The complicated hydrographical conditions in the South-African region, resulting from an intermixture of warm water of the Agulhas Current moving southwards from the Indian Ocean and turning westwards off the south coast of Africa, and cold water of antarctic origin sending a branch, the Benguela Current, northwards off the west coast, have been mentioned above (p. 229), and we have seen that, in accordance herewith, the neritic fauna is a mixed fauna. It is remarkable, therefore, that the fauna of epipelagic, oceanic medusae entirely consists of warm-water species.

It should first be emphasized that none of the predominantly southern species, belonging to antiboreal or antarctic waters, have been found in the South-African region. In this respect the epipelagic, oceanic species are in striking contradistinction to the neritic forms.

Several species, it is true, are enumerated in Table X as also occurring in boreal waters, but all of them have their principal occurrence in the tropics and penetrate only slightly into the boreal region.

It is also remarkable that only one of the South-African species, *Solmaris corona*, is purely Atlantic; it penetrates southwards along the west coast of Africa and has been able to turn around the corner to a locality off the southernmost part of the east coast, near Durban. *Bougainvillia platygaster, Euphysora furcata, Cunina frugifera, C. duplicata* and *Sminthea eurygaster* are undoubtedly also derived from the Atlantic, but have been able to extend their distribution considerably farther into the Indian Ocean (see above, p. 247). *Phialopsis diegensis* likewise has its principal distribution in the Atlantic, whence it penetrates northwards off the east coast of Africa to Somaliland, but it is unknown further east in the Indian Ocean and in the Pacific, until it is met with again in the eastern tropical Pacific. All the other South-African species have a more or less continuous circumglobal distribution in tropical waters.

As far as the epipelagic, oceanic medusae are concerned, the South-African region is not an area with a characteristic heterogeneous fauna consisting of species of diversified origin, and it has no endemic species. It simply constitutes a passage, by which the tropical faunas of the Indian and Atlantic Oceans may communicate freely, whereas communication between the Atlantic and Pacific Oceans is only possible for the species which may tolerate the low temperatures in the Drake Strait between South America and the Antarctic Continent.

As mentioned above (p. 247) only four of the epipelagic warm-water species are restricted to the Atlantic Ocean; two of them are rare species, *Bougainvillia niobe* is distinctly West-Atlantic, and the Mediterranean species *Solmaris flavescens* has been found only in some few localities in the eastern Atlantic. On the other hand, we know eight species which occur in the Indian or Pacific Oceans but are not recorded from the Atlantic. Seven of these, however, have been found only in one or two localities; one species, *Solmaris rhodoloma*, is widely distributed in the Pacific but is entirely absent from the Indian as well as from the Atlantic Ocean. It is certainly very remarkable that so few species are restricted to one of the three great oceans, and as a general result we may state that the fauna of epipelagic, oceanic warm-water species in the oceans is very uniform. The species which have been found only in one or a few localities may be disregarded in this connection, and apart from these the vast majority of the species have a circumglobal distribution; some few species have immigrated from the Atlantic into the Indian Ocean or *vice versa* in comparatively recent times and have not yet attained any extensive distribution in the new surroundings, and very few are still restricted to one ocean. The African continent, reaching southward to 35° S., may have retarded the exchange of warm-water medusae, but it does not constitute a permanent obstacle.

6. The antiboreal region.—Hydrographically this region is characterized as the area between the antiboreal and the antarctic convergences, both marked by a rather sudden increase from south to north in the temperature of the upper water layers. From a faunistical point of view it merely constitutes a boundary region for the southward distribution of a number of warm-water species. It does not contain any peculiar or characteristic fauna of epipelagic oceanic hydromedusae, and with very few exceptions the inhabitants of

the warm-water region occur only as stray visitors within the antiboreal belt. We have seen (p. 237) that the waters around the Falkland Islands and off the South-American coast as far north as Montevideo are inhabited by a rich and characteristic fauna of neritic medusae. Within this area very few of the epipelagic, oceanic species occur in the coastal waters, but some have occasionally been met with in off-shore localities, where the cold water of the Falkland Current is mixed with warm water from the Brazil Current, the influence of which may sometimes be traced rather far south. The following warm-water species may be regarded as stray visitors when they occur in this region: *Liriope tetraphylla, Pegantha triloba, Pegantha laevis, Pandea conica,* and *Cunina duplicata. Aegina citrea* has twice been taken near South Georgia and Shag Rocks, but only in deep water. *Rhopalonema velatum* has been found in several off-shore localities off the South-American coast, but never south of 50° S. Only two species, *Pegantha martagon* and *Solmundella bitentaculata* seem to be regular inhabitants of the antiboreal region, and they even penetrate into the antarctic seas; as mentioned above, they have not a correspondingly northward distribution into the cold waters of the North Atlantic.

7. The Antarctic Region.—From a faunistic as well as from a hydrographical point of view the antarctic region, south of the antarctic convergence, is very different from the warm-water and antiboreal regions. As previously mentioned (p. 236) very few neritic species are common to the antarctic and the antiboreal regions; on the other hand, each of the two regions contains a characteristic and fairly rich fauna of these animals. As far as the epipelagic, oceanic medusae are concerned, the antarctic fauna is poor, and the convergence evidently constitutes a barrier as effective as against the neritic forms. We know of only two species penetrating from the warm region into the antarctic, *Pegantha martagon* and *Solmundella bitentaculata,* which evidently are very eurythermic; both have frequently been collected in the waters around South Georgia, the latter also in the Weddell Sea, and both of them occur in the Pacific sector of the antarctic region. In the antarctic waters they were mainly taken in intermediate strata, in water with temperatures slightly above 0°, but also sometimes in the antarctic surface water.

Two species, the Anthomedusa *Calycopsis borchgrevinki* and the Trachymedusa *Pantachogon scotti,* belong entirely to the antarctic region, where both of them have a circumpolar distribution and occur in intermediate strata as well as in surface water.

The antarctic region is thus inhabited by two characteristic species which are entirely restricted to this region, whereas very few of the predominantly epipelagic species penetrate from warmer regions.

Summary.—The Atlantic warm-water region has a rich fauna of predominantly epipelagic, oceanic hydromedusae, 32 species, 15 of which also occur in the Mediterranean; among the 19 species known from the Mediterranean 3 are endemic. From the Atlantic boreal region 13 species are known, two of them have been found only in one locality each, two are distinctly northern species, the others belong to tropical waters and penetrate only slightly into boreal waters. The South-African region is only a part of the warm-water region, and its 23 species all occur in the equatorial belt. The arctic as well as the antarctic region are very poor in epipelagic species, one is endemic in the arctic region, two in the antarctic, all of them circumpolar. The antiboreal region receives a very slight invasion of warm-water species, of which only two have been found in any noticeable number, both proceeding further into antarctic waters. Among the 32 warm-water species in the Atlantic 27 occur in the warm-water regions of the Indian of Pacific Oceans, most of them in both, and there is a free communication of warm-water species between the Atlantic and Indian Oceans south of Africa. Some few species have immigrated one way or the other in comparatively recent times, but the majority have a circumglobal distribution.

3 b. The Bathypelagic Zone.

The bathypelagic zone comprises the intermediate and deep water below the epipelagic zone. The 38 species of hydromedusae enumerated in Table XI do not all occur at the same levels, and it might be valuable, if we could distinguish between an upper and a lower bathypelagic fauna of medusae (cfr. Ekman 1953 p. 356),

Table XI. Oceanic species in the bathypelagic zone.

	Arctic	Atlantic boreal	Mediterranean	Atlantic warm-water	Atlantic antiboreal	Atlantic antarctic	Indian warm-water	Indian temperate	Indian antarctic	Pacific antarctic	Pacific south temperate	Pacific warm-water	Pacific boreal
Botrynema ellinorae	×	..	..	..	..	..	..	..	..	..	..	..	..
Crossota norvegica	×	..	..	..	..	..	..	..	..	..	..	..	..
*Aeginopsis laurentii	×	..	..	..	..	..	..	..	..	..	..	..	..
*Aglantha digitale	×	×	..	N	..	..	..	..	..	..	..	..	×
Crossota rufobrunnea	..	×	..	N	..	..	..	..	..	..	..	..	×
Haliscera bigelowi	..	×	..	×	..	..	..	..	..	..	..	E	..
Pantachogon haeckeli	×	×	..	×	×	×	×	×	×	×	×	×	×
Halicreas minimum	..	×	..	×	×	×	×	×	×	..	×	×	×
Aeginura grimaldii	..	×	..	×	×	..	×	..	..	..	..	×	×
Botrynema brucei	..	×	..	×	×	×	×	×	×	..	W	..	×
Chromatonema rubrum	..	×	..	×	×	×	..	..	×	×	..	E	..
Tiaranna rotunda	..	×	W	×	×	..	..	..	×	..	..	..	..
Colobonema sericeum	..	×	..	×	..	..	×	×	..	..	×	×	..
Rhopalonema funerarium	..	×	..	×	×	..	..	×	..	..	..	E	..
Solmissus incisa	..	×	..	×	..	..	..	..	..	..	..	×	×
*Aegina citrea	..	×	..	×	×	..	×	×	×	..	×	×	×
Annatiara affinis	..	×	..	×	..	..	..	×	..	..	..	..	..
Pandea rubra	..	×	..	×	×	×	..	..	×	..	..	..	×
Solmissus albescens	..	..	×	..	..	..	..	..	..	..	..	..	..
Bythotiara murrayi	..	×	×	×	..	..	×	..	..	..	..	..	..
*Sminthea eurygaster	..	..	×	×	..	..	×	..	..	..	W	..	..
*Persa incolorata	..	..	×	×	..	..	..	..	..	..	W	..	..
Haliscera conica	..	..	×	×	×	×	..	..	×	×	W	..	..
Arctapodema amplum	..	..	×	×	..	×	..	..	×	×	..	..	..
Ransonia krampi	..	..	W	×	..	..	..	..	..	..	..	..	..
Crossota alba	..	..	..	×	..	..	..	..	..	..	..	W	..
*Euphysora furcata	..	..	..	×	..	..	W	..	..	..	..	..	..
Pantachogon militare	..	..	..	×	..	..	..	..	..	..	..	..	..
Aglantha elata	..	..	..	×	..	..	..	..	..	..	?	..	..
*Solmissus marshalli	..	..	..	×	..	..	×	..	..	..	×	×	..
Halitrephes maasi	..	..	..	×	×	..	×	×	..	..	×	×	..
Amphogona apicata	..	..	..	×	×	..	W	..	..	..	..	..	..
Tetrorchis erythrogaster	..	..	..	×	..	..	..	..	..	..	..	E	..
Crossota brunnea	..	..	..	S	×	×	×	×	×	×	×	×	..
Euphysora gigantea	..	..	..	..	×	×	..	..	..	..	..	..	..
Haliscera racovitzae	..	..	..	..	..	×	..	..	..	..	..	..	..
Arctapodema antarcticum	..	..	..	..	..	×	..	×	×	..	..	..	..
*Calycopsis borchgrevinki	..	..	..	..	..	×	..	..	×	×	..	..	..
Number of species	5	16	8	30	14	12	13	10	12	6	11	14	9

* Eurybathic, also included in Table X. N, S, E, W, only in northern, southern, eastern or western parts.

but owing to the uncertainty of the actual depths in which the animals have been captured (see above, p. 246) such a distinction is not possible; we must be content with some remarks on the behaviour of certain species. We may, however, frequently determine the upper limits of their occurrence, and of particular interest are the cases where bathypelagic species occasionally are met with at higher levels than normally, indicating upwelling of water from the deep strata. In the table are included eight species (marked with an *) having a very extensive vertical distribution; they have already been mentioned among the epipelagic species, but they must be dealt with again in the present chapter, because they participate in the characterization of the bathypelagic zone. On the other hand, predominantly epipelagic species, which only occasionally descend into the deep layers, are omitted here.

Since the hydrographical conditions in the bathypelagic zone are rather uniform throughout extensive areas, and the currents are slow, a horizontal division into zoogeographical regions is less complicated than in the case of the epipelagic zone with its diversified current systems. In Table XI, however, I have mainly retained the same division as in Table X, except that the South-African region is omitted, because the complicated current system in that region only comprises the upper layers, whereas the deep-sea is an integral

part of the wide warm-water region and is inhabited by the same bathypelagic fauna. The Mediterranean must, of course, be kept separately, because it is separated from the ocean by a narrow strait with shallow water less than 320 m. deep.

It was pointed out above that the faunas of epipelagic, oceanic hydromedusae in the boreal and antiboreal regions are very poor, and most of the species, which have been found within their limits, occur there only as stray visitors. The reason why I have retained these two regions in Table XI is expressly to demonstrate the great difference between the epipelagic and the bathypelagic zone in this respect. As far as the horizontal distribution of the bathypelagic fauna is concerned, its penetration into the arctic and antarctic regions is particularly interesting.

Geographically the limits of the arctic deep-sea region differs considerably from the limits of the arctic region in the upper layers. The northward distribution of the bathypelagic warm-water species is very effectively barred by the submarine ridges with depths of less than 600 m. between Scotland, Iceland, Greenland and Baffin Land, the North-Atlantic Transversal Ridge. The deep-sea area off the southern part of the west coast of Greenland is merely a prolongation of the oceanic deep-sea basin; on the other hand, the deep basin of the Norwegian Sea contains an enormous body of arctic water with temperatures below 0° up to about 550—600 m. below the surface and belongs, therefore, to the arctic deep-sea region, though on three sides it is surrounded by boreal coastal waters.

The antarctic deep-sea region is less distinctly limited, because Atlantic deep water penetrates below the antarctic surface water almost to the antarctic continental slope, though with lowered temperatures. The influence of these remarkable conditions on the composition of the fauna will be discussed below.

1. The arctic region.—Three species are endemic in the arctic region. One of them is *Aeginopsis laurentii*, which has a circumpolar distribution; it is predominantly epipelagic, but may descend at least to 1000 m. below the surface, though only in areas with low temperatures in the deep strata. In accordance herewith, in the Davis Strait south of the submarine ridge between Holsteinsborg in Greenland and Cape Walsingham in Baffin Land it occurs only in the upper layers of cold water and has never been found in deep water. On the other hand, it is recorded from the cold, deep water in the Norwegian Sea.—*Botrynema ellinorae* and *Crossota norvegica* are distinctly bathypelagic; the former occurs in Baffin Bay and between Spitzbergen and East Greenland, the latter in the northern part of the Norwegian Sea near the bottom at temperatures about — 1°.—*Aglantha digitale* is circumpolar in the arctic region, where it has an extensive vertical distribution, but it is also common in boreal waters.—With the exception of one single occurrence of *Pantachogon haeckeli*, in Baffin Bay (see below), these four species are the only representatives of oceanic hydromedusae in deep water in the arctic region, and only two of them belong exclusively to the deep strata, whereas the two others mainly belong to the epipelagic zone and probably never descend into depths exceeding 1000 m.

2. The boreal region.—*Aglantha digitale* is an arctic-boreal species, mainly occurring in the epipelagic region and repeatedly mentioned above. *Crossota rufobrunnea* is very common within a restricted area in the North Atlantic, ranging from the submarine ridges in the north to about 32° N., and it also occurs in the northern Pacific. *Haliscera bigelowi* is likewise a North-Atlantic species, but in the present paper it is also recorded from two localities off the northern part of the west coast of Africa. With these three exceptions all of the species which have been found within this region are almost generally distributed in the entire warm-water region of the Atlantic. Among these 13 species only one, *Pantachogon haeckeli*, has on one occasion been observed in an arctic locality, when a few specimens were taken north of the ridge between Greenland and Baffin Land, 800—1750 m. below the surface, at temperatures between 0.3° and — 0.4°. Though it is a predominantly bathypelagic species, it may occasionally ascend into somewhat higher levels, which explains why it has been able to cross the ridge. An isolated record from Spitzbergen (Maas 1904) was based on a mutilated specimen and must be regarded with some doubt.

The northward distribution of *Halicreas minimum*, *Aeginura grimaldii*, *Botrynema brucei* and *Chromatonema rubrum* is extended to the southern slopes of all the ridges, all of them occurring in the deep basin of Davis Strait as well as in the north-eastern Atlantic (a very peculiar record, providing the labelling is correct, is that of a specimen of this latter species taken at the surface off Sukkertoppen in Greenland by H. P. C.

MØLLER in 1843; the specimen and a simultaneous drawing of it are still in the Zoological Museum of Copenhagen; see KRAMP 1919 p. 9). The Anthomedusa *Tiaranna rotunda* likewise occurs in deep water in the Davis Strait, but from the north-eastern Atlantic its distribution is extended into the Skagerrak and some of the deep fjords on the west coast of Norway, where it occurs together with another bathypelagic Anthomedusa, *Bythotiara murrayi*. The other species enumerated in Table XI as occurring in the "boreal" region reach as far as the slope of the Wyville Thomson Ridge, but have not been found in the Davis Strait. All of them are widely distributed in the Atlantic warm-water region, except *Pandea rubra* which has a somewhat scattered distribution between the far north and the far south.

The only area within the "boreal" region where bathypelagic hydromedusae indicate upwelling of water from the deep-sea is outside the Gulf of Maine, where *Halicreas minimum, Rhopalonema funerarium* and *Aeginura grimaldii* appeared, together with other bathypelagic animals, in hauls from 500 and 600 metres, thus apparently not very near the surface, but nevertheless considered as evidence of an upwelling (BIGELOW 1926 p. 67). Moreover *Chromatonema rubrum* was first described by FEWKES (1882) from New England, presumably from no considerable depth. A comparison between the faunas in the boreal and the antiboreal regions will be given below.

3. The Mediterranean Sea.—Among the 25 species which occur in deep water in the central part of the Atlantic only 7 have entered through the Straits of Gibraltar into the Mediterranean Sea. Two of them, *Sminthea eurygaster* and *Persa incolorata*, are partially epipelagic and have had easy access in and out through the strait; in the Mediterranean *P. incolorata* occurs near the surface in winter, whereas during the summer it is supposed to descend into deep water (PICARD 1951*a* p. 21). A specimen of *S. eurygaster* was taken by the "Dana" in a haul with 1000 m. wire in the Tyrrhenian Sea (see above, p. 54), the previous records are from localities near the coasts. Two other species, the Anthomedusa *Tiaranna rotunda* and the Trachymedusa *Ransonia krampi*, have only been observed immediately inside the Straits of Gibraltar, and this may possibly also apply to *Arctapodema amplum*, which occurs mainly in the southern Atlantic and neighbouring antarctic waters, though it is also recorded from the Gulf of Guinea; it was taken in a haul between 1665 m. and the surface in the Alboran Sea (RANSON 1936); it seems probable, however, that *A. najadis* (PELL 1938) from the Adriatic Sea belongs to the same species.

Another peculiar occurrence in the Mediterranean is that of *Haliscera conica*, which occurs in antarctic waters and in the southern Atlantic as far north as South Africa, mainly at intermediate depths, 750—250 m.; the records from deep water in the Mediterranean (KRAMP 1924, RANSON 1936) may perhaps be open to doubt.

As a matter of fact, there is only one bathypelagic hydromedusa, which is really common and widely distributed in both the Atlantic Ocean and the Mediterranean, and that is an Anthomedusa, *Bythotiara murrayi*; in the Atlantic as well as in the Mediterranean it occurs in the intermediate and deep strata and is rarely met with at somewhat higher levels.

The reason why so very few of the many bathypelagic species in the Atlantic occur in the Mediterranean is undoubtedly the much higher temperature of the water in the deep strata in the Mediterranean, where it is almost constantly about 13° throughout the year. As seen from the above, species which sometimes ascend to higher levels may be carried in through the Straits of Gibraltar, and owing to the upwelling which takes place in the Bay of Cadiz outside the strait several more, even among the most distinctly bathypelagic forms, also have the possibility of crossing the threshold, where the greatest depth is 320 m., but evidently they are unable to settle down in the warm deep water in the Mediterranean.

One species, *Solmissus albescens*, seems to be endemic in the Mediterranean, where it is widely distributed and sometimes may be taken in great abundance. It is undoubtedly a deep-sea medusa, though it has also been taken on several occasions in the upper layers, especially in winter, but only in close vicinity of the coasts, where the bottom slope is steep. Specimens found under such circumstances are generally in a dying condition and have presumably been carried towards the surface by upwelling water from the deep-sea and may, therefore, be designated as indicators of such upwelling. Moribund specimens of this species have been found in the upper layers, partly together with *Octophialucium funerarium* and other deep-sea animals, near

the coasts in the Ligurian Sea, in the Gulf of Naples, on the north coast of Tunesia, and on the coast of Cyrenaica, indicating upwelling of water in these localities; previous records of the species in the Strait of Messina may be explained in the same way.

I am sorry to say that the question of the origin of the Mediterranean fauna (see above, p. 245) does not come nearer to a solution by means of the bathypelagic hydromedusae, which rather seem to confirm the apprehension of the Mediterranean fauna as an impoverished derivation from the Atlantic. There is the possibility, however, that during a colder period the Mediterranean has been inhabited by a richer fauna dying out as the temperature of the water increased to its present stage, which is too high for most of the species which abound in the Atlantic deep-sea.

4. The Atlantic Warm Water Region is divided into a number of deep basins with depths down to about 5000—6000 metres; they are separated by submarine ridges, but there is free communication across all the ridges at depths of at least 3000 m. below the surface of the ocean. It is possible that some species of medusae descend into the deepest layers in the basins, but we know very little about that and, at any rate, all of them also occur at depths of less than 3000 m. below the surface, and in these layers the communication is free. The ridges, therefore, cannot be presumed to establish any effective barriers to the horizontal distribution of the medusae, except indirectly by their influence on the hydrographical conditions. The currents in the deep and intermediate strata are slow, and it is only during very long periods and through numerous generations that the medusae have been carried along and attained their present extensive distribution. We may presume that the bathypelagic medusae are rather stationary (apart from vertical movements) in the areas where they occur, but it is possible that the hydrographical conditions in some of these areas are unsuitable to certain species, and since the 30 species of bathypelagic hydromedusae recorded from the warm-water region are not equally distributed, we must try to examine whether the differences may be explained by local conditions.

We will first describe the actual distribution of the species and, as a matter of fact, they may be divided into characteristic groups in this respect.

a). The arctic-boreal *Aglantha digitale* needs no further consideration.—*Crossota rufobrunnea*, which is a distinctly bathypelagic species, is generally distributed across the North Atlantic from the Wyville Thomson Ridge and its continuations across Greenland to Baffin Land, southwards to about 32° N., but never found further south (in contradistinction to *C. brunnea*, see below).

b). Species with a predominantly southern distribution, all occurring in the antarctic region, with a more or less scattered northward distribution: *Euphysora gigantea* and *Haliscera conica* to 35° S., the latter perhaps also in the Mediterranean (see above); *Arctapodema amplum* to the equator near Africa and in the Mediterranean; *Crossota brunnea* widely distributed in the South Atlantic to slightly north of the equator, in the other oceans likewise mainly restricted to the southern hemisphere. The distribution of *Pandea rubra* is discontinuous (so far as known up to now); besides in the Antarctic it is recorded from the waters around the Bermudas and west of the British Isles, always in deep water.

c). Generally, or almost generally distributed across the entire warm-water region, including the "boreal" region from its northern limits, most of them penetrating into the antiboreal or antarctic regions: *Pantachogon haeckeli, Halicreas minimum, Botrynema brucei, Chromatonema rubrum, Tiaranna rotunda, Aegina citrea, Aeginura grimaldii, Colobonema sericeum.*

d). Species occurring across the ocean, but only within the warm-water region proper: *Sminthea eurygaster, Persa incolorata* and *Halithephes maasi*, the first two partially epipelagic, the last distinctly bathypelagic.

e). Species distributed across the North Atlantic, but in the South Atlantic restricted to the eastern waters: *Rhopalonema funerarium, Solmissus incisa, Annatiara affinis, Euphysora furcata*, the first with an isolated record from the Argentine Basin north of South Georgia, the others never found south of about 38° S.

f). Species which have been found in the eastern Atlantic only: *Haliscera bigelowi, Bythotiara murrayi* (these two penetrating into the boreal region), *Ransonia krampi, Crossota alba, Pantachogon militare, Aglantha elata, Solmissus marshalli, Tetrorchis erythrogaster* (none of these north of 47° N. or south of 38° S.), *Amphogona apicata* (30° N. to 37° S. and near the Falkland Islands and South Georgia).

Since the most common and conspicuous of the species with a wide distribution have been taken in numerous localities in the western part of the South Atlantic, the absence of the species mentioned under *e*) and *f*) in that region can hardly be due merely to deficiency of knowledge. It is possible, however, that some of the species enumerated above have a wider distribution, especially in the South Atlantic, but it has proved necessary to disregard some of the statements by THIEL (1936), because he has united species, which really are distinct.

Circulation in the deep-sea. At the Antarctic Convergence, about 50° S. in the Atlantic, the north-going antarctic surface water sinks below the antiboreal water and continues far northwards as "antarctic

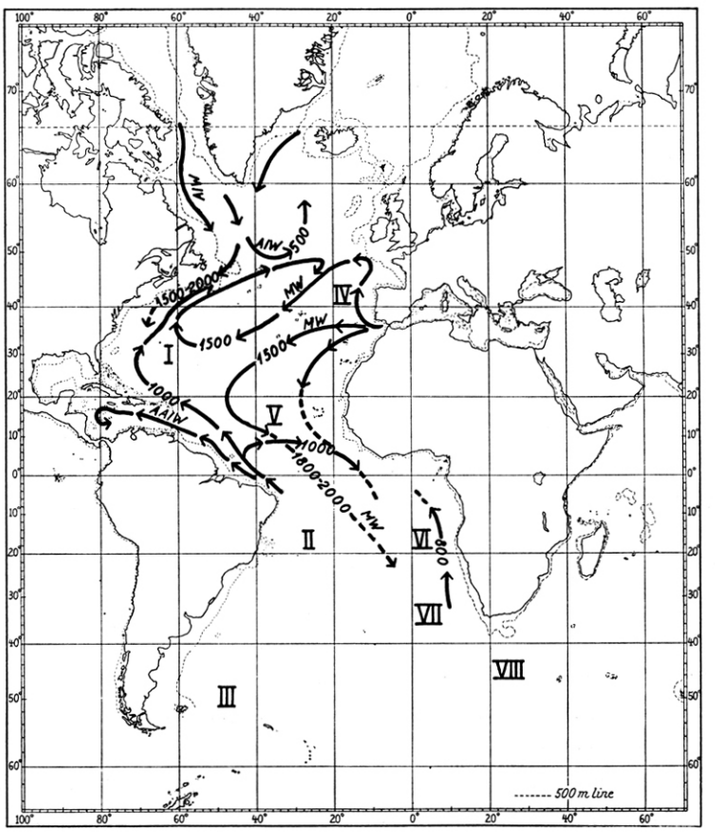


Fig. 329. Approximate directions of flow of the intermediate water masses. Numerals indicate average distances in metres from surface. — AIW Arctic Intermediate Water; MW Mediterranean Water; AAIW Antarctic Intermediate Water. — The figures I—VIII indicate the positions of the deep basins mentioned in the tables p. 258 (after The Oceans, from COE 1946, supplemented by the author).

intermediate water". It occupies a layer approximately between 800 and 1800 metres below the surface, varying in the different parts of the ocean, and it may be traced even as far north as in the North American Basin around the Bermuda Islands. Its temperature gradually increases by mixing with other water masses, and its salinity, which is less than 34.5 $^0/_{00}$ in its southern portions, likewise increases northwards. It flows slowly north, but it is only in the western Atlantic that it crosses the equator, sending a branch into the Caribbean Sea and another further north into the North American Basin, which also receives an influx of "arctic intermediate water" from the Davis Strait advancing below the layer of antarctic water. Part of the antarctic intermediate water, however, does not continue northwards from the Antarctic Convergence, but returns southwards as "antarctic deep water" (see below).

Another body of water has a considerable influence on the conditions of the deep and intermediate waters of the Atlantic; it originates from the Mediterranean, it is warm and salt (temp. 11.9°, sal. 36.5 $^0/_{00}$ off the

Straits of Gibraltar), and its effects are traced far away, southwards in the eastern Atlantic, north- and westwards in the northern Atlantic.

The various current systems are well illustrated in the map, fig. 329, and their effects on the temperatures in the different basins appear from the following tables.

Bottom temperatures at the greatest depths in the principal basins of the Atlantic warm-water region.

I. North American Basin	6000 m 2.5°	IV. Spanish Basin	4500 m 2.5°
(Para Rise)		(Azores Rise)	
II. Brazilian Basin	6000 m 0.4°	V. Cape Verde Basin	5700 m 2.5°
(Rio Grande Rise)		(Sierra Leone Rise)	
III. Argentine Basin	5300 m 0.1°	VI. Angola Basin	5500 m 2.4°
		(Walvis Ridge)	
		VII. Cape Basin	5200 m 0.9°
		VIII. Agulhas Basin	5200 m 0.2°

The eastern and western series af basins are separated by the Mid-Atlantic Ridge.

Even at the bottom in the deepest parts of the basins the temperature of the water increases remarkably from south to north, and in the South Atlantic the bottom temperatures are remarkably lower in the western than in the eastern basins. We know nothing about the fauna of medusae in these great depths; our knowledge of the bathypelagic medusae is mainly derived from depths of less than 3000 or 2000 m. below the surface, where the water masses are in free communication across the submarine ridges. When we will endeavour to trace a relation between the distribution of the medusae and the hydrographical conditions, a general impression of the hydrographical facts may be obtained by regarding the temperatures 1000 m. below the surface in conjunction with the directions of the various currents as they are seen in the map, fig. 329.

Temperatures 1000 m. below the surface above the basins.

I. North American Basin	7°	IV. Spanish Basin	9–10°
		V. Cape Verde Basin	5–6°
II. Brazilian Basin	3–4°	VI. Angola Basin	4°
		VII. Cape Basin	4°
III. Argentine Basin	2°		
		VIII. Agulhas Basin	2–3°

It is evident that the remarkable differences between the temperatures at these depths in the western and eastern Atlantic are due to the cooling effect of the antarctic intermediate water in west and the warming effect of the Mediterranean water in east, but the Mediterranean water proceeds far westwards in the North Atlantic raising the temperature in the North American Basin, though not to the same high degree as in the area off Spain and France. In the South Atlantic the Mediterranean water mainly keeps east of the Mid-Atlantic Ridge but dives down below the antarctic intermediate water, and its warming effect is diminished by mixing with the latter and with the still deeper water masses, which have lower temperatures and are moving southwards. In these deeper layers the differences between the various areas are more or less effaced; at higher levels the temperatures are influenced by the radiation of the sun. Altogether, the conditions are, of course, more complicated than set forth in the account above which, however, covers the essentials in the water masses in which the bathypelagic medusae mainly occur.

The correlation with the distribution of the medusae is obvious, at least as far as the majority of the species is concerned. I refer to the groups *a*—*f* mentioned above.

a). It is very remarkable that the distribution of *Crossota rufobrunnea* is restricted to the North Atlantic, where it is generally distributed in the deep and intermediate strata north of about 30° N. It is probably not the lower temperatures in the South Atlantic which prevent this species from penetrating further south, since it is abundant at comparatively low temperatures, 3.1—3.8°, in deep water in Davis Strait. Its restricted distribution must be considered in connection with a discussion of the speciation of the genus *Crossota*, of which four species occur in the Atlantic, one in the high-arctic deep-sea, one in the North Atlantic, and two in the South Atlantic.

b). Among the 5 southern species enumerated under this group *Crossota brunnea* has been collected in numerous localities from the antarctic region northwards to a little beyond the equator. The records of the other four species outside the antarctic region are so very few, partly even uncertain, that they do not afford a sufficient basis for a zoogeographical discussion.

c). With the exception of the eurybathic *Aegina citrea* these 8 widely distributed species are distinctly bathypelagic. Six of them (*Botrynema brucei* and *Chromatonema rubrum* being the exceptions) have been found in the Bay of Cadiz, where upwelling of water from deep strata frequently takes place, which might give them access to the Mediterranean across the threshold in the Straits of Gibraltar, and *Tiaranna rotunda* has really been found in the upper layers in the strait, but none of them occur in the Mediterranean. All these species have an extensive distribution from east to west and from north to south in the Atlantic and may accordingly tolerate temperatures within the limits measured in the intermediate and deep layers in all parts of the Atlantic, but they avoid the high temperature, about 13°, of the deep water in the Mediterranean. Two of them, *Aeginura grimaldii* and *Colobonema sericeum*, also avoid the low temperatures in the southernmost parts of the Atlantic (see below).

d). *Sminthea eurygaster* and *Persa incolorata*, which occur mainly in the upper portion of the bathypelagic zone and may ascend into still higher layers, are evidently warm-water species. *Halitrephes maasi*, on the other hand, is decidedly a deep-sea medusa, which has been observed in the upper layers only on one occasion (near the southern part of the west coast of Africa, where upwelling takes place). In the North Atlantic it has been found only in the western parts, in hauls with 1000, 2500 and 4000 m. wire out; in the South Atlantic it has been taken mainly in the eastern waters, where it occurs in deep as well as in intermediate layers; in the western parts of the South Atlantic the hauls, in which this species was taken, are given as 2700—0, 2500—0 and 2000—0 m.; the exact depth of capture, therefore, cannot be stated; but in the two southernmost localities, 48—50° S., the isotherms are almost perpendicular from 2000 m. to near the surface, so that we may state that the medusae have lived there at a temperature of about 1—1.5°, perhaps 2°.

e). The 4 species, which I have referred to this group, occur in the western as well as in the eastern parts of the North Atlantic, but in the South Atlantic their occurrence is restricted to the eastern waters, off the African coast; apparently they avoid the lower temperatures in the western waters. All of them are predominantly bathypelagic; near the west coast of Africa *Rhopalonema funerarium* may occasionally occur at higher levels, indicating upwelling of water. *Solmissus incisa* is a well-marked deep-sea medusa.

f). This group comprises 9 East-Atlantic species. The Anthomedusa *Bythotiara murrayi* occurs in some of the deep Norwegian fjords and is common in the Mediterranean, where none of the others occur. The distribution of *Haliscera bigelowi* extends northwards to the southern slope of the Wyville Thomson Ridge; *Amphogona apicata* has been found in the south-western Atlantic 1000—750 m. below the surface. The limits of distribution of the others are the Bay of Biscay and the waters near the Cape of Good Hope. All of them are distinctly bathypelagic, except that some of them have been taken in upwelling water near the African coast, and they all belong to the eastern parts of the Atlantic, where the temperatures of the deep and intermediate strata are comparatively high.

As a result of these statements and considerations we may state that the temperature of the water is an important determining factor for the distribution of the bathypelagic hydromedusae within the warm-water region. Some few are more or less eurybathic and may endure the high temperatures of the upper layers in

tropical seas, and to some extent the varying temperatures in the Mediterranean Sea (*Sminthea eurygaster* and *Persa incolorata*). The distinctly bathypelagic species, on the other hand, avoid high temperatures; with only one exception (*Bythotiara murrayi*) they do not occur in the Mediterranean, and when some of them occasionally approach the warm surface layers, it is due to upwelling of cold water from below. They also avoid very low temperatures and, therefore, cannot live in the cold deep-sea regions north of the North-Atlantic transversal ridges. Some of them follow the southward penetration of Atlantic deep water towards the Antarctic Continent, but in these high southern latitudes they never ascend into the antarctic water above. Many of them are even so sensitive that the comparatively slight differences between the temperatures in the different parts of the ocean prevent them from attaining a general distribution. Most of them seem to prefer the temperatures above c. 4° in the North Atlantic and the eastern parts of the South Atlantic.

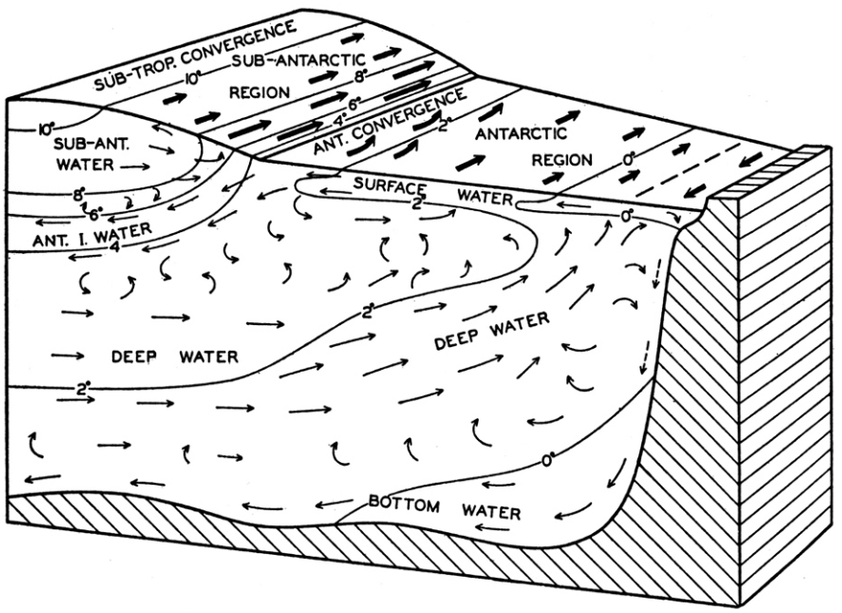


Fig. 330. Schematic representation of the currents and water masses of the Antarctic region and of the distribution of temperature (after The Oceans).

Upwelling of water from deeper strata is indicated by the occurrence of bathypelagic medusae at higher levels in several localities along the west coast of Africa, as follows: the Bay of Cadiz (*Tiaranna rotunda* and *Ransonia krampi*), southern part of the Mauretanian coast (*Ransonia krampi*), south of Cape Blanco (*Rhopalonema funerarium*), western and southern slopes of the Cape Verde Islands plateau (*Pantachogon haeckeli* and *Solmissus marshalli*), between Cape Verde and Freetown (*Ransonia krampi, Rhopalonema funerarium* and *Halicreas minimum*), off Cape Palmas (*Annatiara affinis*), near the small islands St. Thomas and Annobon in the Gulf of Guinea (*Rhopalonema funerarium, Solmissus marshalli* and *Halicreas minimum*), off the mouth of Congo (*Solmissus marshalli*), near Luderitz Bay (*Halitrephes maasi*).

5. The antiboreal region.—Whereas the North-Atlantic Transversal Ridge constitutes a distinct barrier for the northward distribution of the bathypelagic warm-water medusae, there is no such natural barrier in the southern Atlantic. Even the plateau around the Falkland Islands, South Georgia and the South Sandwich Islands has depths of more than 3000 m., and further east the deep Argentine and Agulhas Basins are in direct communication with the Antarctic Basin. The Atlantic Deep Water, therefore, has free admission towards the slope of the Antarctic Continent (see the well known block diagram, fig. 330). In accordance herewith the southward distribution of the bathypelagic medusae depends only on the sensibility of each single species to the gradually lowered temperatures of the deep water. I have previously dealt with the southward distribution of some of these species (Kramp 1957, pp. 100—106, illustrated by maps), and I found that a slight difference in temperature puts a stop to the penetration of some of them.

Among the 14 species enumerated in Table XI as occurring in the antiboreal region the following have reached only as far south as the northern slope of the Falkland—South Georgia plateau: *Tiaranna rotunda*, *Rhopalonema funerarium*, *Aegina citrea*, *Halithephes maasi* and *Amphogona apicata*; they were taken, partly in closing-nets, at depths between about 300 m. and more than 1000 m., where the temperature of the water was at least 1°, probably 2° or more. *Aeginura grimaldii* is recorded from south-west of Tristan da Cunha, 41°13′ S. 17°05′ W., 750—0 m. (THIEL 1936 p. 86, as *Aeginura lanzerotae*), the only locality from which this species has been recorded south of 20° S.

The following species, which have their principal occurrence in the warm-water region, penetrate farther south, even into the Weddell Sea: *Pantachogon haeckeli*, *Halicreas minimum*, *Botrynema brucei* and *Chromatonema rubrum*. Their occurrence in these southern latitudes is restricted to the deep strata, the "warm deep water" with temperatures slightly above 0°.

Crossota brunnea occupies a special zoogeographical position; it has been collected in numerous localities south as well as north of the Falkland—South Georgia plateau, whence it is distributed northwards to the equator; in the Indian Ocean it has been found in some localities near the Antarctic Continent as well as in the tropics. It always occurs in deep water.

All these have their principal areas of occurrence in the central parts of the warm-water region; but there are also a number of species which belong to the antarctic region, whence they penetrate northwards into the antiboreal region, or further. This applies to *Euphysora gigantea* (northern limit of distribution 35° S.), *Haliscera conica*, which has been found near the Cape of Good Hope (and perhaps in the Mediterranean, see above), *Pandea rubra* and *Arctapodema amplum*, both of which are recorded from scattered localities much farther north.

The deep and intermediate water below the antiboreal surface water does not constitute a distinct zoogeographical region, but is merely a transitional area between the equatorial belt and the antarctic region, and it has no endemic species. It resembles the boreal region, in so far as it is merely a part of the Atlantic warm-water region, but it differs from the boreal region in the absence of a distinct boundary line to separate it from the cold areas in higher latitudes.

6. The antarctic region.—The number of species enumerated in Table XI as occurring in the antarctic region amounts to 12. Five of them, which are immigrants from the north, and four others, which have spread from the antarctic seas more or less northwards, are mentioned above. The remaining three species distinctly belong to the antarctic region, though not to the antarctic water-masses. Two of them are recorded only from rather few localities. *Arctapodema antarcticum* has been taken in closing-nets west of the South Sandwich Islands, 750—250 m. (temperature about 0.5—1°) and west of South Georgia, 1400—1000 m. and 1800—1300 m. (temp. about 2—2.5°), thus in the Atlantic Deep Water. In the Indian sector of the Antarctic it was likewise taken in deep water, and moreover it was found in a locality considerably farther north, 32° S. 75° E., between South Africa and Australia in a haul from 1050 to 600 m. I have previously expressed the opinion (KRAMP 1957 p. 100) that this occurrence might indicate that the northward movement of antarctic bottom water in the Indian Ocean is particularly strong along the Kerguelen-Gaussberg Ridge, which extends far northwards at this longitude, about 75° E. This species thus seems to be very stenotherm, avoiding the antarctic surface water as well as the Atlantic Deep Water where its temperature is above 2 or 2.5°.

Haliscera racovitzae occurs at somewhat higher levels, 600—0 and 200—0 m. in the Weddell Sea, where the temperature at depths from 200 m. downwards is above 0°, and near South Georgia, 750—500 m., temp. about 1.7°.

Calycopsis borchgrevinki is a common medusa in the antarctic region, where it has a circumpolar distribution with a northern limit almost exactly following the Antarctic Convergence. It occurs at very different depths, though never so near to the surface that it is exposed to the antarctic surface water. In the surroundings of South Georgia and the South Sandwich Islands it has been taken at all depths between about 200 m. and 1500—2000 m. below the surface, at temperatures between about 0.25 and 2°. Further east in the South Atlantic south of 50° S. it occurs at somewhat higher levels, where temperatures of 1—2° reach right up to the surface. Accordingly this is also a very stenotherm species, avoiding temperatures above c. 2° and below c. 0.5°; its area of distribution falls within the antarctic region, but it is not a truly antarctic species.

As a general result we may state that the fauna of predominantly bathypelagic, oceanic hydromedusae in the antarctic region consists of three groups of species, some eurytherm warm-water species which may tolerate the temperatures in the body of Atlantic Deep Water which penetrates below the antarctic surface water almost to the slope of the Antarctic Continent; some which have their principal occurrence in this same body of water, but also may occur in latitudes with much higher temperatures; and three species which are remarkably stenotherm with a low optimum and are restricted to the deep and intermediate layers below the antarctic surface water, but unable to enter into the slightly warmer regions north of the Antarctic Convergence.

In the arctic region the deep basins contain enormous bodies of very cold arctic water-masses inhabited by three species of arctic, bathypelagic (or partly bathypelagic) hydromedusae. In the antarctic region the strata below the antarctic surface water consists of Atlantic water with temperatures between about 0 and 2°, separated from the bottom of the sea by a comparatively thin layer of antarctic bottom water, sinking down along the continental slope, and from this water no medusae are known.

Comparison with the epipelagic fauna.—In the epipelagic as well as in the bathypelagic zone the majority of the oceanic species of hydromedusae belong to the warm-water region, but the distribution towards or into the adjacent regions is remarkably different for the two faunas.

In the arctic region we know one endemic species with an extensive vertical distribution and two distinctly bathypelagic endemic species.

The boreal region has no endemic oceanic species, neither of epipelagic (apart from two rare species), nor of bathypelagic forms. The epipelagic warm-water species, which penetrate into the boreal region, occur only in its southernmost parts, whereas most of the bathypelagic warm-water species have an extensive distribution in the boreal region, many of them right up to the North Atlantic Transversal Ridge.

The Mediterranean Sea has three endemic epipelagic species, but only one bathypelagic. About half the number of the epipelagic species in the Atlantic warm-water region occur in the Mediterranean, whereas only one bathypelagic species, and that an Anthomedusa, is common in both regions, besides two which are partly epipelagic; three species have been observed immediately inside the Straits of Gibraltar, and the sporadic occurrence of one species is somewhat doubtful.

The antiboreal region receives a very slight and occasional invasion of epipelagic warm-water species, whereas the distribution of several bathypelagic warm-water species is extended more or less into this region, partly even further south.

The fauna of epipelagic, oceanic hydromedusae in the antarctic region is very poor, consisting of only four species, two of which are endemic. Among the bathypelagic species nine occur in the Atlantic warm-water region (some of them in great abundance) and also in the Atlantic deep water below the antarctic surface water; three species are endemic in the antarctic region but remain in the deep and intermediate layers with temperatures above 0°. All these bathypelagic species occur within the antarctic region, but not in antarctic water.

These summarized remarks prove the characteristic ecological difference between the epipelagic and the bathypelagic fauna.

Distribution in the other oceans.—No natural barriers prevent an exchance of bathypelagic medusae between the Atlantic and the Indian Oceans and further east into the Pacific, and the majority of the Atlantic species really occur in the other oceans, as immediately seen from Table XI. But there are some exceptions.

The arctic-boreal *Aglantha digitale* and the distinctly arctic *Aeginopsis laurentii* are circumpolar in the arctic seas, but the two arctic deep-sea species *Crossota norvegica* and *Botrynema ellinorae* have only been found in the western basins of the Polar Sea.

Among the species which have their principal occurrence within the antarctic region *Calycopsis brochgrevinki* and *Haliscera conica* are circumpolar. *Pandea rubra*, *Arctapodema amplum* and *A. antarcticum* occur in the Indian sector of the antarctic region but have not yet been found in the Pacific, where the antarctic waters are very insufficiently investigated. *Haliscera racovitzae* and *Euphysora gigantea* are known from the Atlantic sector only.

One species, *Solmissus albescens* is endemic in the Mediterranean.

Among the 29 species belonging to the Atlantic warm-water region there are only two or three which have not been found somewhere in the other oceans. One of them, *Aglantha elata*, is a somewhat doubtful species, recorded by HAECKEL (1879) and MAAS (1893) from two localities off the west coast of Africa; it may be identical with *A. elongata* which is recorded from south-eastern Australia. *Ransonia krampi* and *Pantachogon militare* occur off the entire west coast of Africa but are not observed elsewhere.

Seven species are almost evenly distributed and very common in the warm parts of all the oceans (see the Table); the same probably applies to *Botrynema brucei* and *Chromatonema rubrum*, though the present records of these two species in the Indian and Pacific Oceans are somewhat scattered. The latter may, however, be identical with *C. erythrogonon* in the eastern tropical Pacific, and *C. hertwigi* which was found in the Bay of Bengal. The different species of *Crossota* will be specially mentioned below.

There are, however, seven species, which are widely distributed in the Atlantic, but have been found only in some few localities in the Indian Ocean and never in the Pacific, with the exception that the two eurybathic species, *Persa incolorata* and *Sminthea eurygaster*, have recently been recorded from South-East Australia. The others are *Euphysora furcata, Amphogona apicata, Annatiara affinis, Tiaranna rotunda* and *Bythotiara murrayi*. They might be supposed to be of Atlantic origin, in the act of extending their distribution eastwards into the other oceans, but not yet commonly established there.

Still more remarkable is the distribution of the following four species, which are more or less widely distributed in two distant areas, the Atlantic and the eastern tropical Pacific. One of them is *Rhopalonema funerarium*, which has been found in two localities in the antiboreal part of the Indian Ocean, whereas the three others, *Solmissus incisa, Tetrorchis erythrogaster* and *Haliscera bigelowi* have never been observed in the Indian Ocean. In the Pacific the two latter species have been found only in the eastern tropical waters, where they are fairly common, whereas *S. incisa* also occurs in the northern Pacific and near Japan. The peculiar distribution of these species might indicate that they are survivors from a time when there was a free communication between the Atlantic and Pacific Oceans across Central America; but this supposition is contradicted by the fact that in the Atlantic all of them have their principal distribution in the eastern parts of the ocean and have never been found in the West Indies.

The peculiar distribution of the genus *Crossota* is not easy to explain, and the discussion of the possible reasons is better postponed to the concluding chapter. Here I shall only give the available facts. One species, *C. brunnea*, is widely distributed and very common in the deep strata in the Atlantic and Indian Oceans, probably also in the Pacific where, however, it is only recorded from a number of localities in the eastern tropical region, besides a single record from the antarctic region and one from Japan. Most remarkable is the fact that its distribution in all the three oceans is restricted to the southern hemisphere (apart from the record from Japan). *C. rufobrunnea*, on the other hand, belongs to northern waters, being common and generally distributed in deep water in the Atlantic north of about 30° N., and in corresponding latitudes in the northern Pacific, thus in two widely separated areas, and also separated from *C. brunnea*. *C. alba* likewise occurs in two widely separated areas, in the eastern Atlantic from the Bay of Biscay almost to South Africa, and near Japan in the Pacific. *C. norvegica* has been found in three localities in the arctic bottom water of the Norwegian Sea. A fifth species, *C. pedunculata*, was taken in a single locality off the west coast of North America. I have examined the four first-named species myself and may state with certainty that they are distinct and valid species.

Finally I will call attention to the remarkable fact that we do not know one single species of bathypelagic hydromedusae from the Indian or Pacific Oceans which does not occur in the Atlantic.

The more or less discontinuous distribution of several bathypelagic species may be due partly to insufficient knowledge of the Indian and Pacific faunas; on the other hand, the fact that the species may be divided into groups, each with a characteristic distribution, indicates that there is a reality behind the apparently peculiar data derived from our present knowledge.

4. Concluding remarks.

In every discussion of zoogeographical problems we have to issue from our present knowledge, and since many geographical areas are insufficiently investigated, we must always consider the possibility of species turning up in unexpected localities, which may upset the suppositions we had advanced. Moreover it is indispensable that the identification of the species be quite certain; much confusion has arisen from taxonomic uncertainty or mistakes. I will especially call attention to the inclination by some authors to unite several different species, which perhaps occur in quite different areas. It is better to retain too many species than to draw unreliable zoogeographical conclusions from a heterogeneous assemblage of presumably identical species. In the literature we find many insufficient descriptions of species, and it is more advisable to keep them separate than to unite them with other and better known species without very convincing reasons.

Since medusae are pelagic animals, they may be carried along with the currents over distances which depend on the duration of their pelagic life and the physical conditions in the waters into which they are conveyed. The limits of a continuous distribution, therefore, is usually easily explained. The problems arise when the distribution of a species is found to be discontinuous. In such cases we must consider the question as to whether the discontinuity is an established fact or merely due to insufficient knowledge of the fauna in the intervening spaces. Some such problems will be discussed in the following pages.

A. Discontinuous distribution within the Atlantic Ocean and adjacent waters.

A, 1. Bipolarity.—It should first be emphasized that no indication of bipolar distribution is known among the oceanic hydromedusae, neither the epipelagic nor the bathypelagic species or genera. The few of these species inhabiting either the arctic or the antarctic regions are entirely different, and the boreal and antiboreal regions are inhabited by warm-water species penetrating more or less towards the north and the south. But among the neritic forms we know four species with a bipolar distribution. Only one of them, the semibenthic Trachymedusa *Ptychogastria polaris*, belongs to the polar seas, being circumpolar in the arctic as well as in the antarctic regions; the genus, however, is not bipolar, since another species occurs in the Mediterranean.

The three other bipolar species, *Euphysa aurata*, *Staurophora mertensi* and *Halopsis ocellata*, are meropelagic Antho- and Leptomedusae, which are widely distributed and very common in the boreal waters and have also been found in the antiboreal region, near the Falkland Islands. All of them are so characteristic and well known that we may state with certainty that they do not occur in the warm regions between their northern and southern areas of distribution. It is true that THIEL (1938 p. 290), who has recorded *E. aurata* from the Patagonian Bank, will unite all the other species of *Euphysa* with *E. aurata*, but he gives an adequate description of the two Patagonian specimens, from which the idenfication seems reliable; moreover, the only two other Atlantic species of this genus have a distinctly northern distribution. The other bipolar species mentioned above have been examined by myself, and their identification is beyond doubt.

The problem of bipolarity has been much discussed. As far as the present four species of medusae are concerned, I am inclined to support the view that there was a time during the glacial periods, when the waters in the equatorial belt had temperatures low enough to be inhabited by animals, which now are restricted to higher latitudes. The increasing temperatures killed these animals in the tropical seas, and they retreated into colder areas, some of them only one way, others towards the south as well as towards the north, and these species became, what we now call bipolar. There is not the slightest reason to believe that the four species of medusae mentioned above might have a continuous distribution in the cold deep-sea layers of the ocean.

Two bipolar genera must be mentioned: *Halitholus*, which has two arctic and one antiboreal species, the latter being structurally intermediate between the two others, and *Ptychogena* with the two species *lactea* and *antarctica*, which are very similar to each other, but distinct and valid species.

A, 2. Discontinuity between east and west. The oceanic medusae present no problems in this connection. Any apparent discontinuity in the distribution of these animals may be due to insufficiency of knowledge, and the same applies to a number of rare species among the neritic.

It was pointed out above (pp. 214, 222) that many neritic species are common to the West-Atlantic and the East-Atlantic boreal regions, which is quite comprehensible, since these two regions are connected by coastal areas with only fairly narrow gaps of open water, which may easily be traversed, at least occasionally. It is more remarkable when a neritic warm-water species is found in both sides of the Atlantic. The vast majority of these species are restricted to one or the other side, indicating that a transgression across the ocean is difficult, and nevertheless some species have accomplished such a journey.

Some species may have been transported by ships. This probably applies to *Gonionemus vertens*, which for many years was known only from the American coast, but has now been observed in several European localities; perhaps also to *Olindias phosphorica* (with its varieties) and *Cladonema radiatum*; all these live among seaweed, to which their polyps are attached, and it is presumably in the polyp stages that the distribu-

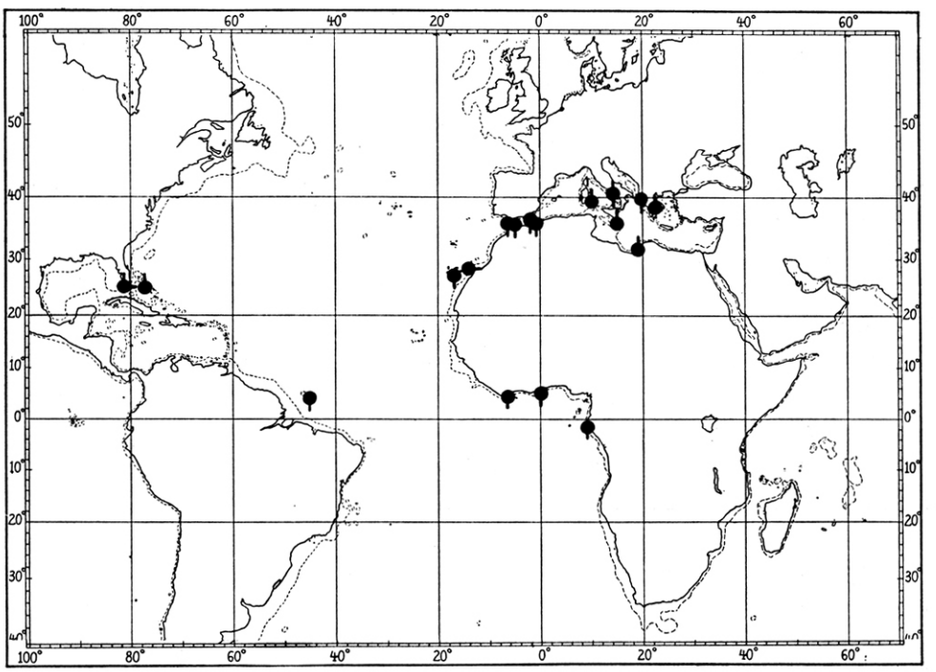


Fig. 331. Distribution in the Atlantic Ocean and the Mediterranean of *Merga violacea* (●–), *Staurodiscus tetrastaurus* (●) and *Lovenella cirrata* (●), three species belonging to eastern waters and sporadically observed in Western Atlantic.

tion of these species is extended to distant coasts. *Blackfordia virginica* is indigenous in the Black Sea, and its occurrence in Chesapeake Bay in America and in the Ganges estuary in India is most probably due to transportation by ships. It is also possible that the American medusa *Nemopsis bachei* has been transported in a similar way to the two European localities where it has been found.

Three species, *Merga violacea*, *Lovenella cirrata* and *Staurodiscus tetrastaurus*, which occur partly in the Mediterranean, partly on the west coast of Africa, have each been found in one or two localities in tropical American waters (see the map, fig. 331); on the other hand, *Bougainvillia carolinensis*, *Stomotoca pterophylla* and *Rhacostoma atlanticum* belong to the American coast between Cape Cod and Florida, and each of them has been found in one single locality near the west coast of Africa (see the map, fig. 332). I am unable to propose an explanation of the distribution of these species; the duration of their pelagic life is hardly long enough to enable them to cross the ocean by passive transportation with the transatlantic currents (perhaps with the exception of *Rhacostoma atlanticum*, which is a fairly large medusa). Various exceptional circumstances may be imaginable, and I don't think we need to take refuge in a supposed closer geographical connection in a former geological period. If so, we might expect a considerably greater number of the neritic warm-water species to be common to the coastal waters in the eastern and western Atlantic. The fact remains that

discontinuous distribution may occasionally be brought about under special circumstances which are beyond our apprehension.

A, 3. Antarctic and antiboreal elements in the South-African fauna (see the maps, fig. 333 and 334).—In spite of the great distances between the few small islands in the southern Atlantic five neritic species of hydromedusae belonging to the antiboreal coastal waters in the south-western Atlantic and adjacent parts of the antarctic region have been found in the South-African region (see above, p. 230). Owing to the cooling effect of the Benguela Current the physical conditions in this region may be favourable to these species, and the directions of the currents are not contradictory to a transportation from one group of islands to another and finally to the South-African coasts. It is also very probable that the species actually live near these islands, though they have not yet been found there. But whether they have followed a southern route

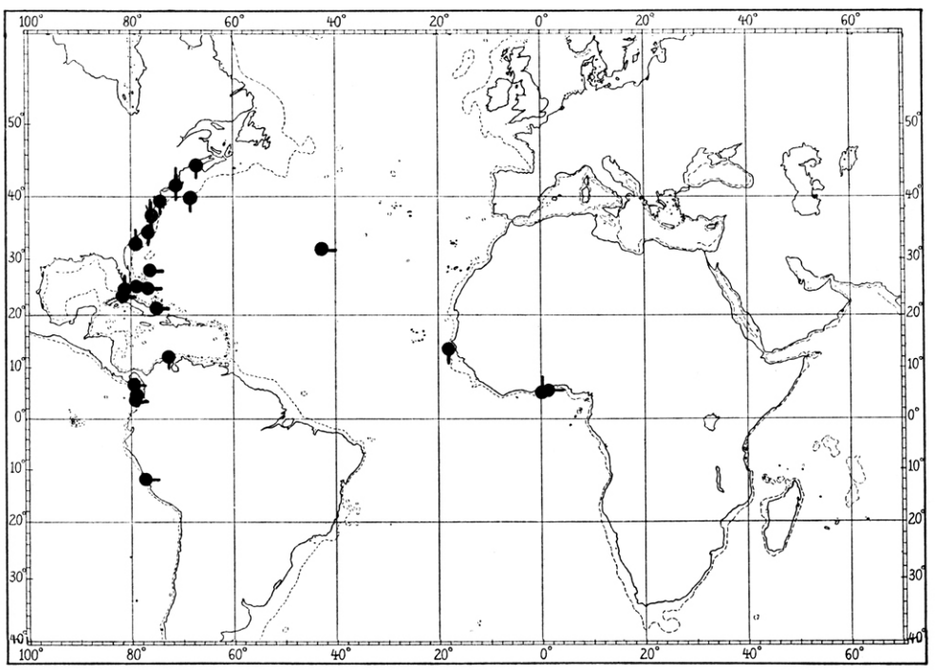


Fig. 332. Distribution of *Bougainvillia carolinensis* ●, *Stomotoca pterophylla* ●— and *Rhacostoma atlanticum*[1]) ●, three species belonging to West-Atlantic waters and sporadically observed off the west coast of Africa.

from the Scotia Sea area *via* Bouvet Island or a northern route *via* Gough Island and Tristan da Cunha, they must have crossed extensive deep-sea basins. The distances from the Cape of Good Hope to Bouvet Island is about 1300 miles, to Gough Island only slightly less, a considerable distance for these small medusae. It is possible, however, that their hydroids may have been transported with drifting sea-weed, favoured by the prevailing directions of the currents.

None of the antarctic species of oceanic medusae have been found in the South-African region (see p. 251).

A, 4. Arctic survivors.—As mentioned above (p. 220) three arctic species of Anthomedusae, *Halitholus cirratus*, *Euphysa tentaculata* and *Plotocnide borealis*, have an isolated occurrence in the waters between the Skagerrak and the Baltic, and have been considered arctic survivors. Recently, however, Mr. D. Edwards, Millport, informed me in a letter, dated 13th March 1958, that he has found *Plotocnide borealis* in the Clyde area, Scotland[2]), which bridges the gap between the arctic distribution of this species (West Greenland, White Sea and the Siberian Polar Sea) and its occurrence in Oslo Fjord, a severe warning against premature supposition of discontinuous distribution!

For the two other species we may provisionally retain the supposition that their occurrence in the Baltic

[1]) After the above was printed, I have seen a specimen of *Rhacostoma atlanticum* collected off the mouth of Congo in tropical West Africa.

[2]) I have seen the specimens and verified the determination.

area is widely separated from their further, decidedly arctic distribution. They have probably invaded the Baltic area during the cold period of the Yoldia Sea. When the Baltic Basin was cut off from the Atlantic Ocean and transformed into a fresh-water lake, the Ancylus Lake, they survived in the exterior parts of the area, probably in the deep channels of the Kattegat, which remained as a fjord with sufficiently high salinity for these animals. During the subsequent warm period they disappeared from the western Scandinavian coasts, but adapted themselves to a continuous existence in the Kattegat, whence one of them, *H. cirratus*, later invaded the Baltic proper, where it is now very abundant, especially in the cold, deep basins.

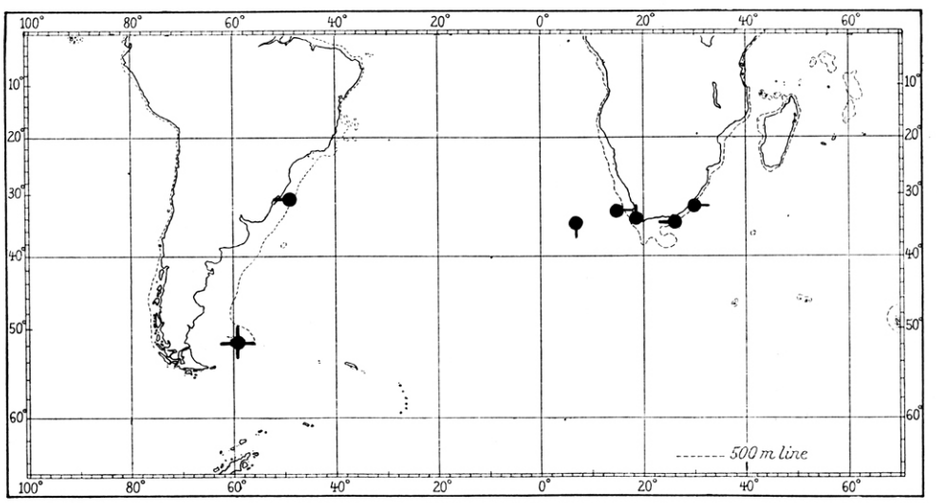


Fig. 333. Distribution in the southern Atlantic of four species belonging to antiboreal or antarctic waters and also found in the South-African region. ● *Sarsia gracilis*, ● *Mitrocomella frigida*, ●– *Halitholus intermedius*, –● *Phialidium simplex*.

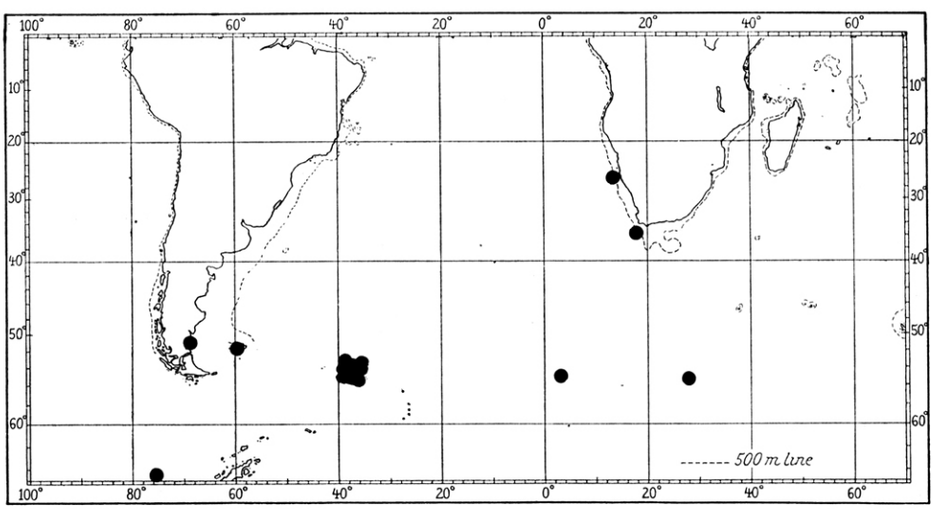


Fig. 334. Distribution in the southern Atlantic of *Cosmetirella davisi*.

B. Summary of the Mediterranean fauna.—In the composition of the Mediterranean fauna the three ecological groups of hydromedusae, neritic, epipelagic-oceanic and bathypelagic oceanic, behave in rather different ways, which are mentioned above, especially pp. 226, 245, 255, and may be summarized as follows.

65 neritic, 19 epipelagic and 8 bathypelagic species are known from the Mediterranean. 17 neritic, 3 epipelagic and 1 bathypelagic species are "endemic", *i. e.* up to now they have not been found elsewhere. In the composition of the neritic fauna the boreal elements distinctly predominate over the tropical, whereas the epipelagic-oceanic forms are predominantly tropical. Apart from the "endemic" species, all the epipelagic

and bathypelagic and all the neritic except one rare species also occur in the Atlantic Ocean. On the other hand, numerous Atlantic species do not occur in the Mediterranean. This applies to a great number of neritic species and to 16 epipelagic warm-water species (among 32). Among 25 bathypelagic species in the central parts of the Atlantic only 7 have entered through the Straits of Gibraltar; two of them are partially epipelagic and have had easy access through the strait, 5 have ascended towards the surface with upwelling water from deeper strata in the Bay of Cadiz and have been carried in with the inflowing surface water, but have reached only slightly inside the strait, being unable to settle in the warm, deep water in the Mediterranean; only one strictly bathypelagic Atlantic species, *Bythotiara murrayi*, is widely distributed in the Mediterranean.

Among the neritic species in the Mediterranean 16 occur in the Indian or Pacific Oceans, but only one of these has not yet been found in the Atlantic; it is a rare species, *Eutonina scintillans*, with a scattered distribution, only seen in the Red Sea and off the Pacific coast of Mexico. 10 of the epipelagic and 6 of the bathypelagic species occur in Indo-Pacific waters, all of them also in the Atlantic.

In its present state, accordingly, the Mediterranean fauna of hydromedusae has a distinctly Atlantic character and may safely be designated as an impoverished Atlantic fauna. But this does not imply that it is entirely derived from the Atlantic. Some species may be descendants from the Tethys fauna, as presumed by some authors, whereas others have immigrated from the Atlantic. Among the neritic and epipelagic species a further immigration is possible, but the temperature in the deep strata is too high for the majority of the strictly bathypelagic species. It is possible, however, that the great difference between the bathypelagic faunas of the Atlantic and the Mediterranean has not always been so pronounced as it is now; during a former, colder period the Mediterranean may have been inhabited by a richer fauna which died out as the temperature increased.

One of the facts which have given rise to much speculation is the presence in the Mediterranean of several species of other groups of animals which occur in Indo-Pacific waters but not in the Atlantic. No such species are known among the hydromedusae which, therefore, do not contribute to a solution of the question of the origin of the Mediterranean fauna, but rather confirm the apprehension that it is an impoverished derivation from the Atlantic.

C. Interchange between the Atlantic Ocean and the Indian and Pacific Oceans.— A thorough discussion of this subject involves a mutual comparison between the faunas in all the oceans and their adjacent waters, for which we are not prepared, as long as considerable geographical areas are insufficiently investigated. When the large collections from the "Dana" expedition across the Pacific and Indian Oceans, and from other expeditions in these waters, have been worked up, we may be better equipped for such a mutual comparison, which may lead, not merely to a knowledge, but also to an understanding of the distribution of the animals, the genera and families as well as the species, which is the real object of zoogeography. Provisionally I must confine myself to an account of the further distribution of the Atlantic hydromedusae in the other oceans and an attempt, however unpretentious, to approach an understanding of the determining factors.

The possibilities of distribution are different for the oceanic and the neritic species which, therefore, must be treated separately. Among the "slope species" only two species of *Calycopsis* have been found outside the Atlantic; they will be dealt with in connection with the neritic.

C, 1. Neritic species.—When the 17 endemic Mediterranean species are excluded, 234 species of hydromedusae directly dependent on the coastal shelves and slopes are known from the Atlantic and adjacent waters, besides an undetermined number of *Obelia*, which cannot be specifically identified. Among these 234 species as many as 146 have been found only in the Atlantic. A similar number of Indo-Pacific species, about 158, are unknown in the Atlantic. The number of species which occur in the Atlantic as well as in the Indian or Pacific Oceans amounts to 88, *viz.* 50 Anthomedusae, 30 Leptomedusae, 7 Limnomedusae and 1 Trachymedusa (*Ptychogastria polaris*).

The distribution of these species will be discussed in the following pages, but we must bear in mind that the results can only be provisional, partly on account of still existing uncertainty of exact identification of

some species (though rather few I hope), partly because future investigations may increase our present knowledge of the distribution of several species.

In my attempts to elucidate the ways in which the present distribution of the various species may have been established, I shall begin with the cases which leave no doubt.

The North Polar Seas constitute an uninterrupted route of distribution for species which may endure the low arctic temperatures, and a more or less continuous distribution between the North-Atlantic and the North-Pacific arctic waters is stated for at least 16 species, but not all them are completely circumpolar. *Eumedusa birulai* is generally distributed from the north coast of Alaska westwards along the Siberian coast to the Kara Sea, but not further west. *Catablema multicirrata* and *Halitholus pauper*, on the other hand, are unknown in the Eurasian Polar Sea, and their occurrence in the waters west of Greenland and in the northern Pacific may be connected through the channels between the arctic Canadian islands, where the fauna is almost unknown. The following species have an almost continuous distribution from West Greenland along Eurasia to Bering Strait, whence all of them penetrate more or less into the northern Pacific. Predominantly arctic species: *Ptychogastria polaris* (also in the Antarctic), *Sarsia princeps*, *Euphysa flammea*, *Plotocnide borealis*, *Halitholus cirratus*, *Catablema vesicarium*, and *Ptychogena lactea*; arctic-boreal species: *Sarsia tubulosa*, *Hybocodon prolifer*, *Rathkea octopunctata*, *Bougainvillia superciliaris*, *Staurophora mertensi*, and *Tiaropsis multicirrata*.

The South Polar Seas constitute a broad, open belt of water around the Antarctic Continent. Unfortunately the Pacific sector is very insufficiently investigated. Strictly antarctic species may follow the continental coast all the way round, but neritic species which require somewhat higher temperatures must concentrate around the scattered groups of islands in the antiboreal belt.

Some few species are concentrated within the Scotia Sea area and on both sides of the Graham Land peninsula. This applies to *Russellia mirabilis* (also found in the West Indies), *Tiaricodon coeruleus* (which has also followed the Peru Current northwards along the west coast of South America), and *Staurocladia vallentini*; *S. hodgsoni* is also recorded from the Ross Sea in the Pacific sector of the Antarctic. *Ptychogastria polaris*, *Zanclonia weldoni*, *Köllikerina maasi*, *Ptychogena antarctica* and *Phialidium iridescens* are strictly antarctic species with a more or less complete circumpolar distribution around the continent; the same applies to *Mitrocomella frigida* which, however, has also been found near South Africa (see p. 230). *Cosmetirella davisi* likewise occurs along the continental coast, whence it has followed the various north-going derivations of the west-wind drift to the antiboreal islands and to South Africa.

The following species have never been found near the Antarctic Continent, but belong to the antiboreal region, where they have been able to cross the great distances between the islands. *Laodicea pulchra* is recorded from the Falkland Islands and Kerguelen Island, *Bougainvillia macloviana* also from Campbell Island south of New Zealand, *Phialella falklandica* from the Falkland Islands and the Auckland and Campbell Islands, and the Peru Current has brought it far northwards on the west coast of South America. *Phialidium simplex* was originally described from the Falkland Islands, but its distribution is extended northwards in three widely separated areas: to the southern part of the Brazilian coast, to South Africa, and to the north-eastern coast of Australia. Drifting sea-weed may be responsible for the distribution of these species from one group of islands to another far away with the east-going currents and their northward derivations.

One species with a peculiar distribution, *Pandea rubra*, must still be mentioned here. It occurs in the Atlantic and Indian sectors of the antarctic waters, but also in the northern Atlantic and the northern Pacific. Though it is an Anthomedusa, it is bathypelagic, and future investigations may show that it has a wider distribution than known up to now.

All the species occurring in the antarctic and antiboreal regions have had easy access to spreading over the entire coastal areas within these regions. When nevertheless the occurrence of several species seems to be restricted to narrow areas, it may be due to insufficient investigations in these inhospitable waters.

Neritic warm-water species. (Table XII).—The first eight species in the table occur so far south on the west coast of Africa that their Atlantic and Indo-Pacific areas of distribution are directly connected

Table XII. Neritic, predominantly warm-water species and their distribution in the three great oceans.

	South American	West Indies and N. American warm-water	W. Atlantic boreal	E. Atlantic boreal	Mediterranean	E. Atlantic warm-water	South Africa	East-Africa	Indian Ocean	Malayan Archipelago	Australia and Polynesia	East-Asian warm-water	North Pacific	East-Pacific warm-water	Peru-Chilensic
Bougainvillia platygaster	×	×	..	..	..	×	×	×	..	..	..	..	..	..	..
Calycopsis bigelowi	..	..	..	..	..	..	×	×	..	..	..	..	..	..	..
Calycopsis chuni	..	×	..	..	..	×	×	×	..	..	..	..	..	..	..
Phialopsis diegensis	(×)	..	..	(×)	..	×	×	×	..	..	..	..	E	×	..
Proboscidactyla ornata	×	×	(×)	..	..	×	..	×	×	×	×	×	..	×	..
Zygocanna vagans	..	..	..	..	..	×	×	..	..	×	..	..	..	×	..
Aequorea macrodactyla	×	×	..	×	..	×	×	×	×	×	×	×	..	×	..
Aequorea coerulescens	×	..	..	..	..	..	×	..	..	..	..	×	..	×	..
Turritopsis nutricula	..	×	×	×	×	×	..	..	×	×	×	×	..	..	..
Oceania armata	..	(×)	..	..	×	×	..	..	..	..	..	×	..	..	..
Merga violacea	..	×	..	..	×	..	..	..	×	..	×	..	..	×	..
Scolionema suvaensis	..	×	..	..	×	..	..	..	×	..	×	×	..	..	..
Sibogita geometrica	..	..	..	..	..	×	..	..	..	×	..	..	..	..	..
Hybocodon forbesi	..	×	..	..	..	..	..	..	×	..	..	×	..	..	..
Halitiara formosa	..	×	..	..	..	..	..	..	×	..	×	×	..	..	..
Phialucium carolinae	..	×	..	..	..	..	..	..	×	×	×	×	..	..	..
Staurodiscus tetrastaurus	..	×	..	..	..	×	..	..	×	..	..	..	..	..	..
Gossea brachymera	×	×	..	..	..	..	..	..	..	..	..	..	..	×	..
Eucheilota comata	..	×	..	..	..	..	..	..	..	..	..	..	..	×	..
Eucheilota duodecimalis	..	×	(×)	..	..	..	..	..	..	..	..	..	..	×	..
Phialidium bicophorum	..	×	×	..	..	..	..	..	..	..	..	..	E	..	..
Stomotoca pterophylla	..	×	(×)	..	..	(×)	..	..	..	..	..	..	..	×	..
Amphinema australis	..	×	..	..	..	..	..	..	..	..	..	..	..	×	..
Amphinema turrida	..	×	..	..	..	..	..	..	..	..	×	..	..	×	..

around South Africa. The first four of these species are evidently derived from the Atlantic, whence they have spread to the east coast of Africa, but not further east in the Indian Ocean. The occurrence of *Phialopsis diegensis* in the eastern Pacific is difficult to explain. The four other species have an almost circumglobal distribution, though partly with considerable gaps. None of these species occur in the Mediterranean.

The distribution of the remaining species in Table XII cannot be explained by a present-day connection around South Africa, and a connection around South America is excluded. As far as these species are concerned, we must consider the possibility that their present distribution is due to a direct connection between the warm parts of the oceans during a former geological period. We know that such a connection has existed, when a continuous belt of water, the Tethys Sea, encircled the equatorial belt of the globe, including a broad Mediterranean basin which also comprised the areas around the Black Sea and the Caspian Sea. The extension and delimitation of the Tethys Sea underwent considerable changes during the ages, and the connection between the European and the Indian seas was closed in the later Tertiary Period, with the exception that in early Quaternary Period there was a narrow opening between the Mediterranean and the Red Sea. A connection between the Atlantic and the eastern Pacific across Central America existed, probably as late as in the Pliocene Period.

If these 16 species really are remnants of the ancient Tethys fauna, they must be very conservative, since their specific characters have not been visually altered during the ages after their geographical separation. As far as the last seven species in the table are concerned, however, there can hardly be any doubt. Apart from two doubtful records of *Amphinema turrida* in Japan and the Torres Strait, and an isolated and probably secondary record of *Stomotoca pterophylla* off the west coast of Africa (see above, p. 265) they are endemic in the Pan-American warm-water region, a distribution which can only be explained by the supposition of a former connection across Central America. If this supposition is adopted, it seems reasonable that the other

Table XIII. Neritic, predominantly boreal species and their distribution in the three great oceans.

	South America	West Indies and N. American warm-water	W. Atlantic boreal	E. Atlantic boreal	Mediterranean	E. Atlantic warm-water	South Africa	East Africa	Indian Ocean	Malayan Archipelago	Australia and Polynesia	E. Asian warm-water	North Pacific	E. Pacific warm-water	Peru-Chile
Leuckartiara breviconis	..	..	..	×	..	..	..	..	..	..	..	..	×	..	..
Melicertum octocostatum	..	..	×	×	..	..	..	..	..	..	..	..	×	..	..
Eutonina indicans	..	..	..	×	..	..	..	..	..	..	..	..	×	..	..
Proboscidactyla stellata	..	..	..	×	..	..	..	..	..	..	..	(×)	W	..	..
Pochella polynema	..	..	..	×	..	..	..	..	..	..	..	..	E	..	..
Leuckartiara nobilis	..	..	(×)	×	(×)	..	..	..	..	..	..	..	E	..	..
Sarsia eximia	..	..	..	×	(×)	..	..	..	..	..	..	..	E	..	×
Cladonema radiatum	..	×	..	×	×	..	..	..	..	..	..	×	W	..	..
Gonionemus vertens	..	..	×	×	×	..	..	..	..	..	..	×	×	..	..
Aequorea aequorea	×	×	×	×	×	×	×	..	W	..	..	..	?	..	..
Eirene viridula	..	..	..	×	×	×	..	×	×	..	..	..	..	..	..
Phialidium hemisphaericum	..	..	..	×	×	×	..	..	×	..	×	..	..	..	..
Amphinema dinema	..	×	×	×	×	×	..	..	×	..	×	..	..	..	..
Dipurena ophiogaster	..	..	..	×	×	..	..	..	×	..	..	×	..	..	..
Amphinema rugosum	..	×	×	×	×	..	..	..	..	..	..	×	..	..	..
Ectopleura dumortieri	..	×	×	×	×	×	..	..	×	..	..	..	..	×	..
Zanclea costata	..	..	×	×	×	×	..	×	×	×	×	×	..	×	..
Leuckartiara octona	..	..	×	×	×	×	..	..	×	×	×	×	E	×	..
Podocoryne carnea	..	..	×	×	×	..	×	..	..	..	..	..	..	..	×
Phialella quadrata	..	..	..	×	..	×	..	..	..	..	N.Z.[1])	..	..	..	..

species likewise have remained unaltered since the tertiary connections between their areas of distribution. The four species which occur in the Mediterranean and the Indo-West-Pacific region may be remnants from the Tethys fauna, whereas the history of the origin of the other species, which have a more scattered distribution, not including the Mediterranean, is more doubtful.

A very peculiar distribution is that of *Heterotiara anonyma* (which is not included in the table); it occurs in the northern Pacific, in the Malayan Archipelago, and in the western part of the North Atlantic; moreover it was taken near the South-African coast, apparently in deep water (see above, p. 17).

Neritic, predominantly boreal species. (Table XIII).—The 20 species enumerated in this table may be divided into two groups. The first seven species are entirely lacking in the Indian Ocean, and in the Pacific they occur only in the northern parts. All of them are common in the East-Atlantic boreal region, whereas only one is a regular inhabitant of the western Atlantic. None of them have been found in the Eurasian arctic waters, so that the connection between the North-Atlantic and the North-Pacific populations is entirely cut off. We must presume, however, that such a connection has existed during a warmer, postglacial period.

The two shallow-water species, *Cladonema radiatum* and *Gonionemus vertens*, have a similar distribution, though in slightly warmer waters; owing to their special way of life, among algae, they have special means of dispersal (see above, p. 265).

The other 11 species in Table XIII have an entirely different distribution, their occurrence outside the Atlantic being restricted to the southern parts of the other oceans, whence only one, *Leuckartiara octona*, has secondarily been carried as far north as to northern Japan and Vancouver Island in America (records of *Aequorea aequorea* in the North Pacific are doubtful). All of them are common in the East-Atlantic boreal region, most of them also at the North-American coasts; eight species are recorded from the tropical west coast of Africa, and with one exception (*Phialella quadrata*) they all occur in the Mediterranean. In their eastward distribution two of them are only recorded from isolated localities in the southern or eastern Pacific (*Phialella quadrata* at New Zealand, *Podocoryne carnea* at the coast of Chile), all the others occur mainly or

[1]) New Zealand.

exclusively in the Indo-West-Pacific region. Though a few of them may possibly be able to pass around the South-African coast, it seems to me most reliable that all these species, like the warm-water species mentioned above, are descendants from the Tethys fauna, but are more eurythermal, since they occur in boreal waters of the Atlantic.

In a discussion of the distribution of neritic medusae we must accordingly consider the configuration of land and sea during former geological periods.

The following species have a scattered distribution of which I am unable to propose any reliable explanation. Each of them has been found in only a few widely separated localities: *Hybocodon unicus* at the Falkland Islands and India; *Ectopleura minerva, Köllikerina elegans* and *Niobia dendrotentaculata* in the East-American warm region and in India; *Lizzia gracilis* at Florida and between Sumatra and Java; *Cirrhitiara superba* in the western tropical Atlantic and Australia; *Eucheilota paradoxia* at Florida and in Japan; *Cnidotiara gotoi* in the central part of the North Atlantic and in Japan; *Melicertissa clavigera* at the Canary Islands and India; *Phialidium brunescens* in tropical South America and at the Maldive Islands. *Blackfordia virginica* is most probably derived from the Black Sea and has been transported by ships to the coast of New England and to the Ganges estuary in India. Further information of the actual distribution of these species must be obtained before their zoogeographical character can be stated.

C, 2. Oceanic species.—The distribution of the epipelagic and bathypelagic, oceanic species was summarized above (pp. 252 and 262—263), and it was pointed out that only some few of them are restricted to arctic or antarctic waters, where at least some of them are circumpolar. Apart from a few species, which up to now have only been found in one or a few localities and, therefore, must be disregarded in a discussion of the interoceanic distribution, all the others may be regarded as "warm-water" species. It was also pointed out that almost all the epipelagic species are widely distributed in the oceans, because there is no barrier against a free communication between the Atlantic and Indian Oceans south of Africa so that, even if some of them may have existed since the Tertiary Period, when the Tethys Sea encircled the globe, an interchange is also possible under the present conditions.

The same also applies to most of the bathypelagic species but, as a matter of fact, some of these have a more or less discontinuous distribution, which calls for attention (see above, p. 262). One species is endemic in the Mediterranean, two or three occur off the west coast of Africa, but have not yet been found elsewhere. Seven species are apparently of Atlantic origin and have extended their distribution into the Indian Ocean where, however, they have been found only in some few scattered localities, and they have never been observed in the Pacific. But there are also four species, *Haliscera bigelowi, Tetrorchis erythrogaster, Solmissus incisa* and *Rhopalonema funerarium*, which have an extensive distribution in the eastern Atlantic and in the eastern tropical Pacific, whereas only one of them, *R. funerarium*, has been found in a few localities in the Indian Ocean. Apparently none of them occur in West-Indian waters or anywhere else in the West-Atlantic tropical region. There is no reason to believe, therefore, that their Atlantic and Pacific occurrences have any relation to the connection between these two oceans across Central America in the Tertiary Period. Moreover this connection comprised only a comparatively thin layer of surface water and gave no access for bathypelagic animals from one ocean to the other. I see no other explanation of the discontinuous distribution of these species than lack of knowledge of their actual distribution, which may be far more extensive than known up to now. We must await further investigations in the Indian and Pacific Oceans. Thus, as far as the majority of the oceanic hydromedusae are concerned we need not take the former configuration of land and sea into consideration.

Within some genera, however, the distribution of the species indicates that a speciation has taken place in comparatively recent time. This applies to the Anthomedusae of the genus *Calycopsis*, which was thoroughly dealt with on pp. 24 ff., where it was maintained that the eight existing species of this genus all have arisen in separate geographical areas, and the division into different species was designated as a typical example of geographical speciation.

One of the very few bathypelagic hydromedusae which has a narrowly restricted area of distribution, is *Botrynema ellinorae*; it occurs in deep water in the arctic basins west and east of Greenland, cut off from

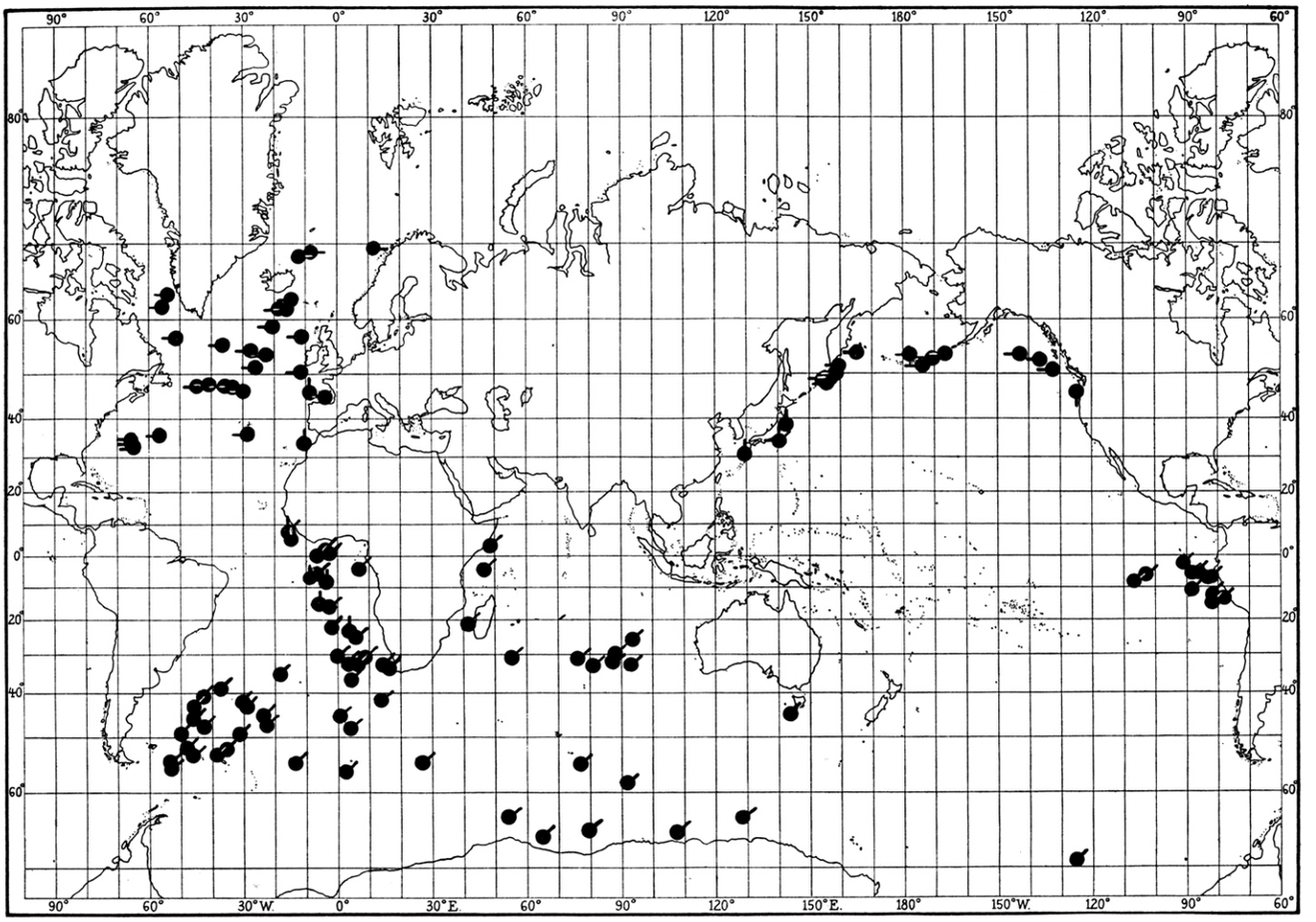


Fig. 335. Geographical distribution of all species of *Crossota*. *Crossota alba*, *Crossota brunnea*, *Crossota norvegica*, *Crossota pedunculata*, *Crossota rufobrunnea*.

all other deep-sea areas by submarine ridges. The only other species of the genus, *B. brucei*, has a world-wide distribution, penetrating to the antarctic slope, to the Aleutian Islands in the northern Pacific, and to the North-Atlantic Transversal Ridge. The two species are very similar to each other, but for me, who has seen them both alive, there is no doubt of their specifical distinction. I take it that in comparatively recent time a population of the cosmopolitan species was geographically isolated and developed into a separate species, adapted to arctic conditions and with no possibility of extending its distribution beyond the arctic basins, where it now occurs.

I think that the peculiar distribution of the five species of *Crossota* is likewise the result of a geographical speciation in comparatively recent time (see the map, fig. 335). Their actual distribution was mentioned above (p. 263). Morphologically *C. rufobrunnea* seems to be the most primitive among the species. It may have existed at a time, when a connection was possible between its present two areas of distribution, the northern Atlantic and the northern Pacific. From the North-Atlantic population *C. norvegica* was derived and isolated in the arctic deep-sea of the Norwegian Sea. A southern population was likewise developed into a separate species, the highly organized *C. brunnea*, which has obtained a circumglobal distribution in the southern hemisphere. *C. alba* may have been derived from *C. brunnea* as a larger species with a colourless umbrella. *C. pedunculata* is known only from a single locality in the northern Pacific. It seems to me that the present peculiar distribution of the species belonging to this cosmopolitan genus is best explained as a result of a geographical speciation.

Other examples of geographical speciation serving to explain zoogeographical peculiarities may be brought forward when we know more about the faunas in all the oceans.

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YASCHNOV, W. A., see JASCHNOV, W. A.

INDEX OF SPECIES

The species marked * are represented in the "Dana" collections. Fat types: principal references.

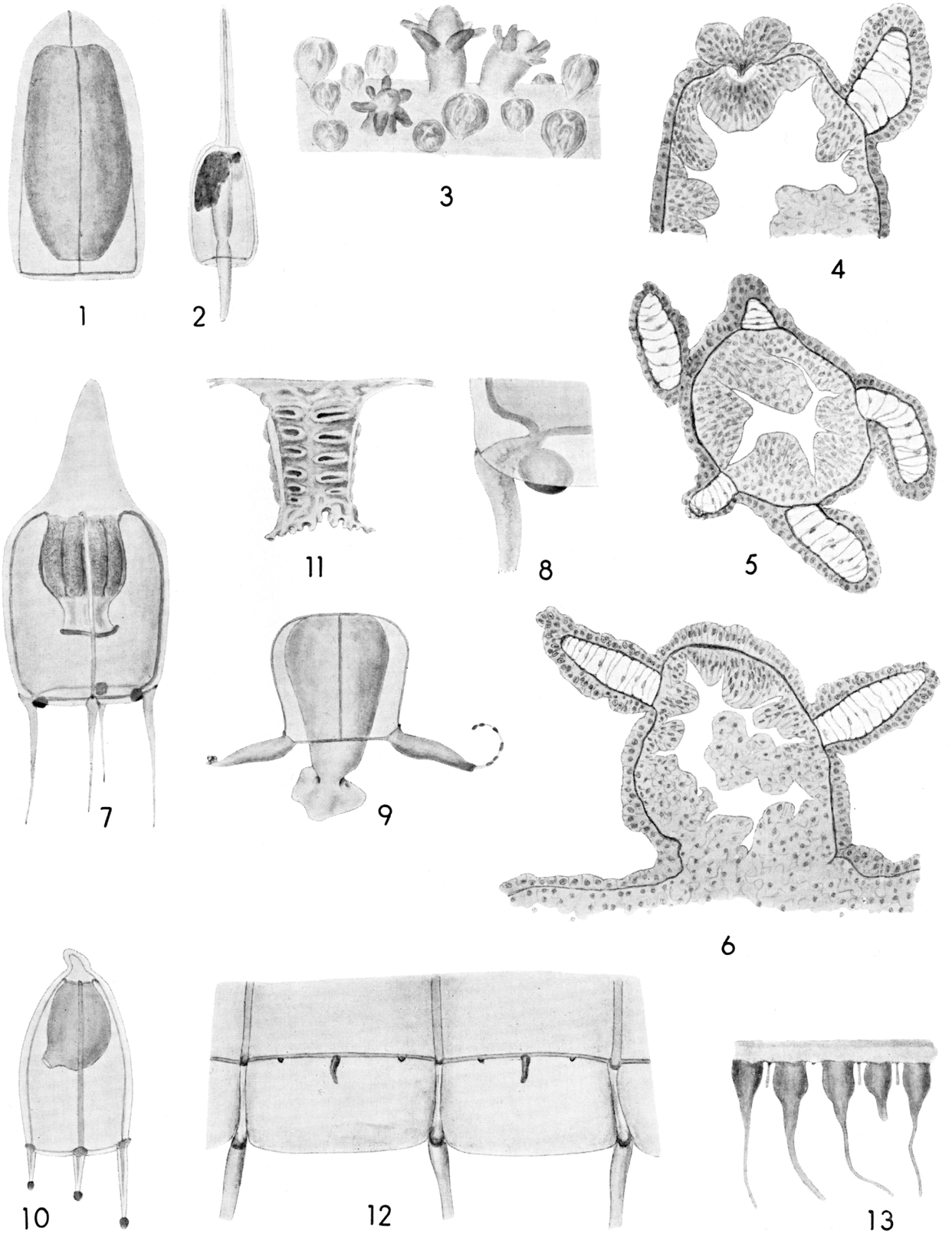
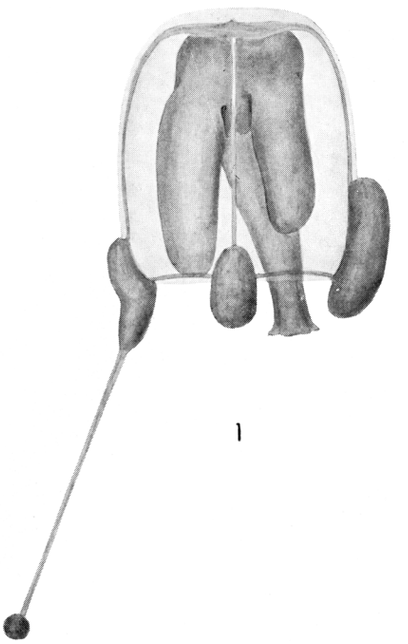


Fig. 1. *Pennaria pauper* n. sp. "Dana" St. 4005. — ×7. Fig. 2. ? *Steenstrupia* sp. "Dana" St. 4158. — ×16. Fig. 3. *Cytaeis tetrastyla*, "Dana" St. 4007. Polyp buds and medusa buds on manubrium of medusa. Fig. 4—6. *Cytaeis tetrastyla*, "Dana" St. 4007. Sections of polyp buds. — ×250. Fig. 4. Longitudinal section of distal part of polyp through the mouth, which is still closed. Fig. 5. Transverse section, showing bases of tentacles. Fig. 6. Longitudinal section of entire polyp, showing confluence of the endoderm of the polyp with that of the manubrium of the medusa. Fig. 7. *Cnidotiara gotoi*, "Dana" ("Agent Petersen") St. 303. — ×10. Fig. 8. *Cnidotiara gotoi*. Base of tentacle, showing the large, spherical, adaxial knob of nematocysts. Fig. 9. ? *Amphinema* sp., "Dana" St. 1323. — ×20. Fig. 10. ? *Heterotiara anonyma* juv., "Dana" St. 4009. — ×15. Fig. 11. *Sibogita geometrica occidentalis*, "Dana" St. 1371. Manubrium. Fig. 12. *Sibogita geometrica occidentalis*, "Discovery" St. 3332. Part of bell margin, abaxial view. Fig. 13. *Toxorchis polynema* n. sp., "Dana" St. 3988. Part of bell margin, showing tentacles and cordyli, abaxial view.



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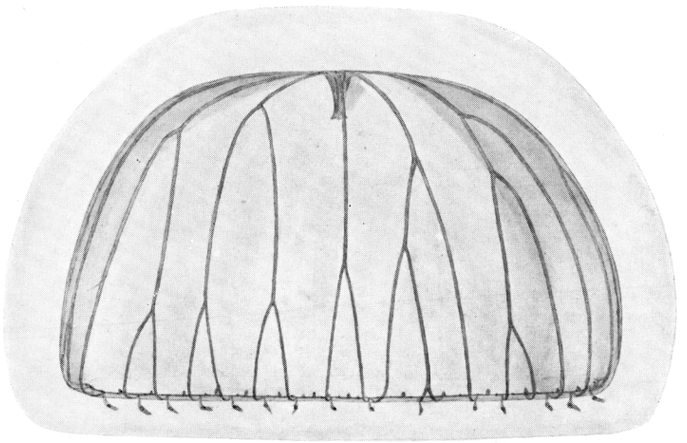

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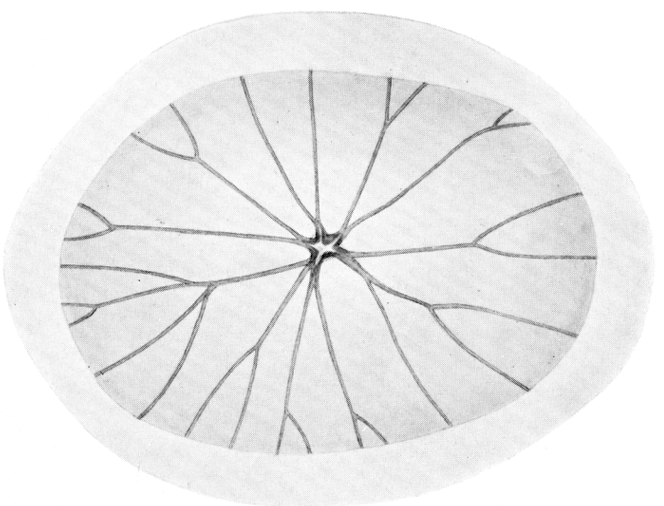

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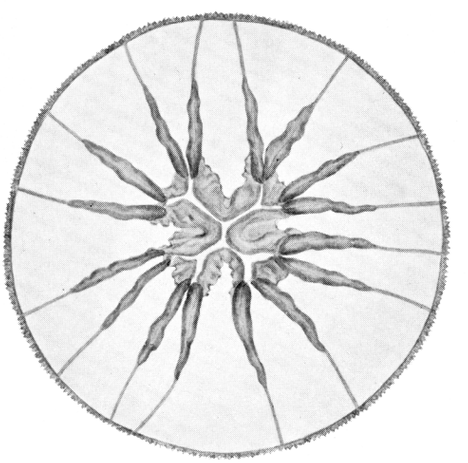

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Fig. 1. *Gotoea similis* n. sp., "Dana" St. 3996. Figs. 2—3. *Sibogita geometrica occidentalis* nov. subsp. "Discovery" St. 3332. Fig. 2. Lateral view. Fig. 3. Aboral view. Fig. 4. *Toxorchis polynema* n. sp., "Dana" St. 3988. Aboral view.

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