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THE DANISH INGOLF-EXPEDITION.

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VOLUME V.

7.

HYDROIDA.

(PART II.)

BY

HJALMAR BROCH.

WITH 1 PLATE AND 95 FIGURES IN TEXT.

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I. Comparative anatomy of the nourishing individuals, and systematic division of the thecaphore hydroids.

As with the athecate hydroids, so also in the case of the thecaphores, the comparative anatomy of the nourishing individuals affords us a certain working basis in systematical respects. With regard to this group, however, the investigations are still somewhat incomplete, as will be seen from the following.

The ectoderm of thecaphore hydroids is apparently very uniform in point of development, and the nematocysts, which in the athecates furnished good material for study, seem in the thecaphores to vary but slightly, and should on the whole be referred to the same type as in *Athecata filifera.* This point is of some considerable interest as further confirmation of the old theory as to a closer relationship between the thecaphores and the mentioned group than between the thecaphores and *Athecata capitata.* Even among the *Grammaria*, where the nematocysts, in one species at any rate, are dimorphously developed, we can find no resemblance to the capsule form in *Athecata capitata.* The arrangement of the stinging cells also is very uniform in the thecaphores. As a general rule, we may say that the nematocysts in the thecaphores appear in marked transverse zones about the tentacles; the only exception I have found here is that of the gigantic *Bonneviella* polyps, where the zonate arrangement has become effaced.

A somewhat different organisation of the ectoderm is encountered in one or two families. The grown polyps of *Syntheciidæ* and *Sertulariidæ* have developed adhesive lamella, an exterior ectodermal lamella covering the inner side of the hydrotheca for a greater or lesser extent when the polyp has withdrawn into the same. It is this ectodermal lamella which Nutting (1904 p. 10) considers as one or more "protractors", evidently from more or less accidental breaks in the lamella, this being, in the living polyps, continuous. Nutting even goes so far as to base part of his system upon the number of "protractors", and is here followed by Broch (1905, 1909). These protractors, however, form, as pointed out by Kühn (1913 p. 66) an unbroken sheath or covering on the inner side of the hydrotheca, attached at its basal margin to the body of the polyp, and at the distal to the opercular apparatus. A similar arrangement is also found in *Aglaopheniidæ*; here likewise we encounter lamellous extensions of the ectoderm, attaching the polyp to the inner ribs of the hydrotheca.

We see then, that the ectoderm itself gives us very little to go upon in a systematic classification. On the other hand, its derivates, i. e. the periderm, will in the thecaphores be found of great importance in this respect. The thecaphores are, as we know, characterised by their stiff, almost

chitinous sheath, which is extended to form the hydrotheca. Incipient hydrotheca formation is found once or twice among the athecates, as for instance in *Perigonimus*, where a folding pseudo-hydrotheca surrounds the polyp below the tentacle whorl. Less attention has perhaps been paid to similar formations in a species such as *Eudendrium vaginatum* Allman, though even here we seem to find trace of an incipient hydrotheca. In the thecaphores, however, the hydrotheca has developed into a permanent component of the colony, and up to now, the systematic arrangement of the thecaphores as a whole has been based mainly upon the hydrotheca and its features. In some few families such as *Haleciidæ*, *Plumulariidæ* and *Sibulariidæ*, the hydrotheca is so small that the polyp cannot as a rule be withdrawn entirely into it; often, indeed, the hydrotheca seems merely to furnish a support for the basal part of the polyp. In view of the other structural conditions of the polyp, however, this must not be regarded as a purely primary feature, but should apparently in most cases be considered secondary, as is shown more particularly by the two first-named families. Despite the fact that the hydrotheca in *Lafoëidæ*, for instance, is far more highly developed, we must nevertheless, from the structure of the polyp, consider the last-mentioned family as representing a more primitive stage in the process of development.

A point of more importance is whether the ground plan of the hydrotheca is radial or bilateral. This again is generally connected with the presence or absence of stalk. The stalked, and thus free hydrotheca, will as a rule be constructed on a radial base type, as seen in *Lafoëidæ*, *Campanulinidæ*, and *Campanulariidæ*. The more or less marked curvings of the hydrotheca, not infrequently found particularly in *Lafoëidæ*, do not suffice to efface the radial base type, and even in *Lafoëidæ* and *Campanulinidæ*, where the hydrotheca is sessile or even partly fused with the stolons, the radial type is distinctly perceptible. In *Sibulariidæ*, on the other hand, the hydrotheca is assymmetrical or bilateral, the cause of which peculiarity it is by no means easy to comprehend, since the hydrotheca is quite freely set on its stalk, which is as a rule of considerable length. This family is, however, altogether but imperfectly known up to now. The sessile hydrotheca has a greater tendency to develop bilaterally. In the *Plumulariidæ*, this tendency is not yet quite pronounced; we find, however, that the diaphragm in most of the species takes up an oblique position relatively to the longitudinal axis of the hydrotheca. In *Aglaopheniidæ*, the development has proceeded considerably farther, the diaphragm here being either markedly oblique or else generally falling into two obliquely set portions, whereby the symmetry is arranged about a sagittal plane. This sagittal plane is often also found to be the plane of symmetry for the hydrotheca as a whole, the arrangement of the teeth at the opening being symmetrical according to the mentioned plane, while at the same time, a more or less marked lateral compression is observed in the hydrotheca. A similar bilateral development of the hydrotheca is encountered in *Syntheciidæ* and *Sertulariidæ*, where the diaphragm is as a rule also oblique, although rarely, if ever, falling so distinctly into two halves as in several of the *Aglaopheniidæ*. In *Sertulariidæ* also, the distal parts of the hydrotheca show a distinct bilateral construction according to the same sagittal plane as in the diaphragm.

A secondary formation in the hydrotheca, the closing apparatus, is likewise of considerable importance in systematic respects. In one genus of the *Lafoëidæ*, *Toichopoma*, we find a very primitive type of closing apparatus; the lid here is simply formed by the one side of the distal end of the

hydrotheca, which is somewhat thinner than the wall of the hydrotheca generally, and can be brought in over the aperture of the hydrotheca, so as to close it. Within the family of *Campanulinidæ*, several types of lid have been developed, some consisting of the distal part of the hydrotheca (subfamily *Cuspidellinæ*) others formed by the primary roof of the hydrotheca (subfamily *Calycellinæ*). The closing apparatus in the first case consists of folding, membranous parts, roof-shaped or conical, covering the opening of the hydrotheca. In the latter case they form a conical roof, consisting partly of folding membrane, partly of triangular plates; in this group, the closing apparatus is always sharply marked off from the hydrotheca, whereas in the *Cuspidellinæ*, it passes gradually over into the same. In *Sertulariidæ* also, we find several forms of closing apparatus either consisting of some few separate triangular plates, and thus exhibiting the same type as certain *Campanulinidæ*, or reduced to two — sometimes even a single plate — but they always appear to be formed from the original roof of the hydrotheca, in contrast to *Toichopoma* and *Cuspidellinæ*.

These features have been the subject of general attention in systematic respects; less consideration, on the other hand, has been devoted to the different structural conditions in the polyps themselves, as arising from varying conditions in the endoderm.

In *Lafoëidæ* and *Campanulinidæ*, the endoderm is, as a whole, but little differentiated; here also, however, we find an oral part above the tentacle whorl, where the indifferent cells with small nuclei are decidedly in the majority, and the structure of the polyps here strikingly resembles that of the *Bougainvilliidæ*. In *Haleciidæ*, on the other hand, we find practically throughout, a marked distinction below the tentacle whorl between a fore-stomach and the actually digesting, basal part, the stomach itself. While the digestive cells in the former are decidedly in the minority, it is they alone which form the endoderm of the stomach. The same differentiation into two stomach sections is still more pronounced in *Plumulariidæ*, and in the polyps of both families we must notice a ring-shaped, external constriction of the polyp, where the boundary between the two endodermal zones must be taken to lie. The same division of the endoderm of the polyp into two regions is likewise found in *Aglaopheniidæ*, but it is not always so easily distinguishable here on mere external observation of the polyp, being in particular frequently obscured by the ectodermal extensions previously referred to, by which the hydranth is attached to the inner ribs of the hydrotheca.

Even more pronounced is the differentiation of the endoderm in most of the *Syntheciidæ* and *Sertulariidæ*. Here, the polyps are as a rule furnished with a single (ventral) blind sack placed abcaulinally to the colony. The endoderm of the stomach parts, otherwise formed by a high cylindric epithelium, forms in the blind sack only a low epithelium, which does not appear to contain digestive elements. This seems to suggest that Kühn's supposition (1913 p. 68) is correct, and that the abcauline blind sack in these families serves for storage of nutritive matter to be digested subsequently, when the polyp is again in a resting position. The abcauline blind sack must be said to be characteristic of the two families, even though in primitive forms such as for instance *Thyroscyphus* and *Dynamena*, only an indication of it may be found.

Finally, there is yet another type of polyp found in *Campanulariidæ* and *Silicularidæ*. While all the remaining families of thecaphores are characterised by a conical peristome, this is, in the two mentioned families, clubshaped, situate with a narrow base above the tentacle whorl on the broad

body of the polyp. In external habitus, the polyps of these families thus markedly resemble those of *Eudendriidæ*, and the similarity in point of internal structure is equally remarkable. The endoderm of the peristome, or the proboscis, is quite predominantly composed of indifferent cells, while the gastral part has a fairly homogeneous endodermal covering of digestive cells. Owing to the deviation of the polyps in external habitus, I have in a former work, (1909 p. 133) marked off these two families as a separate sub-order, *Proboscoidea*. Considering the mentioned features of organisation, however, in the light of what has been stated above, it will hardly be correct to retain this sub-order; but it forms a special family series, ranking with the others, where the thecaphores as a whole must be said to fall, as will be further referred to in the following.

A much disputed group is formed by the genus *Bonneviella*, which I formerly (1909 a) noted off as a separate family. Kühn (1913 p. 252) inclines to the view that the genus must be referred to *Lafoëidæ*, whereas Nutting, in his latest work (1915 p. 94) retains the family of *Bonnevielliдæ*. Such description as has been given of the anatomical conditions in this species is as a matter of fact not sufficient fully to elucidate the relationship of the group, and Nutting's explanation, in which he considers that my previous observations may be confirmed, still lacks the essential point required; to wit, the development of the so-called "veloid". A comparison with the remaining genera has led me rather to incline towards Kühn's theory, that the formation in question can hardly be regarded as altogether ectodermal, the inner layer being probably rather an extreme development of the indifferent cells of the endoderm. If this supposition prove correct — a point which can only be determined by study of the development of the polyps — the position of the genus will nevertheless still be doubtful; most of the facts would then seem to lead towards their inclusion as a high form of development of *Campanulariidæ*; we may, however, also with good reason suppose the origin to be in *Lafoëidæ*. Having no suitable material for further study of these questions available, I do not purpose here to enter upon further theoretical discussion as to the systematic position of the genus. I would merely point out once more, that the interpretation of the peristome as an ectodermal gullet is doubtful in the highest degree.

On summing up the above anatomical data, we find that the thecaphore hydroids fall into four main groups or series of families, which are of great interest from a phylogenetic point of view. The most primitive family series is that of *Hebellina*, with its conical proboscis and with homogeneous gastral endoderm. This group, which embraces the families *Lafoëidæ*, and *Campanulinidæ*, exhibits a marked affinity with the athecate family of *Bougainvilliidæ*, and probably originated from the same.

From *Hebellina* again, two new family series are derived, viz: on the one hand that of *Haleciina*, with the families *Haleciidæ*, *Plumulariidæ*, and *Aglaopheniidæ*, and on the other, the series *Sertulariina*, with the families of *Syntheciidæ* and *Sertulariidæ*. *Haleciina* is characterised by its bipartite gastral portion, which is divided into a fore-stomach (probably non-digesting) and a digestive basal part. This division is, especially in certain primitive *Halecium* species, still but slightly pronounced, thus giving the transition from *Hebellina*. In *Sertulariidae*, on the other hand, the basal, one-sided blind sack is developed as a storage chamber; the transition from *Hebellina* is here represented by forms such as *Thyroscyphus*, where the partition of the gastral parts into the divisions named is still barely indicated.

An exceptional position is that of the *Proboscoida* series, with club-shaped proboscis. The

group may be supposed to originate from *Hebellina*; there is, however, much which would seem to suggest closer relationship with *Eudendriidæ*. I have in a previous work (1909 p. 132) drawn attention to several features pointing in this direction; Kühn, (1913 p. 246) endeavours to disprove the close resemblance, while on the other hand Nutting, (1915 p. 20) notes further similarities, and, like Stechow, (1913 p. 22) comes to the conclusion that a close relationship between *Proboscoida* and *Eudendriidæ* is not to be denied. I would here merely mention one point, which Kühn regards as of great importance, but which Nutting has not subjected to closer consideration. Kühn finds that there is a difference of principle in the gonosomes. In this connection, several of the gonangia of the *Campanulariidæ* will be found of considerable interest. In the athecates, we repeatedly find that single gonophores, as in *Bougainvillea*, *Hydractinia*, and *Eudendrium*, collect on the stalks of some few hydranths; in several species moreover, we find a reduction of the terminal polyp, so that the whole of the gonophoriferous complex is here transformed into a blastostyle. As a matter of fact, we have in such cases to deal with gonangia aggregates, differing only in gonotheca formation from the gonosome in species such as for instance *Laomedea flexuosa*. The development of the gonangia here shows us a reduced terminal polyp, which has now formed an "Endplatte", on the stalks of which gonophores appear. If at the same time we imagine that the gonophores do not penetrate the perisarc, but that the latter expands instead into a protecting sheath, we have then the gonotheca in its typical form for *Campanulariidæ*. It may also be imagined as arising by formation of gonophores on the basal parts of the hydranth, within the hydrotheca, when, on the one hand, the hydranth will thereby be reduced to an "Endplatte", while on the other hand, hypertrophy of the hydrotheca will set in. Either of these alternatives may be considered as the possible starting point. I do not insist that this explanation of the origin of the gonosome in the group is the correct one; there is, however, nothing to disprove it in the results of investigations made up to date, and it will, if confirmed, altogether disprove the existence of a difference of principle in the gonosomes, as maintained by Kühn. This proof is thus likewise inadmissible as finally disposing of the supposition of a closer relationship between *Proboscoida* and *Eudendriidæ*.

If we now endeavour, as in the case of the athecates, to summarise the elucidated features and previous views in a key for determination, we must at the outset point out that in this instance such a method cannot so easily be employed without reserve, as the transitions in the thecaphores are more gradual than in the athecates. An endeavour may nevertheless be made to draw up a scheme of the nature indicated.

I. Polyps with conical, pointed oral part.

A. The gastral endoderm uniformly developed; polyps and hydrothecæ constructed according to a radially symmetric ground plan. (Family series **Hebellina**).

I. Hydrothecæ without opercula or with a primitive closing apparatus formed from the thinner distal part of one side of the hydrotheca. Family *Lafoëidæ*.

II. Hydrothecæ with roof-shaped or conical opercula of composite structure. Family *Campanulinidæ*

B. Gastral endoderm differentiated in heterogeneous parts.

I. Polyps with fore-stomach and digestive basal stomach parts. (Family series **Haleciina**).

a. Hydrothecæ small, radially symmetrical, cannot accommodate the contracted hydranth. Family *Haleciidæ*.

b. Bilaterally symmetrical hydrothecæ, with obliquely set diaphragm.

x. Diaphragm simple. Hydrothecæ small, approximately radial structure, generally without teeth; rudimentary or stalked and mobile, two-chambered sarcotheca. Family *Plumulariidæ*.

xx. Diaphragm generally composed of two obliquely set portions; hydrothecæ markedly bilateral, large, most frequently toothed. Sarcothecæ all or some one-chambered, sessile and immobile. Family *Aglaopheniidæ*.

II. Polyps with a basally situate, ventral blind sack with low endoderm cells. Hydrothecæ generally bilateral. (Family series **Sertulariina**).

a. Hydrothecæ without opercula. Family *Syntheciidæ*.

b. Hydrothecæ with opercular apparatus. Family *Sertulariidæ*.

2. Polyps with club-shaped or trumpet-shaped oral parts. (Family series **Proboscoida**).

A. Hydrothecæ large, radially symmetrical. Family *Campanulariidæ*.

B. Hydrothecæ small, thick-walled, and bilaterally symmetrical. Family *Silicularidæ*.

II. Thecaphore Hydroids of the Northern Atlantic.

Family series **Hebellina** nov.

Family Lafoëidæ.

Hydrothecæ deep bell- to tube-shaped, radially symmetrical after their ground plan, stalked or sessile, at times partly fused with the mother tube; diaphragma rarely present. The hydrothecæ without opercula; exceptionally, the distal end of the one wall in the hydrotheca may fold in over the aperture. The colonies are stolonial or sympodial. The polyps are radially symmetrical, with conically pointed oral part; the endoderm is divided into an oral and a gastral part; the gastral endoderm is homogeneous.

The structure of the polyps gives this family a primitive rank among the thecaphores, and among its lowest genera *Hebella* must be counted as taking a typical position; this genus is, however, especially distributed in the warmer seas. The genus has also been recorded from northern waters, although evidently erroneously; its only northern representative should be *Hebella pocillum* (Hincks) but as it lacks the diaphragm, it cannot be allowed to remain in this genus, and its identity will be dealt with later on.

In course of time, a whole series has been set up with genera of *Lafoëidæ*, and on going through the list compiled by Stechow (1913 p. 44) we find that considerable weight is attached to the accumulation of the gonangia in aggregates (scapus, coppinia) or their appearing singly. I have recently (1917) in studying the coppinia of *Grammaria abietina*, set forth what we know up to the

present concerning this distinguishing feature; our knowledge is, in reality, so insufficient that the greatest care should be exercised in answering for species even where this character has been noted, after superficial study, as the only point of difference in comparison with the nearest related species. It is clear, that in certain species, the gonothecæ of the one sex (the female) appear aggregated as scapus or coppinia, while those of the other sex (the male) occur singly. Even though we may not at present possess definite proof, it is nevertheless highly probable that also certain *Lafoëidæ* may have unisexual colonies; in such case, however, the occurrence of the gonothecæ singly or in aggregates will even fail us as a specific character. Obviously then, in the present imperfect state of our knowledge as to the gonangia of the different species, the feature in question must be discarded altogether as a generic character. Until we know more about the matter, it will certainly be most correct to disregard the question of gonangia entirely when drawing the limitations of the various genera.

Gen. Lafoëa (Lamouroux).

The colony consisting of upright rhizocaulome formations, or creeping, with tubular or narrow bell-shaped hydrothecæ. The hydrothecæ are without diaphragma or opercular apparatus, stalked or sessile, in the latter case separated from the stolon by a more or less marked constriction; where the hydrotheca lies adjoining the stolons, it is possible to distinguish between the wall of the hydrotheca and that of the stolon.

A whole series of species belonging to this genus have been described from the northern seas, and many of them are based on the distinction as to whether the colonies are creeping or upright, a character which, as we find on closer investigation, can only be applied with the greatest caution. It has long been recognised that *Lafoëa dumosa* may either occur as a creeping form, or may form upright rhizocaulome colonies; this fact in itself should be sufficient to point the necessity of careful consideration, and a closer study of the northern species reveals the fact that one and the same species may at times occur creeping, at others form upright colonies, when some few stolons emancipate themselves from the underlayer and thus form a suitable substratum over which other stolons may creep.

Another feature in the *Lafoëa* species which renders their limitation exceptionally difficult is their extrordinary power of variation. Such variation is evidently due in part to the influence of physical conditions in their environment, which have led to the formation of gigantic arctic forms, or heavily built, robust cold-water forms. Critical study of the very extensive material available has thus ed to considerable reduction in the number of species.

Lafoëa dumosa (Fleming) L. Agassiz.

1828 *Campanularia dumosa*, Fleming, A History of British Animals, p. 548.

1860 *Lafoea dumosa*, L. Agassiz, Contributions to the Natural History of the United States, p. 351.

Colonies creeping or upright, irregularly branched and stiffly built rhizocaulome formations. Hydrothecæ developed slightly asymmetrically, tubular, with slightly outward curving margin; they

are separated by a constriction from the stolons, or may, more rarely, exhibit an indication of stalk, forming half a spiral whorl.

The gonangia are collected in coppiniæ with tubes much twisted. The coppiniæ are hermaphroditic, with the male gonothecæ wedged in among the female.

Material:

"Ingolf" St. 6, 63°43′ N., 14°34′ W.; depth 90 fathoms, 7,0°
— - 86, 65°03,6′ N. 23°47,6′ W.; — 76 — (West-Iceland)
— - 87, 65°02,3′ N. 23°56,2′ W.; — 110 — (West-Iceland)
"Thor" 63°30 N. 20°14′ W.; — 80 metres
Greenland: Sukkertoppen (on *Boltenia*) (no further data)
Iceland: Vestmannö depth 28 fathoms
— Skjálfandi Bay depth 28 fathoms
The Faroe Islands: 62°29′ N., 7°37′ W.; depth 110 metres, 8,71°
— — 62°16′ N., 6°06′ W.; — 110 —
— — 7 miles N. by E. of Myggenæs point; depth 57 fathoms
— — 6 — N. by W. of Store Kalsö; — 60 —
— — Deep hole at north point of Nolsö; — 100 —
— — Borönæs N. 75 W. — 30 —

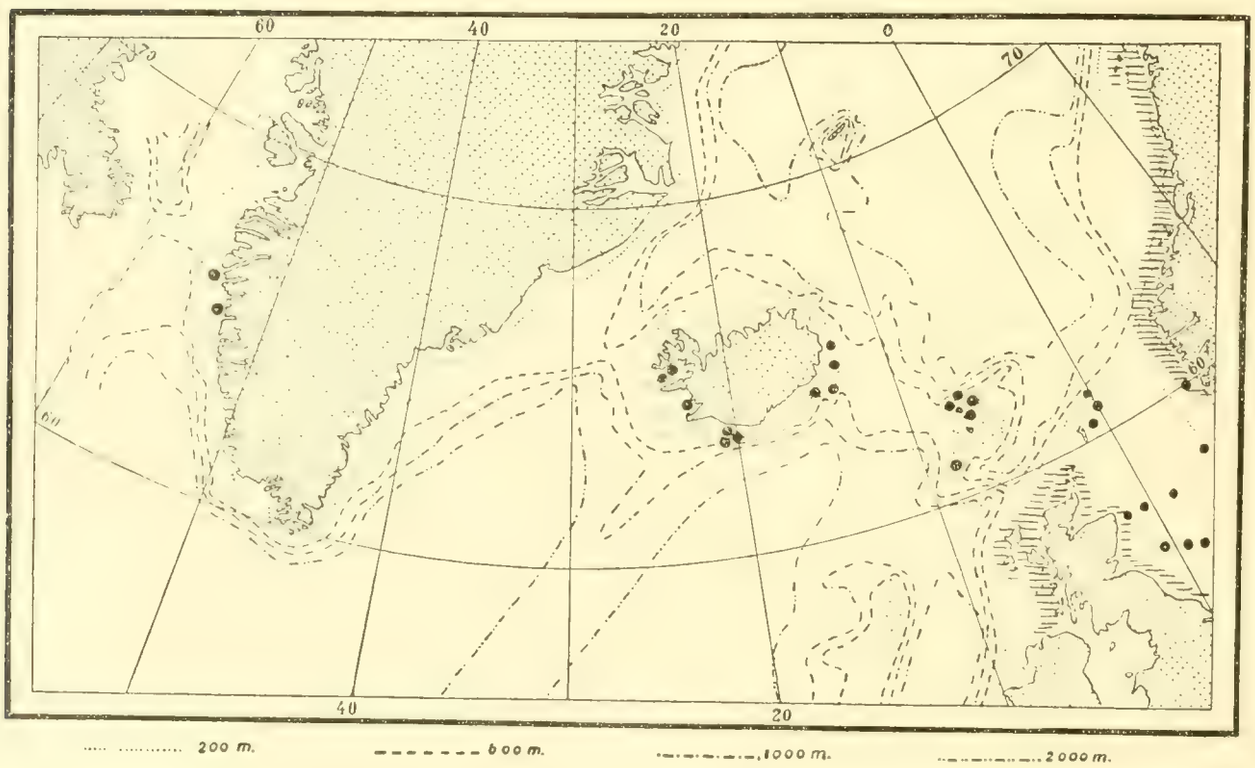

Fig. I. The Distribution of *Lafoëa dumosa* in the Northern Atlantic.
In the hatched regions the literature notes a common occurrence.

Some writers unite this species with the two following; this is, however, as I have previously shown (1908 p. 33) not correct. Both in its creeping form and in the upright colonies it is very typically distinct from the remaining northern *Lafoëa* species, partly by its very slightly asymmetrical hydrothecæ, which have practically no real stalk at all, partly by the fact that the hydrothecæ, which are set very far apart, form almost a right angle with their corresponding stolon.

The species is widely distributed in the northern seas (Fig. I). It is a distinctly boreal species, which can, however, penetrate far into southern waters, and has been recorded, for instance, from the Mediterranean (Babić 1910 p. 213). On the other hand, purely arctic conditions seem quickly to set a limit to its progress.

Lafoëa gracillima (Alder) Hincks.

1856 *Campanularia gracillima*, Alder, A notice of some new genera and species, p. 361, pl. 14 figs. 5—6.
1874 *Lafoëa gracillima*, Hincks, Notes on Norwegian Hydroids from deep-water, p. 132.
1868 *Lafoëa pygmæa* pars, Hincks, A History of the British Hydroid Zoophytes, p. 205, pl. 40 fig. 3.
1887 *Lafoëa fruticosa* pars, Bergh, Goplepolyper (Hydroider) fra Karahavet, p. 334.

The colony is creeping or upright, with irregularly branched rhizocaulome formation. The hydrothecæ are narrow, tubular, curved, with the convex side turned upwards; the opening margin is on the concave (lower) side never curved outwards, but may be slightly so on the convex side of the hydrotheca. The hydrotheca passes gradually over into the stalk, which is of varying length, and with a spiral coil closer in some, more open in others. In upright colonies, the stalk axis forms as a rule a very acute angle with that of the mother tube, the basal part of the hydrotheca is often nearly parallel with the latter.

The gonothecæ are compressed in hermaphroditic coppiniæ, the long tubes of which are as a rule highly curved. The male gonothecæ occur wedged in between the female.

Forma *typica*: finely built colonies, with hydrothecæ set wide apart; the hydrothecæ entirely tube-shaped, with loosely spiral stalk, as a rule with two turns.

Forma *elegantula*: colonies of coarser build, with closely set hydrothecæ; the hydrothecæ often with the upper part of the opening margin curved slightly outwards; stalk with a varying number of mostly close-spiral windings.

Material:

Forma *typica*:

"Ingolf" St.	1,	62°30′	N.,	8°21′	W.,	depth	132	fathoms	7,2°
—	- 55,	63°33′	N.,	15°02′	W.,	—	316	—	5,9°
—	- 85,	63°21′	N.,	25°21′	W.,	—	170	—	—
—	- 87,	65°02,3′	N.,	23°56,2′	W.,	—	110	—	—
—	- 95,	65°14′	N.,	30°39′	W.,	—	752	—	2,1°
—	- 127,	66°33′	N.,	20°05′	W.,	—	44	—	5,6°
Iceland: Skagestrand						—	44	—	

9 miles N.74E. of Hornet, east coast of Iceland, depth 38 fathoms
62°17′ N., 4°57′ W., depth 144 fathoms.

Forma *elegantula*:

"Ingolf" St. 3, 63°35′ N., 10°24′ W., depth 272 fathoms, 0,5°
— - 29, 65°34′ N., 54°31′ W., — 68 — 0,2°
— - 31, 66°35′ N., 55°54′ W., — 88 — 1,6°
— - 33, 67°57′ N., 55°30′ W., — 35 — 0.8°
— - 34, 65°17′ N., 54°17′ W., — 55 — —

Greenland: Davis Strait (precise locality not stated) depth 100 fathoms.
Akudlek (no further data)
Egedesminde (- — —)
Mouth of Ameralikfjord (- — —)
Sukkertoppen, on *Boltenia* (- — —)
Jakobshavn (- — —)
Hurry Inlet, depth 0—7 fathoms (East Greenland Expedition)
— — — 57 — (— — —)
Harry Land — 20 — (— — —)

Iceland: "Thor" 52 miles E. of Langanes
Skjalfandi Bay, depth 28 fathoms
9 miles N. 74 E. of Hornet, east coast of Iceland, depth 38 fathoms
64°17,5′ N., 14°44′ W., depth 40 fathoms, 5,12°

The Faroe Islands: 61°40′ N., 7°40′ W., — 135 — .
6 miles N. by W. of Store Kalsö, depth 60 fathoms

Kara Sea "Dijmphna" (labelled *Lafoëa fruticosa*).

The distinguishing features between *Lafoëa gracillima* and *Lafoëa fruticosa* may often appear very insignificant, and in arctic waters especially one may often be in doubt as to whether a specimen is a robustly built colony of *L. gracillima* forma *elegantula* or a finely built *L. fruticosa* forma *genuina*. The feature emphasised by Bonnevie (1899 p. 61) viz: the number of spiral turns on the stalk, is in particular extremely variable in somewhat larger colonies, and it is likewise found that the angle between stalk and mother stolon, especially among creeping colonies, is little to be relied on. Another feature, however, to which I have long since drawn attention (1907 p. 7) seems to be more constant, and will also according to the present material serve to determine the identity of species. The feature in question consists in the fact that the abcauline concave side of the hydrotheca in *Lafoëa gracillima* lacks the basal convexity found in *Lafoëa fruticosa*, and that the margin of the hydrotheca on this side is never curved outwards in *Lafoëa gracillima*, in contrast to *Lafoëa fruticosa*, where the lower (concave) side of the hydrotheca is thus always more or less S-shaped in profile.

Among the synonyms for *Lafoëa gracillima* we have also here included *Lafoëa pygmæa* pars. Jäderholm (1909 p. 80) includes this species as a synonym under *Calycella syringa*, and he is undoubtedly right in so doing. According to Hincks (1868 p. 205) the original drawings by Alder exhibit indications of opercular formation in the hydrotheca here and there, a point which beyond question suggests this species. On the other hand, Hincks's description is entirely in agreement with the

creeping colonies of *Lafoëa gracillima*, and a number of colonies which have later been identified as *Lafoëa pygmæa* should doubtless be referred to *Lafoëa gracillima*. Bonnevie, (1899 p. 62) notes in her table as to the hydrothecæ that they have "slightly outward-curving margin"; this does not agree with Hincks's expression "hydrothecæ . . . cylindrical, elongate and narrow" or with his drawing of the species. In my first report on the hydroids from "Michael Sars" (1903 the table) I recorded *Lafoëa pygmæa* from several localities, giving also a drawing of the coppinia of the species; subsequent revision of the material has shown me that the specimen indicated is, like most of the others, a typical, creeping *Lafoëa gracillima*, while some few colonies are creeping *Lafoëa dumosa*. *Lafoëa pygmæa* must

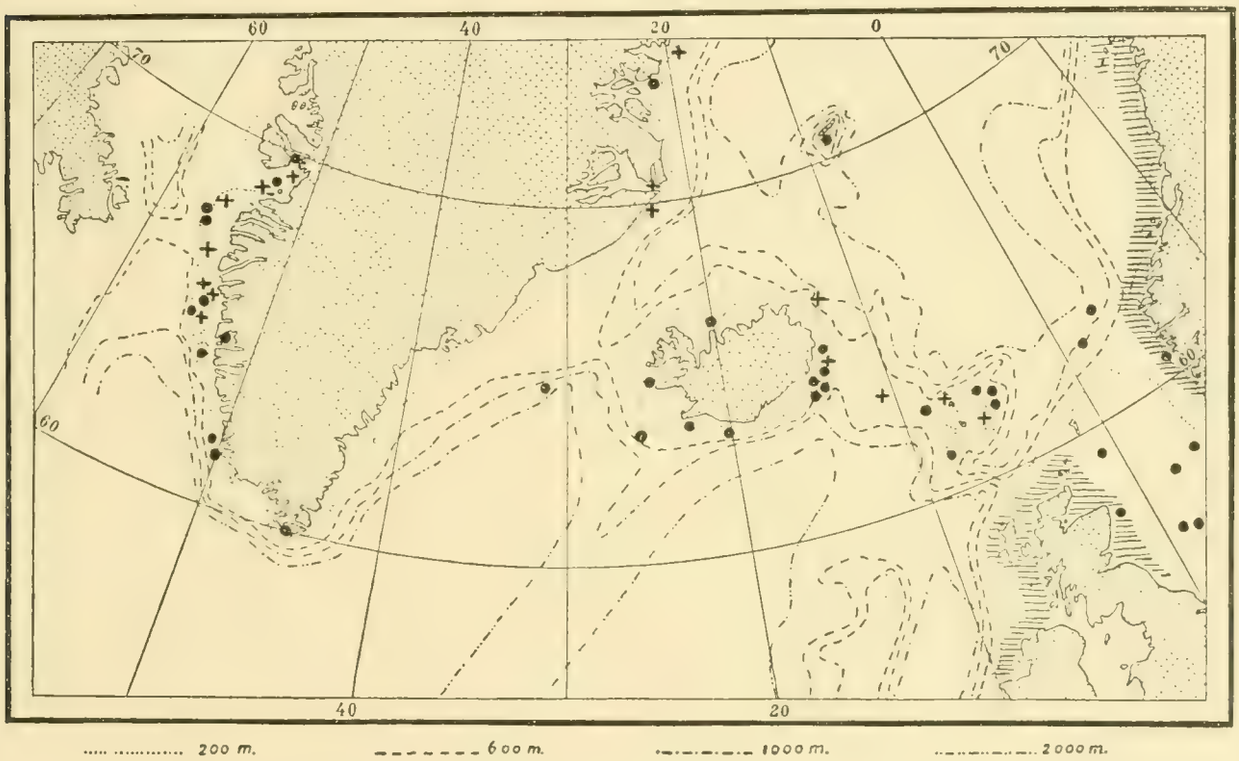

Fig. II. Localities of *Lafoëa gracillima* forma *typica* ● and forma *elegantula* + in the northern Atlantic. In the hatched regions the literature denotes a common occurrence of the species. (The dates from British seas are incomplete on account of a general confusion with *Lafoëa fruticosa*).

thus mainly be regarded as synonymous with *Lafoëa gracillima* and *Calycella syringa*, and can accordingly no longer be counted as an independent species.

Lafoëa gracillima appears in two forms, affording parallels to those of the following species. The finely built forma *typica* is quite cosmopolitan in its occurrence, and has been met with in all seas from pole to pole. In arctic — and as far as can be seen also antarctic — waters, there has also developed, in addition to forma *typica*, a more robust and closely built forma *elegantula*, the stalk of which generally commences with a single loose winding, continuing then in a varying number of close turns. Forma *elegantula* is, as mentioned, arctic, but may (text fig. II) also at times penetrate into boreal waters.

Lafoëa fruticosa M. Sars.

1851 *Campanularia fruticosa*, M. Sars, Beretning om en i Sommeren 1849 foretagen zoologisk Reise, p. 131, 138.

1863 *Lafoëa fruticosa*, M. Sars, Bemærkninger over fire norske Hydroider, p. 30.

1868 — *pocillum*, Hincks, A History of the British Hydroid Zoophytes, p. 204, pl. 40, fig. 2.

1874 — *grandis*, Hincks, On deep-water Hydroida from Iceland, p. 147, pl. 6, figs. 1—2.

1899 — *symmetrica*, Bonnevie, Norske Nordhavs-Expedition, p. 64, pl. V, figs. 2 c and 4.

The colonies are creeping, or form upright, irregular rhizocaulomes. The hydrothecæ are cylindrical or narrowly bell-shaped, more or less asymmetrically developed or slightly curved, the one side as a rule curving somewhat more markedly outwards than the other. The hydrothecæ have as a rule a slightly expanded basal part and a more or less outward curving opening margin, they are sharply marked off from the stalk, which is of varying length, spirally turned, or less frequently divided into rings. The stalk itself forms, in the upright colonies, an open angle of 45°—80° with the mother tube.

The gonothecæ are gathered in hermaphroditic coppiniæ, the tubes of which are as a rule highly curved. The male gonothecæ are wedged in among the female.

Forma *genuina*: finely built colonies, always with asymmetrical, narrow hydrothecæ, the stalk forming an acute angle with the mother tube.

Forma *grandis*: coarsely built colonies with wide cylindrical to narrowly bell-shaped hydrothecæ; hydrothecæ often almost or entirely symmetrical, the stalk generally forming a more obtuse angle with the mother tube.

Material:

Forma *genuina*:

"Ingolf" St. 34 65°17′ N., 54°17′ W., depth 55 fathoms
— - 86 65°03,6′ N., 23°47,6′ W., — 76 —
— - 87 65°02,3′ N., 23°56,2′ W., — 110 —
"Thor" 65°52′ N., 23°58′ W., — 62 metres
— 61°07′ N., 9°30′ W., — 835 —
Greenland: Egedesminde (no details noted)
Proven (- — —)
Cape Tobin, depth 57 fathoms (East Greenland Expedition)
Mouth of Hurry Inlet, — 50 — (— — —)
Iceland: Skjalfandi Bay, depth 28 fathoms
9 miles N. 74 E. of Hornet, east coast of Iceland, — 38 —
The Faroe Islands: 7 miles N. by E. of Myggenæs, — 57 —

Forma *grandis*:

"Ingolf" St. 2 63°04′ N., 9°22′ W., depth 262 fathoms 5,3°
— - 4 64°07′ N., 11°12′ W., — 237 — 2,5°
— - 34 65°17′ N., 54°17′ W., — 55 — —
— - 95 65°14′ N., 30°39′ W., — 752 — 2,1°

Greenland: Egedesminde, depth 30—40 fathoms
Sukkertoppen, on *Boltenia* (no details noted)
Ingmikertok, Angmagsalikfjord (depth not given) (East-Greenland Expedition)
Iceland: 33 miles SE. $^1/_2$ E. of Stokkesnæs near Hornsvig, depth 84 fathoms (labelled *Lafoëa fruticosa*).

We have here a species of highly variable character, especially in the northern waters, where the biophysical factors evidently exercise an important and determinative influence upon the variation of the species. There is consequently also much confusion as to the synonymy of the species. *Lafoëa fruticosa* was established by M. Sars (1849) and in his description we find the following with regard to the hydrothecæ: "superne latioribus, inferne coarctatis". This certainly gives the impression of a hydrotheca having its lower portion, partly on account of the curvature of the wall, broader than the upper, which again expands nearer the opening. The same is also seen in the drawing subsequently given by G. O. Sars (1873 Tab. IV, figs. 17—18) of the species, undoubtedly based upon M. Sars's type specimens. This does not agree with the statements of Bonnevie (1899 p. 65) and we can hardly help feeling that among Bonnevie's *Lafoëa fruticosa* there must also be some colonies of *Lafoëa gracillima* forma *elegantula*; a supposition which is, moreover, confirmed by the study of her material in Christiania. On the other hand, Bonnevie has (l. c.) established an entirely new species, *Lafoëa symmetrica*, which as a matter of fact is based upon variants of *Lafoëa fruticosa*. The principal difference between *Lafoëa fruticosa* and *Lafoëa symmetrica* is, according to Bonnevie, the fact that the latter species has symmetrical hydrothecæ, whereas these are of asymmetrical structure in the former. It will be seen, however, from the drawings of hydrothecæ given (1899 Tab. V, fig. 2 c') that asymmetrical hydrothecæ can also occur in *Lafoëa symmetrica*. On the other hand, further examination of the hydrothecæ in *Lafoëa fruticosa* (cf. Broch 1908 fig. 4, 1909 textfig. 19) shows that the asymmetry is often but very slightly pronounced, and even disappears altogether in a greater or lesser percentage of the hydrothecæ in a fairly large colony. We find, in other words, that in this respect, every imaginable transition form may be met with from *Lafoëa fruticosa* to *Lafoëa symmetrica*; the character in question is therefore not suitable for purposes of specific distinction. There remains then, the size, which is said to differ as between *Lafoëa fruticosa*, *L. symmetrica*, and *L. grandis*. It is soon found, however, that this character likewise is here unserviceable. On the one hand, the three species form, according to Bonnevie, a finite series of sizes, *Lafoëa symmetrica* being from the drawings and description, larger than *Lafoëa fruticosa*, but smaller than *Lafoëa grandis*. On the other hand, a large material of the three forms reveals the fact there is no discernible interval throughout the series; all intermediate stages are found, from finely built colonies of *Lafoëa fruticosa* to such extreme cold-water variants as those upon which Hincks's *Lafoëa grandis* is based. We are thus compelled to include the forms under one species, the correct name of which should be *Lafoëa fruticosa*.

The amalgamation of these three species into one, however, involves the further abolition of *Lafoëa pocillum* Hincks (1868 p. 204, pl. XL, fig. 2). The shape of the hydrothecæ is very correctly described by Hincks as follows: "tumid below, with the sides curved inwards above, and expanding again slightly towards the top". This coincides entirely with M. Sars's "superne latioribus, inferne coarctatis". The length of the stalk in *Lafoëa* species and its spiral winding or division into separate

rings varies even within a single large colony to such a degree that the features in question cannot be taken as distinctive specific characters, unless combined with others more sound. There remains then the creeping form of colony. But *Lafoëa fruticosa* here differs in no wise from the remaining species of the genus; its colonies may be pure upright rhizocaulome formations, but this is very rarely the case. Generally, the somewhat larger colonies consist partly of upright, partly of creeping portions, and it is very common to meet with such composite colonies, when they are brought up with the underlayer attached. Exclusively creeping colonies thus merely form the other extreme in the

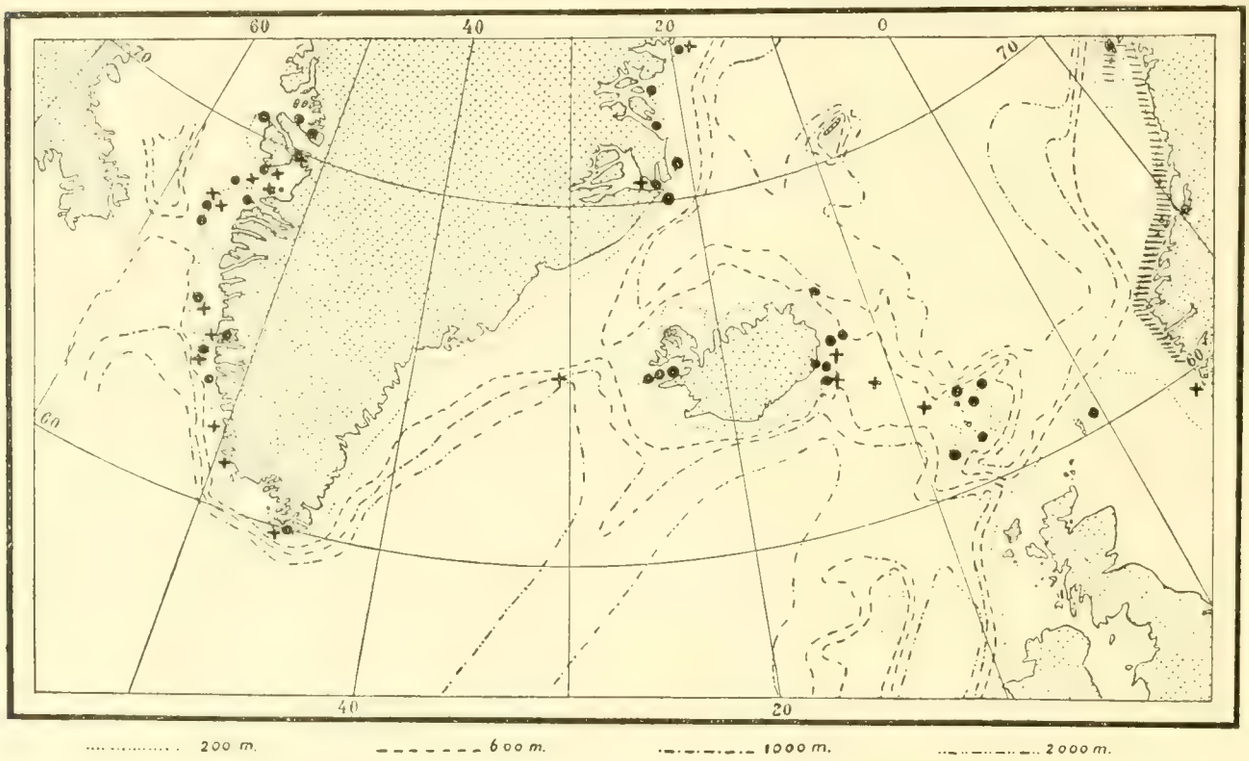

Fig. III. The distribution of *Lafoëa fruticosa* forma *genuina* ● and forma *grandis* + in the northern Atlantic. The hatched region denotes a common occurrence of *Lafoëa fruticosa* according to literature. (In British waters the dates are to be revised owing to confusion of the species with *Lafoëa gracillima*).

same series of variants. Consequently therefore, *Lafoëa pocillum* must be discarded, as being synonymous with *Lafoëa fruticosa*.

Jäderholm (1909 p. 71) follows, stating no particular reason, the example of Nutting (1901 p. 175) and ascribes *Lafoëa pocillum* to the genus *Hebella*. Nutting, in his diagnosis of this genus, states as follows: "Hydrothecæ . . . having their cavities separated from those of the stem by a partial septum". Such septum or diaphragm is altogether lacking in the European specimens of *Lafoëa pocillum*.

It must not be forgotten, however, that the former species partly owe their existence to external determining factors. Disregarding the creeping form of colony as opposed to the upright, the differences presented by the colonies in a less extensive material are considerable enough to warrant at any rate temporary distinction of species, and it would in these cases be incorrect not to notice the

same. Such "species" will on further investigation often be found to represent regular groups of variants. And this is precisely the case here. In *Lafoëa fruticosa*, the transition forms are not infrequent in boreal waters, and it may often appear doubtful where the limits should be drawn. It is perfectly admissible, in the case of *Lafoëa fruticosa*, to distinguish between a forma *genuina* as opposed to forma *grandis*, the first-named comprising that group of variants hitherto indicated as *Lafoëa fruticosa*, and the latter embracing the species *Lafoëa grandis* and *Lafoëa symmetrica*. The two forms also make typical geographical groups.

Forma *genuina*, which must be regarded as the mother form, is of very wide distribution; it is encountered together with the following form (text fig. III) in the arctic region, and alone in boreal and southern waters, both in the Atlantic and the Pacific, where it has been met with so far down as Hawaii. Intermediate forms are, as mentioned, frequently found in boreal and arctic waters, more particularly in the transition zones between the two.

Forma *grandis* is of strictly arctic occurrence, and must here be regarded as a typical character form. Billard's record (1907 p. 176) of a find at Cape Spartel must, from the measurements and figures given, be due to incorrect diagnosis.

Gen. Toichopoma Levinsen.

The colonies are creeping, or form upright, irregularly branched rhizocaulomes, with stalked, cylindrical hydrothecæ. The hydrothecæ lack the diaphragm, but have a primitive closing apparatus; the distal integral part of one side of the hydrotheca wall can be closed down over the aperture.

Toichopoma obliquum (Hincks) Levinsen.

1874 *Calycella obliqua*, Hincks, On deep-water Hydroida from Iceland, p. 149, pl. 6, figs. 4—5.
1893 *Toichopoma obliquum*, Levinsen, Meduser, Ctenophorer og Hydroider, p. 178.
1911 — — Kramp, Report on the Hydroids, p. 374, pl. XX, fig. 4, pl. XXIII, figs. 5—8, pl. XXIV, fig. 1.

The colonies are creeping, or form upright irregularly branched rhizocaulomes. The hydrothecæ have a short stalk with a varying number of spiral windings; they are cylindrical, curved, with an adcauline convexity, as a rule somewhat expanded near the base, and slightly broader again near the aperture, which in open hydrothecæ is somewhat asymmetrical; the hydrotheca passes gradually over into the stalk. The abcauline distal part of the aperture is thin, and can be closed in towards the opposite wall over the contracted polyp.

The gonothecæ are closely packed in a (hermaphroditic?) coppinia on stem or branches; the single gonothecæ are pentagonal or hexagonal, with a short, narrow cylindrical neck. Between the gonothecæ are inserted long, highly curved tubes, forming a close network over the coppinia.

Material:

Greenland: Jakobshavn (no details noted)
Egedesminde (- — —)

Toichopoma obliquum is a high arctic species, recorded both from West and East Greenland, as well as from Spitzbergen and the Murman Sea.

Gen. Grammaria (Stimpson).

Colonies creeping or forming upright, irregularly branched rhizocaulomes with sessile, cylindrical hydrothecæ, which are to a varying extent fused with the tubes, so that in this part it is impossible to distinguish between the wall of the hydrotheca and tube. The hydrothecæ can at times exhibit a basal constriction forming a boundary between them and the mother tube, but such constriction may also often be wanting. Diaphragm and operculum lacking.

In earlier works, the creeping species have been incorrectly noted as a separate genus, *Filellum*. The type of this genus was *Filellum serpens* (Hassall). I have previously (1912 p. 10) pointed out that this species should be classed under *Grammaria*, and am supported here by Kramp (1914 p. 1030). Further proof is afforded by Stechow, who describes (1913 p. 118) a species *Grammaria scandens*, with both creeping and upright colonies; it would seem doubtful whether this species should properly be maintained beside *Grammaria abietina*, which may often be found in Throndhjem Fjord in the same manner. Stechow (l. c. p. 121) considers, however, that the genera should be maintained, "da ihre Beibehaltung eine grosse Bequemlichkeit für die Bestimmung ist".

Grammaria serpens (Hassall) Broch.

1848 *Campanularia serpens*, Hassall, Catalogue of Irish Zoophytes, p. 2223.
1868 *Filellum serpens*, Hincks, A History of the British Hydroid Zoophytes, p. 150.
1912 *Grammaria serpens*, Broch, Hydroida from the "Michael Sars", p. 10.

Colonies creeping. Hydrothecæ cylindrical, bent to an angle, the basal part fused with the stolon. The hydrotheca is tubular, quite cylindrical, or with slightly outward curving opening margin; the transition to the stolon is as a rule marked by a slight constriction.

The gonothecæ are collected in close coppiniæ, with highly curved tubes. They are hermaphroditic, with the male gonothecæ wedged in between the female.

Material:

"Ingolf" St. 87 65°02,3′ N., 22°56,2′ W., depth 110 fathoms
"Thor" 64°16′ N., 22°17′ W., — 50 metres
— 64°02′ N., 22°33′ W., — 34 —
— 63°30′ N., 20°14′ W., — 80 —
Greenland: Egedesminde (without further details)
Store Hellefiskebanke (— — —)
Davis Strait (— — —)
Iceland: Vadlevik, depth 80 fathoms
33 miles SE. of Stokkesnæs near Hornvig — 84 —
9½ — S. by W. ½ W. of Ingolfshofdi, depth not given
The Faroe Islands: 8—10 miles N. of the Faroe Islands (without further details)
7 miles N. by E. of Myggenæs point, depth 57 fathoms

6 miles N. by W. of Store Kalsö	depth 60	fathoms
Deep hole at north point of Nolsö	— 100	—
Borönæs 1¾ miles in N. 75 W.,	— 30	—
5 miles SSE. of Bispen	— 50	—
13 — W. by S. of Munken	— 150	—
Stokken 2 miles in S. 22 E.	— 55	—

This remarkable species was formerly considered as the type of the genus *Filellum*. Bonnevie (1899) notes it under *Lafoëa*, but it should, as I have indicated above, be classed under the genus

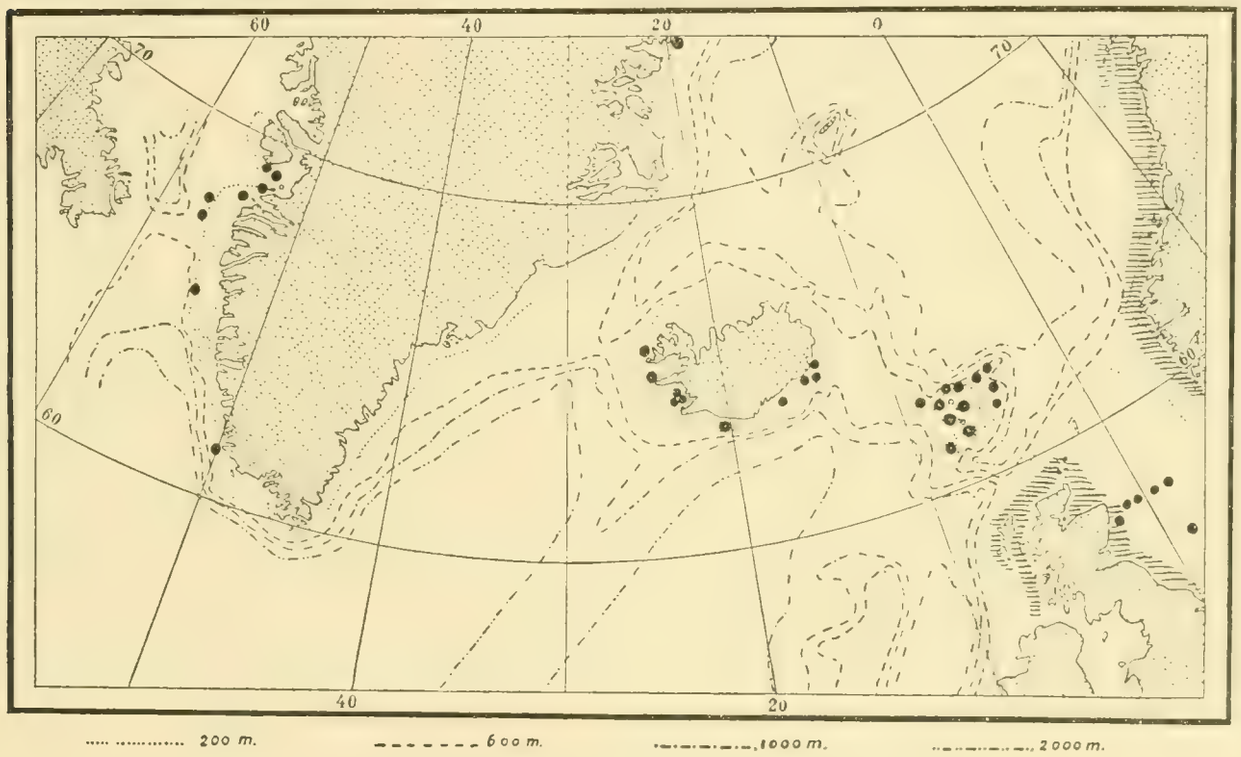

Fig. IV. The occurrence of *Grammaria serpens* in the Northern Atlantic.
In the hatched regions the literature notes a common occurrence.

Grammaria. From the records, the species is of highly cosmopolitan distribution; it is less numerous, however, in the arctic seas, and is likewise not altogether of common occurrence in warmer waters. It is most frequently met with in the mid-littoral parts of the boreal region (fig. IV) and is here but rarely found at greater depths.

Grammaria conferta (Allman) Broch.

1877 *Cryptolaria conferta*, Allman, Report on the Hydroida .... of the Gulf Stream, p. 17, pl. 12, figs. 6—10.

1912 *Grammaria conferta*, Broch, Hydroida from the "Michael Sars", p. 10.

Upright, irregularly branched rhizocaulomes, the outer ramifications monosiphonic, the basal

parts polysiphonic. The hydrothecæ are arranged on the branches and stem in two opposite rows, alternating, with the mouth turned now to one side, now to the other. The hydrothecæ are large, tubular, passing by a slightly marked constriction over into the stolon; the diaphragm is lacking. In its proximal part, the hydrotheca is fused with the stolon; owing to a sharp bend in the hydrotheca, the distal part is almost perpendicular to the proximal. Opening margin slightly everted.

The gonothecæ are set close together in a (hermaphroditic?) scapus (without inserted tubes) on the branches or stem. The gonothecæ are bottle-shaped, with a short neck.

Material:

"Ingolf" St. 11	64°34′ N.,	31°12′ W.,	depth	1300	fathoms	1,6°
— - 31	66°35′ N.,	55°44′ W.,	—	88	—	1,6°
— - 32	66°35′ N.,	56°38′ W.,	—	318	—	3,9°
— - 78	60°37′ N.,	27°52′ W.,	—	799	—	4,5°
— - 92	64°44′ N.,	32°52′ W.,	—	976	—	1,4°

In a previous work (1912 p. 10) it was pointed out that *Cryptolaria conferta* is distinguished from the remaining *Grammaria* species only by differences so slight that they do not by any means warrant generic separation; the bilateral arrangement of the hydrothecæ is not an adequate generic character. — Interesting from a biological point of view is the fact that this typical deep-sea form as a rule developes filiform, root-like basal offshoots, for attachment to the soft bottom; I have, however, once seen a colony which had attached itself to a fragment of the shell of a deep-water mollusc, and had in consequence less highly developed offshoots than most colonies otherwise have.

Grammaria conferta's northern limit of occurrence is moved a considerable distance farther north by the latest finds; otherwise, its distribution is that of a typically abyssal form, and the record of its occurrence in only 88 fathoms' depth far up in Danmark Strait thus comes as a surprise; the more so since the species should generally be noted as a character form for the warmer and deeper waters of the Atlantic. It does not penetrate in over the submarine ridges which form the southern boundary of the Norwegian Sea.

Grammaria abietina (M. Sars) Stimpson.

1851 *Campanularia abietina*, M. Sars, Beretning om en i Sommeren 1849 foretagen Zoologisk Reise, p. 131.
1854 *Grammaria robusta*, Stimpson, Synopsis of the Marine Invertebrata of Grand Manan, p. 9, pl. 1, fig. 3.

The colonies form coarsely built, stiff, irregularly branched rhizocaulomes, in exceptional cases with creeping portions. The hydrothecæ lack the diaphragm, and pass over without constriction into the mother tube; their lower limit is formed by the ring of small chitinous bodies to which the base of the hydranth is attached. The hydrothecæ are tubular, bent to an angle, and have as a rule a slightly everted opening margin. The plane of the aperture itself is normally parallel with the axis of the branch; in forms with particularly short hydrothecæ, the aperture is slightly turned upwards. The hydrothecæ project in most cases far beyond the secondary tubes.

The gonothecæ are closely collected in hermaphroditic coppiniæ with highly curved tubes. The

female gonothecæ are much compressed, sessile; the male are stalked, with the stalks pressed in among the female gonothecæ. There are only a small number of almost spherical male gonothecæ in the coppinia; they are freely placed between the surface of the female aggregate and the outer coils of the tubes. The female gonophores are heteromedusoids; the male reduced cryptomedusoids; the fertile colony has nematocysts dimorphously developed.

Forma *typica*: The upper (adcauline) wall of the hydrotheca projects 1,5—3 times the diameter of the aperture beyond the tubes; the plane of the aperture is parallel with the axis of the branch.

Forma *brevicyatha*: the free portion of the adcauline wall is 0,5—1 times the diameter of the aperture; the aperture itself is turned obliquely upward.

Material:

Forma *typica*:

"Ingolf" St. 34	65°17′ N.,	54°17′ W.,	depth	55	fathoms	
— - 51	64°15′ N.,	14°22′ W.,	—	68	—	7,32°
— - 87	65°02,3′ N.,	23°56,2′ W.,	—	110	—	
— - 92	64°44′ N.,	32°52′ W.,	—	976	—	1,4°
— - 95	65°14′ N.,	30°39′ W.,	—	752	—	2,1°
— - 98	65°38′ N.,	26°27′ W.,	—	138	—	5,9°
"Thor"	66°43′ N.,	15°03′ W.,	—	48	—	

Greenland: Davis Strait, depth 66 fathoms (without further details)
Sukkertoppen, on *Boltenia* (— — —)
Godthaab, depth 50—60 fathoms
Hunde-Eiland (without further details)
Cape Tobin, depth 57 fathoms (East-Greenland Expedition)
Jan Mayen: 70°32′ N., 8°10′ W., depth 470 fathoms

Iceland: 4—5 miles E. of Bakkefjord, — 70 —
5 miles E. of Seydisfjord, — 135 —
64°27′ N., 13°27′ W., — 150 metres

The Faroe Islands: 61°40′ N., 7°40′ W., — 135 fathoms
6 miles N. by W. of Kalsö, — 60 —

Forma *brevicyatha*:

The Faroe Islands: 7 miles N. by E. of Myggenæs point, depth 57 fathoms
6 — N. by W. of Kalsö — 60 —

A rich and well-preserved material of *Grammaria abictina* from the Trondhjem Fjord afforded an opportunity for further study of the species. Its polyps have an oral part with mainly indifferent endoderm cells above the tentacle whorl; the true gastral endoderm exhibits an altogether uniform development. The base of the hydranth is fastened to the wall of the hydrotheca far in between the tubes of the rhizocaulome, by a wreath of small chitinous bodies; this is the only discernible limit between the hydrotheca and its mother stolon, which are otherwise practically of equal breadth. A study of the coppinia (Broch 1917) brought to light several peculiarities. In fertile colonies we find,

in the defensive polyps and elsewhere, large, practically cylindrical nematocysts in addition to the small capsule form which is found in all thecaphores; the nematocysts are thus dimorphous. A remarkable feature about the coppinia is the position of the male gonothecæ, which here appear as stalked, oval to spherical formations between the closely packed female gonothecæ and the outer protective network of the tubes. *Grammaria abietina* thus presents an intermediate stage between types with uniform, hermaphroditic coppiniæ, where the male gonothecæ are wedged in among the female, and those where the male gonothecæ appear singly outside the coppinia or scapus, which has become an altogether female aggregate. The gonophores in *Grammaria abietina* exhibit distinct sexual dimorphism; the female gonophores are heteromedusoids, the male cryptomedusoids. The cryptomedusoid gonophore is, however, here highly reduced, and distinctly presents a transition stage which would, on slight further reduction, become a styloid gonophore.

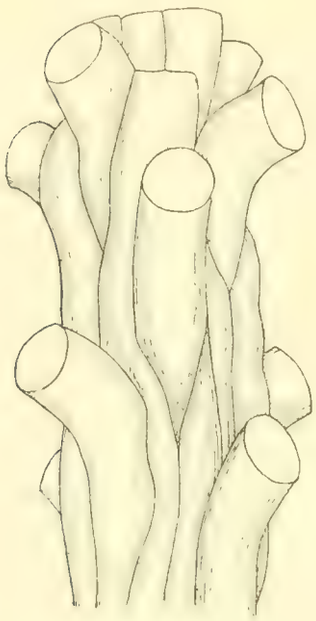

Fig. V. *Grammaria abietina* forma *brevicyatha*. Terminal part of of a branch. Colony from 7 miles N. by E. of Myggenæs point, the Faroe Islands, 57 fathoms. (× 40.)

From two places at the Faroe Islands we have in the material some very richly developed colonies which, owing to the somewhat divergent character of the hydrotheca, are here noted as representatives of a particular form, forma *brevicyatha* nov. In point of habitus, the mentioned colonies differ but little from forma *typica*, they are of equally robust build, and with the same rich ramification; on closer examination, however, one cannot fail to observe the remarkable short hydrothecæ (fig. V). In forma *typica*, the hydrotheca protrudes its distal parts out in front of the stolons so far that the free portion of its upper (adcauline) wall reaches a length of 1,5 to 3 times the diameter of the aperture; in forma *brevicyatha*, on the other hand, the corresponding part is only one-half to one diameter in length. This might perhaps by some be regarded as a good specific character. We find however, here and there among the colonies, hydrothecæ presenting the same features as forma *typica*, and, in slightly greater numbers, intermediate forms with lengths filling the interval between the dimensions named. On the other hand, these intermediate forms, and "*typica*" hydrothecæ occur only in so slight a percentage among the colonies that they exert no influence upon the general character of the colony as a whole. How far we have here to deal with a local variant group, cannot be determined with certainty; that the form can hardly be very common in the northern seas is evident from its rare occurrence in the extensive material now being dealt with, even when this is supplemented by the large collections from Trondhjem Fjord. Still, the form in question cannot be summarily disposed of by noting it under the head of casual single variants, since it occurs in a single colony from one place, but in four remarkably luxuriant ones from the other.

Forma *brevicyatha* exhibits certain resemblances to *Grammaria immersa* Nutting; there are, however, so considerable differences observable that the two cannot be confused. The latter species is immediately recognisable from its finer structure, whereas *Grammaria abietina* is a species of very coarse build. The splitting of the tops of the branches (fig. V) in forma *brevicyatha* also agrees with *Grammaria abietina*, as distinct from *Grammaria immersa*. A certain likeness to the latter species

again, we find in the shape of the hydrotheca; according to Kramp, (1911 p. 376) the margin of the hydrotheca in *Grammaria abietina* — in contrast to *Grammaria immersa* — always curves outwards slightly; in forma *brevicyatha*, on the other hand, this is only quite exceptionally the case, and by far the greater number of hydrothecæ show no indication of outward curvature in the margin. Kramp has (l. c.) pointed out another feature which is here of more importance. In forma *brevicyatha*, the hydrotheca aperture is almost invariably turned somewhat obliquely upwards, not as in forma *typica*, where the plane of the aperture is parallel with the axis of the branch, or in *Grammaria immersa*,

Fig. VI. Localities of *Grammaria abietina* (forma *brevicyatha* +) in the Northern Atlantic. In the hatched region the literature notes a common, although scattered occurrence.

where the opening is even turned slightly downwards. In forma *brevicyatha*, only the few large hydrothecæ have a plane of aperture parallel with the axis of the branch.

Grammaria abietina is a typical arctic-boreal species, recorded also in a single instance (Billard, 1904 p. 164) from the north of France. It may at times penetrate down to great depths, as for instance at the "Ingolf" St. 92, where it reached 976 fathoms, the greatest depth hitherto recorded for this species. Otherwise it is chiefly found (see fig. VI) in the deeper parts of the littoral regions of the boreal and arctic area. *Grammaria abietina* is also apparently an Atlantic species; it is known from the east coast of North America, to Taimur, but has not hitherto been recorded from about Bering Strait or the Pacific. If, however, it should prove correct that *Grammaria scandens* Stechow is a synonym for *Grammaria abietina*, then it must be classed among the circumpolar species.

Grammaria immersa Nutting.

1901 *Grammaria immersa*, Nutting, Papers from the Harriman Alaska Expedition, p. 178, pl. XXI, figs. 5, 6.

The colonies form stiff, but finely built, irregularly ramified rhizocaulomes. The hydrothecæ pass over into the stolon without marked constriction, their basal limit is formed by the series of small chitinous bodies to which the base of the hydranth is attached. Diaphragm lacking. The hydrothecæ are tubular, highly curved in the distal part, and with no outward curvature of the opening margin. The aperture is normally turned somewhat obliquely down; more rarely, we may find the plane of the aperture parallel with the branch axis. The short freely projecting part has an upper (adcauline) wall in front of the stolons, its length being almost invariably less than half the diameter of the aperture.

The gonothecæ are collected in close (hermaphroditic?) coppiniæ, the tubes of which are highly curved, making a close network outside the gonothecæ.

Material:

Iceland: 8 miles E. of Seydisfjord, depth 60 fathoms (labelled *Grammaria abietina*).

Grammaria immersa is an arctic character species; only quite exceptionally does it seem to penetrate into the boreal regions. It is circumpolar, and belongs to the littoral region.

Gen. Lictorella (Allman).

Upright colonies with sympodial growth. The hydrothecæ deep bell-shaped to tubular, often exhibiting a slight asymmetrical development; they have a low yet strong diaphragm, but lack opercular apparatus. Nematothecæ and nematophores lacking. Gastral endoderm of the polyps uniformly developed.

Lictorella pinnata (G. O. Sars) Allman.

1874 *Lafoëa pinnata*, G. O. Sars, Bidrag til Kundskaben om Norges Hydroider, p. 94, tab. 4, figs. 25—28.
1874 — *halecioides*, Allman, Report on the Hydroida .... Porcupine, p. 471, pl. 66, figs. 1, 1 a.
1888 *Lictorella halecioides* pars, Allman, Challenger Report vol. XIII, p. 35.
nec 1907 *Lafoëa pinnata*, Browne, Hydroids collected by the "Huxley", p. 25.

Upright, single or double pinnate colonies, generally in one main plane, with polysiphonic main stem. The hydrothecæ alternating in two rows along the branches, with a tendency to unilateral arrangement; the hydrothecæ all turned obliquely forward towards the one side (front) of the colony. The hydrothecæ are narrowly bell-shaped, with slightly everted opening margin; transition to stalk gradual. The hydrotheca has a low but strongly developed diaphragm. Stalk generally short, with an oblique furrow on the upper side, at times also a furrow running right round the stalk lower down. The latter furrow runs transversely to the stalk. Polyps with uniform gastral endoderm.

The gonothecæ are collected in an openly constructed scapus on the stem or main branches.

The single gonothecæ are reversed, narrowly conical to almost cylindrical, fastened to the hydrocaulus by a rudimentary stalk at the narrow end; distally, they are furnished with three, more rarely with four or two, round lateral openings, each with a short neck.

Material:

"Ingolf" St. 7	63°13′ N.,	15°41′ W.,	depth	600	fathoms	4,5°
— - 25	63°30′ N.,	54°25′ W.,	—	582	—	3,3°
— - 81	61°44′ N.,	27°00′ W.,	—	485	—	6,1°
"Thor"	61°15′ N.,	9°33′ W.,	—	872	metres	

Levinsen (1913 p. 287) believes to have found a blind sack in *Lictorella pinnata*; this must doubtless be due to an accidental S-shaped curvature of the polyp, which would not, however, produce

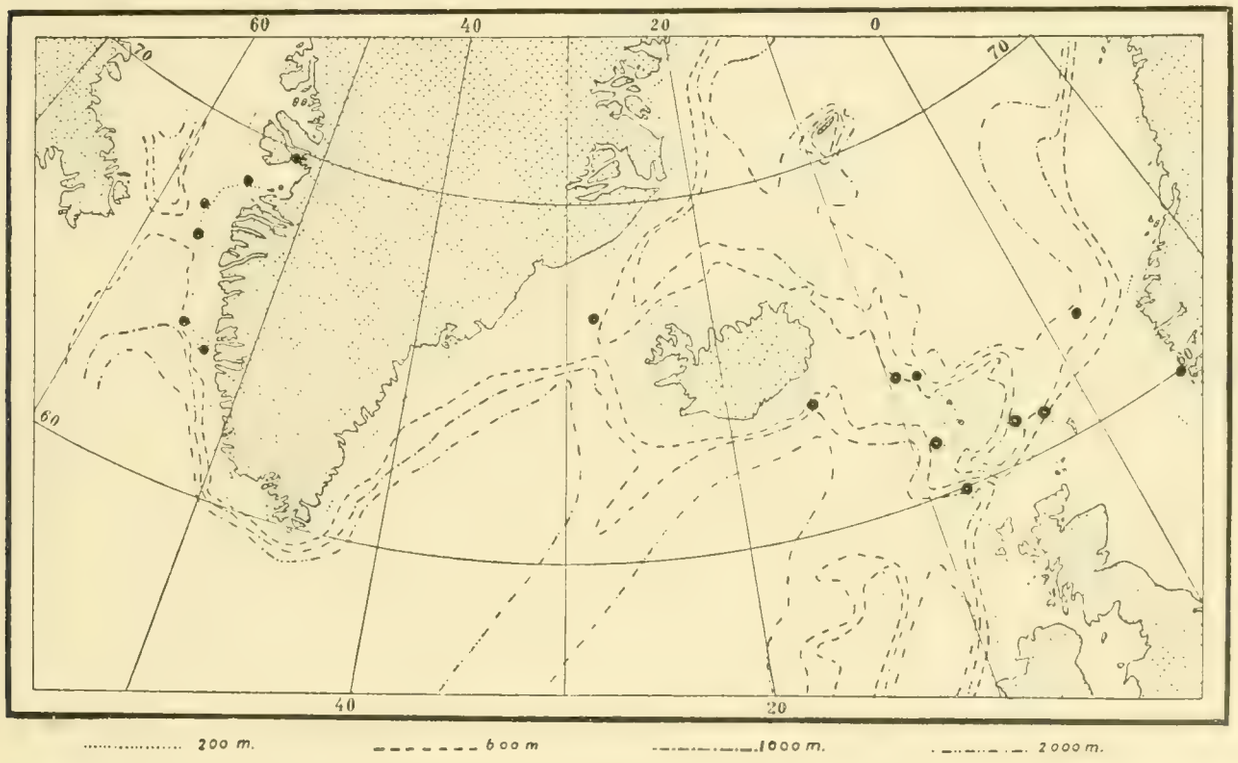

Fig. VII. Finds of *Lictorella pinnata* in the Northern Atlantic.

a blind sack of any real anatomical importance. Microtome sections reveal an entirely uniform gastral endoderm, and I have not been able to find any portion of the endoderm histologically corresponding to the epithelium in the blind sack of *Sertulariidæ*. The "blind sack" observed must thus be due to accident.

Lictorella pinnata exhibits a highly remarkable distribution (fig. VII). It belongs to the upper part of the abyssal region, but penetrates as far down as 1300 metres; on the other hand, the species can at times occur right up in the littoral region, and has been met with in the Hardanger Fjord even up at a depth of only 90 metres. Horizontally, the species seems to be quite widely distributed, but the few records from southern seas are unreliable, as the species has here been confused with *Lictorella antipathes* (Lamarck). Pictet and Bedot (1900 p. 16) record it from the Bay of Gas-

cogne. Browne's specimens from the Bay of Biscay (1907 p. 25) on the other hand, should not be included here; from the nematothecæ, they should be ascribed to *Zygophylax*, and are plainly identical with the following species. In the northern Atlantic regions, the species appears to follow the warmer water-masses in their progress through the boreal regions; it has exceptionally been found right up in the Barents Sea.

Gen. Zygophylax Quelch.

Upright colonies with sympodial growth. The hydrothecæ are narrowly bell-shaped to tubular, not infrequently somewhat asymmetrical in structure, with a low, but strongly developed radially symmetrical diaphragm. The colonies are furnished with small nematothecæ. The polyps have a uniformly developed gastral endoderm.

Zygophylax biarmata Billard.

1906 *Zygophylax biarmata*, Billard, "Travailleur" et "Talisman", p. 180.
1907 *Lafoëa pinnata*, Browne, Hydroids collected by the "Huxley", p. 25.
1911 *Lictorella Levinseni*, Sæmundsson, Bidrag til Kundskaben om de islandske Hydroider II, p. 86.
nec 1913 *Zygophylax biarmata*, Stechow, Hydroidpolypen der Japanischen Ostküste, p. 114.

Colonies upright, in a plane singly or doubly pinnately branched with polysiphonic main stem; the branches nearly regularly alternating. The hydrothecæ are alternately placed, turning obliquely forward towards the one side (front) of the colony; i. e. with a tendency to unilateral arrangement. The hydrothecæ are mainly tubular, with slightly outward curving margin, narrowing evenly downwards to a stalk of varying length, which has one or two more or less distinctly marked segmentations. The hydrotheca has a well developed low diaphragm. At the base of the hydrotheca stalk, and occasionally elsewhere on the tubes, there are small, cylindrical nematothecæ, attached to the tube or apophyse by a short and often indistinct stalk, generally in one piece. The apophyse has normally a couple of nematothecæ.

The gonothecæ are collected in a primitive, open coppinia (hermaphroditic?) on the stem or main branches; the nematothecæ are more richly developed in the gonotheca aggregate than elsewhere, and appear there in large numbers. The gonothecæ are flattened ovate, with an outward and downward curving neck distally on either side in the transversal plane.

Material:

Iceland, near Vestmannö, depth 510 metres. (Type specimen of *Lictorella Levinseni*).

The first description of this remarkable species is that given by Billard (1906 p. 180) who had, however, only sterile colonies to go upon. It is undoubtedly the same species which Browne records (1907 p. 25) from the Bay of Biscay, though he ascribes it incorrectly to *Lafoëa pinnata* G. O. Sars; the nematothecæ show that it must be a *Zygophylax*, and the exhaustive description very distinctly suggests *Zygophylax biarmata*. Sæmundsson (1911 p. 86) describes the species anew under

the name of *Lictorella Levinseni*, and notes the nematothecæ as among its characteristic features; his colonies, which I have had an opportunity of examining, are fertile, wherefore he was also able to describe the gonosome. This is of a highly peculiar character, and at once demonstrates the incorrectness of Stechow's supposition (1912 p. 114) that the species should be identical with *Zygophylax armata* (Ritchie). Ritchie's species (1907 p. 533) has a typical coppinia, the tubes of which are each furnished with several nematothecæ.

The single gonothecæ in *Zygophylax biarmata* resemble not a little those of *Lictorella pinnata*, the number of opening tubes, however, being apparently in *Zygophylax biarmata* constantly reduced to two, the tubes being at the same time somewhat longer. The single gonotheca stands out freely, but the gonothecæ are closely packed in clusters on the stem or main branches, and between them we find numerous long nematothecæ, remarkably well developed, so that the whole aggregate must be regarded as a primitive coppinia, or rather as something between the open scapus and the coppinia.

There are one or two points which seem to count against the identity of *Lictorella Levinseni* and *Zygophylax biarmata*. Sæmundsson's description rather gives the impression that there are not, normally, a pair of nematothecæ on the apophysis; on closer investigation, however, we are led to the conviction that there are, as a rule, a couple of holes in the periderm showing that nematothecæ have been there, but have fallen off. The colony investigated is the same which Sæmundsson shows in fig. 2 a. — A further difference would seem to exist in the hydrotheca stalks, which in Sæmundsson's specimens are somewhat longer in proportion than stated by Billard. The length of stalk, however, varies considerably in hydroid species, and cannot thus be used as a specific character. And finally, the hydrothecæ in the colony here concerned exhibit a tendency to unilateral arrangement. Sæmundsson does not mention this feature, nor does Billard make any reference to the same in his exposition. It would nevertheless seem, from Billard's figure (l. c. text fig. 8) that the hydrothecæ point obliquely forward towards the one side, the hydrothecæ shown being indicated in oblique projection, with the aperture directed slightly forward towards the observer. Here again then, there is nothing which can be taken as evidence of distinction in species.

The find here recorded extends the known distribution of this deep-sea form considerably towards the north, the species having hitherto been known only from the Bay of Biscay and south of the same. It appears to belong to the abyssal region.

Family Campanulinidæ.

The hydrothecæ are tubular to bell-shaped, sessile or stalked, of the radially-symmetrical type, more rarely with diaphragm. The hydrothecæ are furnished with highly organised closing apparatus, falling in the shape of a roof or a pyramid over the indrawn polyp. The colonies are stolonial or sympodial. The polyps have a conically pointed oral part, and gastral endoderm of uniform organisation.

The generic division of this family has given rise to much dispute, and we even find, that certain writers, such as Schneider (1897) and Bonnevie (1899) regard it as a single genus. The

best exposition of the family is that given by Kramp, who has in two works (1911 and 1913) given a close description, which as regards its main features, is adhered to in the present work. Kramp (1913 p. 14) inclines to the view that the family should be divided into two, a primitive family, *Cuspidellidæ*, where the closing apparatus is formed by the upper part of the hydrotheca wall, and a more highly developed family, *Campanulinidæ*, where the closing apparatus consists of the original roof of the hydrotheca. Kramp's point of view is doubtless highly correct, but as my material is not suited to serve as basis for more detailed exposition, I have merely noted the two mentioned groups as sub-families, otherwise following mainly the generic division established by Kramp (1911 p. 383).

The gonothecæ in several members of the family are of considerable interest, differing only in their greater dimensions from the hydrothecæ — doubtless a primitive feature. This peculiarity is known among the genera of *Stegopoma*, *Cuspidella*, and *Lafoëina*. Unfortunately, very little is known as to the gonophores, but we know that the family comprises the polyp-generation of a number of highly heterogeneous Leptomedusæ, which are distributed by systematists throughout a whole series of families. As, however, the polyps, save for the mentioned characters in the sub-families, exhibit very considerable uniformity, we can hardly, from what we know at present, consent to a further subdivision of the family. We have evidently here to deal with a series of biological divergencies in the medusa generation, particularly calculated to demonstrate the impossibility of establishing, in the present state of our knowledge, any common system for the two generations. The hydroid system cannot here be adapted to the medusa system, which evidently demands thorough investigation of the biological adaptation phenomena in order to give a system which can claim to be considered as fairly satisfactory from a phylogenetic point of view.

Sub-family Cuspidellinæ.

Campanulinidæ with closing apparatus formed by the integrating distal part of the hydrotheca wall.

Gen. Stegopoma Levinsen.

Colony creeping or developed to an upright rhizocaulome. The hydrothecæ tubular to narrow bell-shaped, without diaphragm; the closing apparatus consists of two folding membranous parts of the distal hydrotheca wall, which shuts down in a roof-shaped lid over the aperture, between two diametrally opposite teeth. The polyps have uniform gastral endoderm.

Stegopoma plicatile (M. Sars) Levinsen.

1863 *Lafoëa plicatilis*, M. Sars, Bemærkninger over fire norske Hydroider, p. 31.
1874 *Calycella plicatilis*, G. O. Sars, Bidrag til Kundskaben om Norges Hydroider, p. 95.
1893 *Stegopoma plicatile*, Levinsen, Meduser, Ctenophorer og Hydroider, p. 37.
1893 — *caricum*, Levinsen, — — - — p. 37.

Colonies form upright, irregularly pinnate, polysiphonic rhizocaulomes, sometimes with creeping parts. Hydrothecæ long, tubular, some quite free and short-stalked, others with the one side for part of its extent fused with the stolons; more or less curved, exceptionally with the distal part almost perpendicular to the proximal. Diaphragm lacking. Closing apparatus formed by two folding thin distal portions of the hydrotheca, shutting in a roof over the indrawn polyp between two strong, tooth-like, diametrically opposite parts of the distal portion of the hydrotheca.

The gonothecæ are situated on the branches or on the stalk. They present the appearance of gigantic hydrothecæ, with the same structure of the closing apparatus. The gonothecæ are entirely free, short-stalked, or to a greater or lesser extent attached to the tubes.

Material:

"Ingolf" St. 28,	65°14′ N.,	55°42′ W.;	depth 420 fathoms,		3,5°
— - 29,	65°34′ N.,	54°31′ W.;	— 68	—	0,2°
— - 32,	66°35′ N.,	56°38′ W.;	— 318	—	3,9°
— - 34,	65°17′ N.,	54°17′ W.;	— 55	—	
— - 35,	65°16′ N.,	55°05′ W.;	— 362	—	3,6°
— - 126,	67°19′ N.,	15°52′ W.;	— 293	—	—0,5°

Greenland: Davis Strait (without further details) depth 80 fathoms
Umanak (— — —)
Ritenbenk (— — —) on *Ægа crenulata*
Godhavn (— — —)

Kara Sea, "Dijmphna" (Type specimen of *Stegopoma caricum*.)

This remarkable species shows an astonishing power of altering its appearance. One variant is described by Levinsen (1893 p. 37) as a distinct species, *Stegopoma caricum*, from the fact that it has, at the points of the branches, only three hydrotheca-bearing stolons. This feature, however, as I have previously pointed out (1912 p. 11), cannot be maintained as a specific character, since it may occur in certain branches, while others of the same colony have four or five such tubes near the point; very rarely, again, we may find the number of hydrotheca-bearing tubes reduced to two. It was also pointed out, on the same occasion, that the hydrothecæ can vary, being at times entirely free, at others fused with the tubes. Free hydrothecæ on creeping stolons assume entirely the same appearance as in *Stegopoma fastigiatum* (Alder).

The gonothecæ are mentioned several times in the literature, and have been described by Bonnevie (1899 p. 73) as follows: "Gonangia large, cylindrical with circular opening at the distal end". Kramp, (1913 p. 16) on the other hand, describes them in the same manner as noted in the diagnosis, and gives excellent drawings. In the very extensive material at my disposal from Trondhjem Fjord, where the species is extremely frequent, I have often had occasion to observe the gonothecæ, which in all cases agreed with Kramp's description. It might be imagined that the gonothecæ would exhibit sexual dimorphism; up to the present, however, I have not been able to find anything in support of this idea, and it must thus be presumed that the earlier descriptions were based upon inadequate observation of the gonothecæ.

Stegopoma plicatile is an arctic species, which can nevertheless penetrate into the boreal region (fig. VIII); its occurrence is, however, somewhat of a mystery. The species must be described as circumpolar, having been recorded from Davis Strait through the Norwegian Sea, the Barents Sea, the Kara Sea, and the Siberian Frozen Sea to the Bering Sea and the Sea of Okhotsk. Bathymetrically it is mostly found in the lower part of the littoral region. From this, then, the species should be noted as arctic; as a matter of fact, however, this would not agree with the data from the northern Atlantic regions. There are a couple of isolated finds from the cold area, but the species has not yet been noted either from the east coast of Greenland or from the eastern side of Davis Strait, and

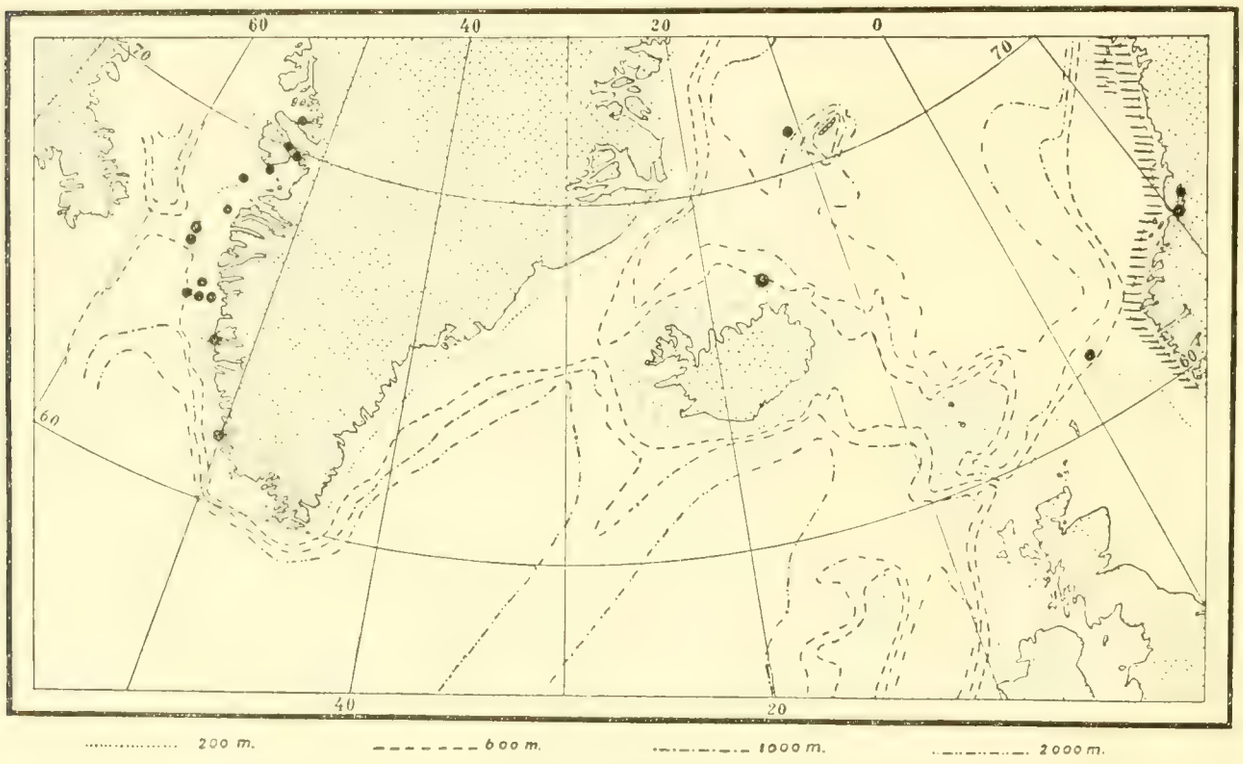

Fig. VIII. The occurrence of *Stegopoma plicatile* in the Northern Atlantic.
In the hatched parts the literature notes a scattered, although common occurrence.

also appears to be entirely lacking in Iceland waters. On the other hand, we find that it is very common along the eastern side of Davis Strait, and — according to the records — along the west coast of Norway; i. e. just in those places where the warmer water layers predominate in the bathymetrical area of its distribution. It may also be noted, in this connection, that the species occurs on the *Lophohelia* reefs in the Trondhjem Fjord, in quantities unknown elsewhere. This occurrence is altogether mysterious in the case of a species otherwise only met with in high arctic waters; one would naturally expect that any extension of its distribution would follow the colder eastern shores, not the boreal western coasts of the continents. It is difficult at present to give any satisfactory explanation of this peculiarity.

Gen. Cuspidella Hincks.

Stolonial colonies, with stalkless, sessile tubular hydrothecæ. The closing apparatus is formed by an integrating distal portion of the hydrothecæ, which folds conically over the indrawn polyp; there is no distinct limitation between the closing apparatus and the remainder of the hydrotheca. Nematothecæ lacking.

Cuspidella humilis Hincks.

1863 *Campanularia humilis*, Hincks, M. S., Alder, Supplement to a Catalogue of the Zoophytes, p. 239.
1866 *Cuspidella humilis*, Hincks, On new British Hydroida, p. 298.

Creeping colonies with cylindrical or slightly downward tapering hydrothecæ, passing over without stalk into the stolons. The hydrothecæ are set perpendicularly on the stolons, and are short, with a closing apparatus in which 10—12 segments can be distinguished.

The gonothecæ are set on the stolons, and are of the same shape and appearance as the hydrothecæ, but much larger. The gonophores develope into free medusæ.

Material:

"Thor" 64°16′ N., 22°17′ W., depth 50 metres
Reykjavik, from the bottom of a well-boat.

This unpretending little species seems to have a fairly wide distribution, and has been met with from the Siberian Frozen Sea down to the Cape Verde Islands. Nevertheless, the few finds lie very wide apart, probably owing to the fact that the species, from its insignificant size, easily escapes observation. Its principal bathymetrical occurrence lies in the middle portion of the littoral region.

Gen. Lafoëina M. Sars.

Stolonial colonies with stalkless, sessile hydrothecæ and nematothecæ. The closing apparatus of the hydrotheca is formed by the integrating folding part of the hydrotheca, and passes over without distinct limitation into the same; it closes conically over the indrawn polyp. The nematotheca has a distal laterally situated aperture.

Hadži points out in a letter that there are possibly two genera concealed under this definition. According to the drawing given by G. O. Sars, of *Lafoëina tenuis* (1874, tab. V, fig. 3), there seems to be a diaphragm occurring in this species at the junction of the hydrotheca and stolon. Levinsen (1893 p. 40) was not able to find any diaphragm in *Lafoëina maxima*, and I have likewise been unable to find any such here; my material, however, is of such a nature that a negative result cannot be considered as of decisive importance. Should it be found that certain species have a diaphragm, while others lack the same, it will then doubtless be most correct to divide the genus, and a further investigation of *Lafoëina tenuis* must then decide which of the two groups is to retain the name *Lafoëina*.

Lafoëina maxima Levinsen.

1893 *Lafoëina maxima*, Levinsen, Meduser, Ctenophorer og Hydroider, p. 182, tab. IV, figs. 9—12.

The colonies form upright, robust rhizocaulomes, often combined with creeping parts, which spread out in plates over the underlayer. The closely set hydrothecæ are cylindrical, somewhat irregularly bent, with their outer portion nearly perpendicular to the branch axis. The hydrotheca has a conically closing distal portion, exhibiting no distinct limitation from the remaining part of the same. Between the hydrothecæ are the nematothecæ, which are very numerous, and closely packed; they are slender, cylindrical, somewhat irregularly curved, with a distal, laterally situated oval aperture, in which are some few large nematocysts.

The gonothecæ are wedged in between the nematothecæ and the hydrothecæ; they differ neither in form nor in size from the hydrothecæ, and their nature can thus as a rule only be determined from section preparations.

Material:

"Ingolf" St. 29 65°34′ N., 54°31′ W.; depth 68 fathoms 0,2°
— - 34 65°17′ N., 54°17′ W.; — 55 —
— Holstensborg Harbour — 30 —

Greenland: Egedesminde (without further details)
Store Hellefiskebanke, depth 24 fathoms
— — north of Holstensborg (— — —)
Holstensborg (— — —)
Godthaab, depth 60—70 fathoms
Davis Strait — 100 —

} Levinsen's type-specimens

Iceland: Hrútafjord, depth 45 metres.

Lafoëina maxima is a typical arctic species, belonging to the upper half of the littoral region (fig. IX). The most southerly records of its occurrence are from Godthaab in Greenland, and Hrútafjord in Iceland; in the Norwegian waters it has hitherto only been met with in Ramfjorden, near Tromsö (about 69°30′ N.)

Gen. Campanulina van Beneden.

Colonies with sympodial growth and stalked, radially symmetrical hydrothecæ. The closing apparatus of the hydrotheca is formed by the distal folding portion of the hydrotheca wall, and goes over into the same without sharp limitation. When folded down, the closing apparatus covers the hydrotheca with a conical lid. The gonothecæ differ in appearance from the hydrothecæ.

Kramp, in his exposition (1911 p. 383) merely draws attention to the stalked hydrothecæ of the genus as opposed to the sessile in *Cuspidella* and *Lafoëina*. Further, secondary characters are, it would seem, here also to be found in the growth types of the colony, whether stolonial or sympodial.

Thus the two last-named genera have, as far as we know, always stolonial colonies, whereas in *Campanulina* they are invariably sympodial.

Campanulina turrita Hincks.

1868 *Campanulina turrita,* Hincks, A History of the British Hydroid Zoophytes, p. 190, pl. 36, fig. 2.

Upright sympodial colonies with monosiphonic hydrocaulus, ringed throughout. The stem slightly zigzag. Stem and branches are divided into slightly pronounced internodia, bearing distally

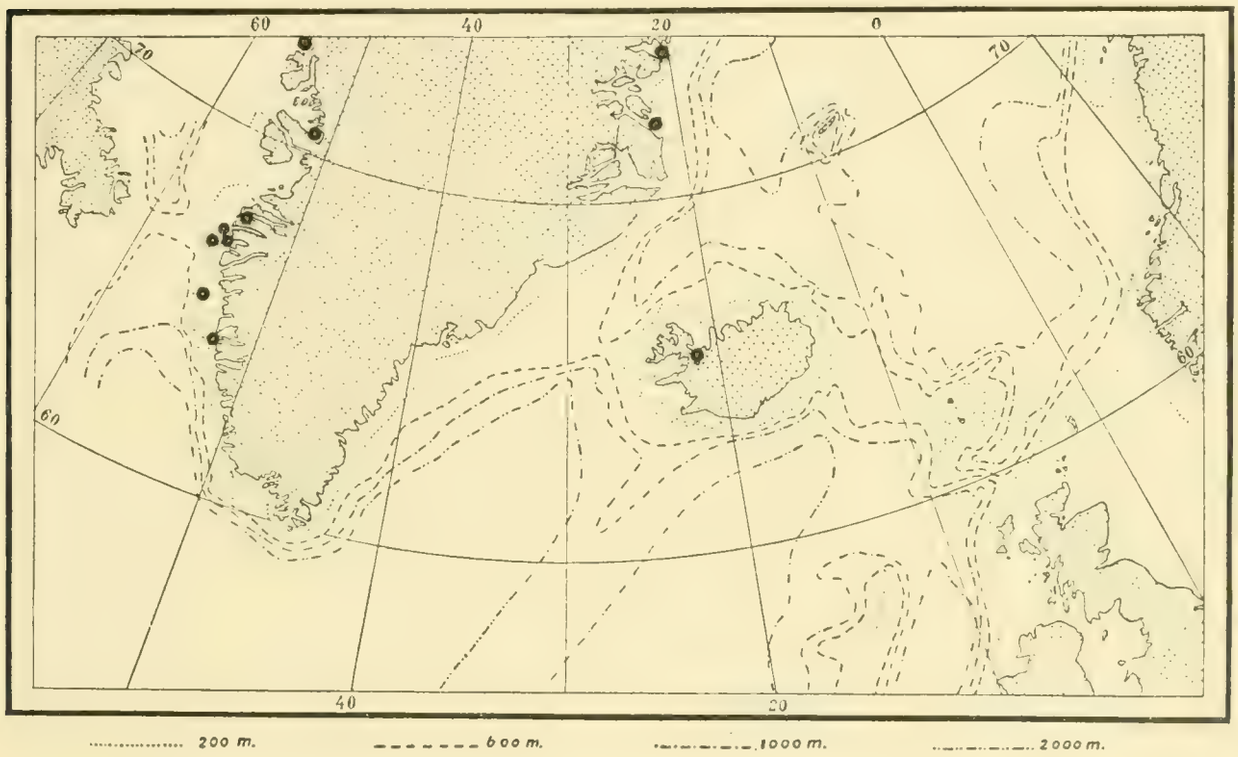

Fig. IX. Finds of *Lafoëina maxima* in the Northern Atlantic.

an apophysis and one or two short-stalked hydrothecæ; from the apophysis the next internodium projects. At irregular intervals, one of the hydrothecæ is replaced by a branch, so that the colonies assume an irregularly bushy appearance. The hydrothecæ are fairly large, and when closed, about twice as long as broad; they are practically cylindrical, with evenly curved proximal part. Diaphragm lacking. Closing apparatus passes over without distinct limitation into the lower portion of the hydrotheca wall; it closes conically over the indrawn polyp.

The gonothecæ are set upon short, ringed stalks, projecting from the stem or branches beside the hydrotheca stalks. The gonothecæ are small, slender, reversed conical or cylindrical with gradually tapering basal part; they are cut off transversely at the distal end. The gonophores develope (according to Hincks) into free medusæ.

Material:

"Ingolf", Holstensborg Harbour, on algæ.

Greenland: Smallesund near Egedesminde, on algæ.

In one of the colonies from Smallesund, a distinct renovation is discernible; unfortunately, it cannot be determined with certainty whether the primary individual has been a hydrotheca or a gonotheca, but the size would seem to suggest a primary hydrotheca. We have in this case not a heteromorphotic renovate, as the renovate is a fully developed, stalked hydranth. The instance in question calls to mind Levinsen's description (1892) of renewal of individuals in certain *Campanulariidæ*.

The new find of *Campanulina turrita* from Greenland is highly interesting. Since Hincks found the species in Ireland it has only been recorded by Levinsen (1893 p. 181) at Egedesminde; from Holstensborg Harbour, the "Ingolf" brought home a whole series of finely developed colonies.

Sub-family Calycellinæ.[1]

Campanulinidæ with closing apparatus formed by the original roof of the hydrotheca.

Gen. Calycella (Hincks).

Creeping colonies with tubular hydrothecæ, the closing apparatus sharply marked off from the hydrotheca itself, and easily falling off. The closing apparatus is formed by the peripheral parts of the original hydrotheca roof, the central portion of which is discarded; the closing apparatus is a folding membrane folding conically over the indrawn polyp. The hydrotheca lacks diaphragm.

Calycella syringa (Linné) Alder.

1767 *Sertularia syringa*, Linné, Systema Naturæ, ed. 12, vol. 1, p. 1311.

1860 *Calicella syringa*, Alder, Descriptions of a Zoophyte . . ., p. 73.

1868 *Lafoëa pygmæa*, Alder, pars, Hincks, A History of the British Hydroid Zoophytes, p. 205.

Colonies creeping. Hydrothecæ tubular, often somewhat bent, with slightly outward curving opening margin; they are borne upon stalks, short or long, furnished with a varying number of rings. The closing apparatus is sharply marked off from the thicker wall of the hydrotheca, and easily falls off; it consists of an entire membrane, which folds down on definite lines, forming a conical roof over the indrawn polyp.

The gonothecæ are attached by short, ringed stalks to the stolons. They are oval, smooth. Gonophores heteromedusoid.

Material:

"Ingolf" St. 95	65°14′ N.,	30°39′ W.;	depth	752 fathoms,	2,1°
"Thor"	64°16′ N.,	22°17′ W.;	—	50 metres	
—	64°02′ N.,	22°33′ W.;	—	34 —	

[1] As the genus *Campanulina* belongs to the preceding subfamily, the present subfamily should not be called *Campanulininæ* but better *Calycellinæ*.

Greenland: Godhavn (without further details)
Egedesminde (-- — —)
Store Hellefiskebanke off Holstensborg, depth 18—20 fathoms
Sukkertoppen, on *Boltenia* and on algæ (without further details)
Davis Strait, depth 80—100 fathoms (— — —)
Iceland: Seydisfjord — 6 —
Vadlavik — 80 —
Rödefjord — 95 metres
Djupivogur — 8 fathoms
Vestmanö — 10—15 —
Skagi — 40 metres
Hvalfjord — 46 —
Stykkisholm — 30 fathoms
Önundarfjord — 10 —
Skjalfandibugt — 28 —
Bredebugt 65°17,5′ N., 23°32′ W., depth 7—12 fathoms
6 miles W. of Iceland (without further details)
The Faroe Islands: 6 miles N. by W. of Kalsö, depth 60 fathoms
Deep hole at north point of Nolsö, depth 100 fathoms.

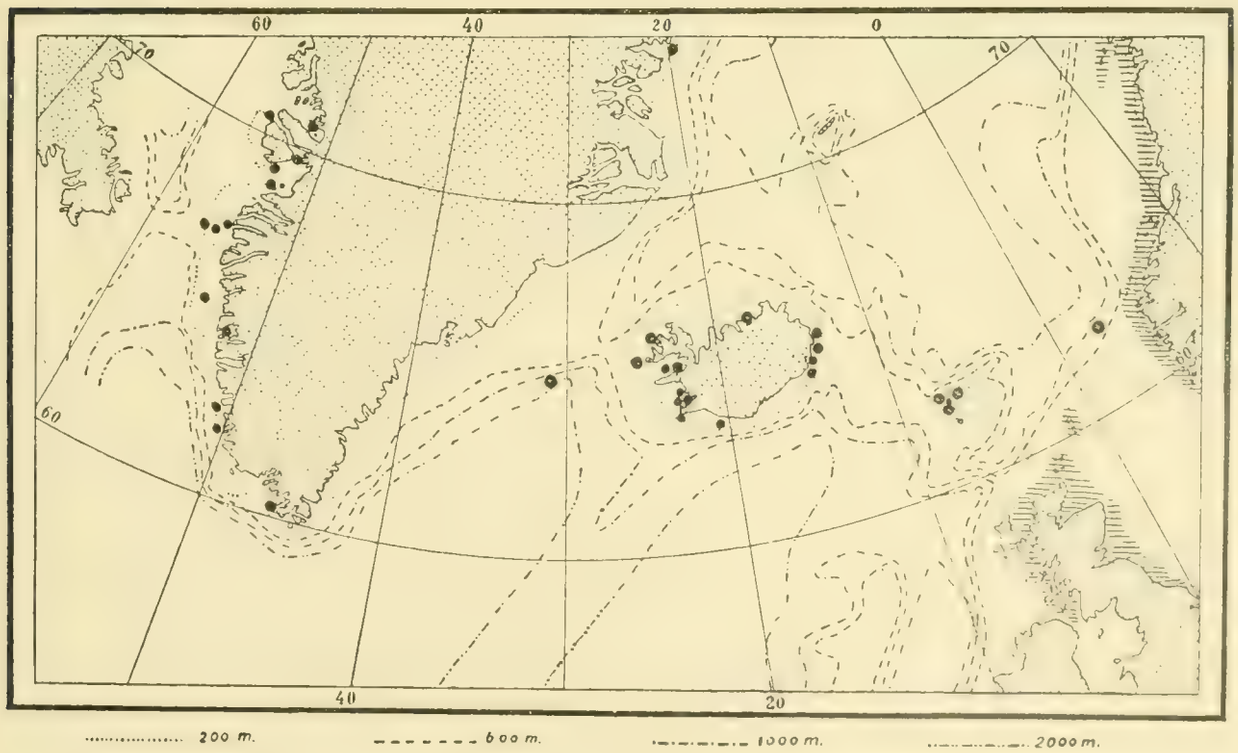

Fig. X. The distribution of *Calycella syringa* in the northern Atlantic.
In the hatched regions the literature denotes a common occurrence.

It is evidently this species which is partly mentioned under the term *Lafoëa pygmæa*; according to Hincks (1868 p. 205) some of Alder's original drawings show a conical lid in this species, which at once shows that Alder's specimens, or at any rate some of them, must have been *Calycella syringa*. That *Lafoëa pygmæa* is here only partly noted as synonymous with this species, is, as indicated under *Lafoëa gracillima*, owing to the fact that several writers at any rate have recorded creeping colonies of the latter species under the same name.

Calycella syringa appears to be a wholly cosmopolitan species, which has been met with in all seas. Its bathymetrical area is very extensive, ranging from about 6 metres down to nearly 1500; it should nevertheless be observed that its occurrence in the abyssal region is exceptional, its chief area of distribution being restricted to the middle and upper parts of the littoral waters. Within the area investigated (fig. X) we find that it is apparently lacking along the greater part of the east coast of Greenland, where it is first met with far to the north, about 76° N. Its occurrence under high arctic conditions is altogether scattered, save where an intermixture of warmer water is discernible.

Gen. Tetrapoma Levinsen.

Stolonial colonies with tubular or narrowly bell-shaped hydrothecæ without diaphragm. Closing apparatus formed by the original roof of the hydrotheca, and separated by a marked limitation from the thicker hydrotheca wall; it consists of (four) separate triangular plates, each attached in a sinus, between as many hydrotheca teeth. The polyps have a uniformly developed gastral endoderm, and lack outer ectoderm lamellæ.

In a previous work (1909 p. 165) I united this genus with *Lovenella*. Kramp (1911 p. 383) separates them again as two genera, chiefly, it would seem, on account of the number of plates in the lid. This feature can hardly be called important as a generic character; there is, however, another distinguishing feature of greater significance, which renders it necessary to separate the two genera. Hincks (1868 p. 178) especially mentions in *Lovenella clausa* (Lovén) the presence of a diaphragm, a formation which does not appear to be found in *Tetrapoma quadridentatum*, and which warrants generic distinction. Secondarily, this separation is supported by the fact that *Tetrapoma* has stolonial colonies, while those of *Lovenella* are sympodial.[1]

Levinsen (1913 p. 283) observes in a footnote, regarding *Tetrapoma*, "This genus must, no doubt, be united with *Thyroscyphus*". In this I am for several reasons unable to concur. In the first place, *Thyroscyphus* has a distinct diaphragm, and hydrothecæ of bilateral structure; in the second, the structure of the polyp also is entirely different. *Thyroscyphus*, with its ectoderm lamellæ and incipient blind sack formation, as also the differentiated gastral endoderm, exhibits closer relationship with *Sertulariidæ*, and should probably far rather be considered as a primitive genus of this family.

Tetrapoma quadridentatum (Hincks) Levinsen.

1874 *Callycella quadridentata*, Hincks, On deep-water Hydroida from Iceland, p. 149, pl. 8, figs. 17—20.
1893 *Tetrapoma quadridentatum*, Levinsen, Meduser, Ctenophorer og Hydroider, p. 180.

[1] Comp. also *Lovenella corrugata* Thornely (Broch 1914 p. 32).

Creeping colonies with tubular hydrothecæ. The hydrotheca stalk is irregularly, but distinctly ringed or spirally coiled. The hydrothecæ pass over evenly into the stalk, they are somewhat expanded at the base, then tapering slightly upwards, to expand again a little towards the opening margin, which curves somewhat outwards. The opening margin itself has four low, but distinctly discernible teeth, and has four triangular opercular plates fastened between them.

The gonothecæ are unknown.

Material:

Greenland: Egedesminde, depth 30–50 fathoms.

Scattered specimens of this high-arctic species have been found at West Greenland, Spitzbergen, in the Murman Sea, the Barents Sea, the White Sea, the Siberian frozen Sea and the Sea of Okhotsk, and must thus doubtless be referred to the circumpolar species. It belongs to the middle parts of the littoral region.

Family series **Haleciina** nov.

Family **Haleciidæ.**

The hydrothecæ are radially symmetrical and very small, at times practically altogether disappearing; they have as a rule a basal cavity, often marked off from the hydrotheca itself by a diaphragm. The hydranths are large, and cannot be drawn quite into the hydrothecæ. They have a conical proboscis, and their gastral endoderm falls into two divisions, answering to the fore-stomach and stomach of the polyp, which as a rule are separated by a limit indicated by a more or less marked ring furrow round the body of the polyp. The basal part, the stomach, forms the digestive portion. The polyps are radially symmetrical in structure. The colonies are stolonial or sympodial, with simple or derived growth of the tips.

Gen. **Halecium** Oken.

Creeping stolonial, or upright sympodial colonies with small radially symmetrical hydrothecæ with basal cavity. The diaphragm can be present or lacking. Nematothecæ and nematophores lacking. The gonophores are developed in gonothecæ.

The *Halecium* colony, in species with polysiphonic stem, often presents a peculiar appearance, differing greatly from that of other hydroid colonies, as the polysiphonic main stem, which is generally very strongly developed, most frequently presents the same impression as an altogether irregularly branched rhizocaulome, while the outer parts of the branches almost always exhibit regular ramification. *Halecium minutum* Broch especially, seems in some respects to take up a remarkable and exceptional position; according to Kramp's observations (1913 p. 5) it can at times exhibit large colonies of composite structure with rhizocaulome-like polysiphonic main stem and main branches, while otherwise, the species normally presents small, monosiphonic colonies proceeding from a network of

creeping stolons. This thus confirms, as Kramp points out, the doubts which have been expressed by certain previous writers as to the fundamental importance of the structure of the colony for hydroid systematics, and partly effaces the limit between creeping species and species with upright, composite colonies.

The genus *Halecium* is characterised by the lively renovation of its hydranths. This should, it would seem, be explained as due partly to the lack of special defensive individuals, partly to the minimal size of the hydrothecæ, and finally also to the large dimensions of the polyps, which probably render them particularly attractive to creatures preying upon hydroids generally. The marked renovation activity often leads to the formation of whole piles of hydrothecæ, or apparently small branches, for which Schydlowski (1901) has introduced the term "pseudohydrocauli".

Not infrequently also, heteromorphotic renovates may be observed; I have previously (1909 p. 151) noticed that the formation of gonothecæ as heterorenovates is characteristic of the male in *Halecium ornatum* Nutting. Heteromorphotic renovates of a more accidental nature will be noted later on in several species; these are of great interest, since renovates of this kind have, according to Hadži (1915) only been met with in nature among *Halecium* and *Synthecidæ*. The question has, however, been too little studied as yet to permit of our drawing further conclusions from this, but the point should be kept in mind, until it has been fully cleared up.

Halecium halecinum (Linné) Oken.

1758 *Sertularia halecina*, Linné, Systema Naturae, Ed. 10, p. 809.
1815 *Halecium halecinum*, Oken, Lehrbuch der Naturgeschichte, vol. 1, p. 91.

Stiffly built, as a rule doubly pinnate colonies with polysiphonic main stem. The branches are as a rule pinnately ramified in the same plane as the main stem, or the colonies may, more rarely, assume an irregular bushy shape. The minor branches are divided up into regular internodia, the length of which is about twice the distal breadth. The primary hydrothecæ are low, often almost like a mere opening in the branch apophysis at the distal end of the internodium. The secondary hydrothecæ are small, with a large basal cavity, generally somewhat asymmetrically developed, and having the basal part of its adcauline wall highly concave. The hydrothecæ are somewhat broader at the aperture than at the well-developed, fairly strong diaphragm; the opening margin is not curved outward.

The gonothecæ are large, and proceed from the apophysis at the base of the primary hydrothecæ. The males are narrowly cylindrical to elongated oval, tapering below, distally cut off transversely, or more often broadly rounded. The female gonothecæ have a distal laterally placed aperture with a pair of hydranths; the aperture is furnished with a short cylindrical neck, and situate normally at the distal end of the hydrothecæ; more rarely, the distal part of the gonotheca may be domed somewhat forward, so that the opening is a little below the point. The gonotheca is slender, almost entirely straight or slightly convex on the side opposite the pair of hydranths, and tapering evenly downwards.

Material:

"Ingolf" St. 7, 63°13′ N., 15°41′ W., depth 600 fathoms, 4,5°
— - 9, 64°18′ N., 27°00′ W., — 295 — 5,8°
— - 54, 63°08′ N., 15°40′ W., — 691 — 3,9°
"Thor" 63°30′ N., 20°14′ W., — 80 metres — [labelled *Halecium halecinum*, *H. Beanii* and *H. labrosum*].

Greenland: Cape Tobin, depth 57 fathoms (East Greenland Expedition).

Iceland: Vadlavik (depth not stated)
Vestmanö, depth 30—40 fathoms [labelled *Halecium halecinum* and *H. Beanii*]
10 miles W. of Akranes (depth not stated) [labelled *Halecium Beanii*].

Between Iceland and The Faroe Islands, depth 192 fathoms (without further details)

The Faroe Islands: 6 miles N. by W. of Kalsö, depth 60 fathoms
Stokken 2 miles in S.22E., — 55 —
Deep hole at north point of Nolsö, depth 100 fathoms.
Glyversnæs near Thorshavn, on red algæ.
Borönæs 13 miles in N.75W., depth 30 fathoms.

Halecium halecinum is generally of somewhat coarser build than *Halecium Beanii*, but a good deal finer than *Halecium scutum*; it is often extremely difficult to distinguish these species one from another, especially when the colonies assume an altogether irregular form, which the males in particular are inclined to do. The female gonothecæ in *Halecium halecinum* will, in their normal shape, with the quite terminal lateral opening, hardly be confused with normal individuals of the other species, but when, as not infrequently occurs, the distal portion of the gonotheca is domed forward, so that the aperture is found somewhat below the point on one side of the gonotheca, the identity is by no means easy to determine. True, *Halecium scutum* is in most instances of far coarser build than the two others, but the variation in dimensions is within each of the three too great to permit the fixing of proper size limits; they would be found to overlap considerably. A useful general character for *Halecium halecinum* is the asymmetrical development of the basal cavity in the secondary hydrotheca (fig. XI); the basal part of the adcauline wall is more strongly developed, and highly curved, so that the hydrotheca axis thus diverges widely from the branch. On the other hand it must be remarked that the hydrotheca aperture is perpendicular to the longitudinal axis, a feature whereby the species is distinguished from *Halecium Beanii*.

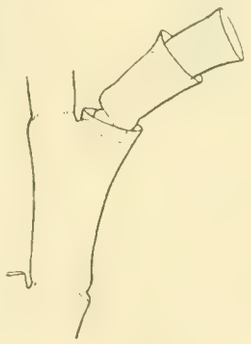

Fig. XI. *Halecium halecinum*. Internode with hydrothecæ. From the Faroe Islands at north point of Nolsö. (× 60).

Halecium halecinum has an extremely wide area of distribution, and is very common right up in the Mediterranean; it has also been recorded from waters south of the Equator. In the northern waters, the species appears as a boreal character form, with warmer tendency (fig. XII) and is mostly met with in the middle part of the littoral region; at times, however, it may penetrate right down into the abyssal, as at the "Ingolf" St. 54, where it was taken in a depth of over 1300 metres. In purely arctic waters, it is very rare, and records of its occurrence there must be treated as doubtful, as it

has evidently on several occasions been confused with *Halecium scutum*. The same applies in part to certain of the records from southern waters, where the species has undoubtedly often been mixed up with *Halecium Beanii*.

Halecium Beanii Johnston.

1847 *Halecium Beanii*, Johnston, A history of the British Zoophytes p. 59, pl. 9, figs. 1–2.

Upright densely built colonies with polysiphonic, fairly robust main stem, and monosiphonic, pinnately ramified outer branches; the ramification of the colony presents as a rule a main plane. The

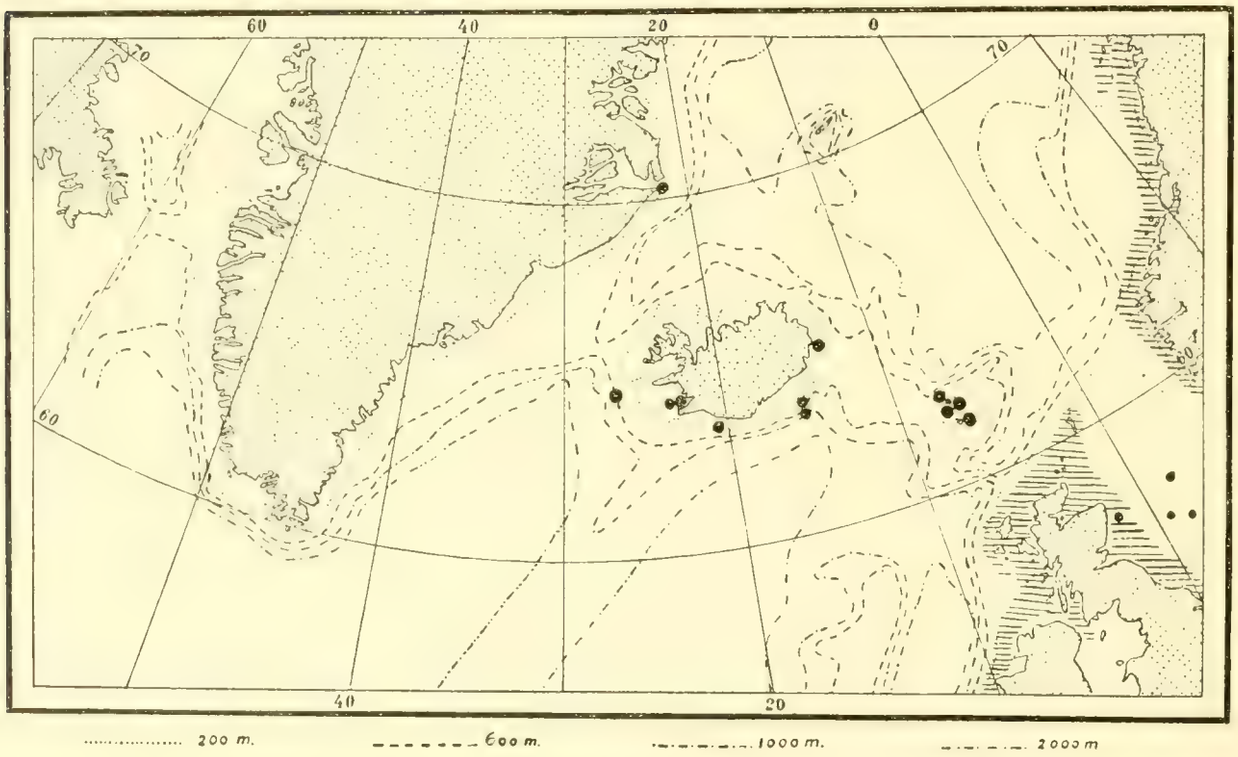

Fig. XII. The distribution of *Halecium halecinum* in the northern Atlantic.
In the hatched regions the literature denotes a common occurrence.

minor branches are divided into slender regular internodia; the distally situate, hydrotheca-bearing apophyse is almost of the same breadth as the branch itself, and sharply defined; the length of the internodium is about 2—2.5 times the distal breadth (including apophyse). The hydrothecæ small, bounded on the lower side by a slight diaphragm. The primary hydrothecæ are hardly more than an aperture in the apophyse, and the hydranth is evidently very soon renewed; the basal chamber of the secondary hydrotheca is symmetrical, with a distinctly marked basal expansion; above this the hydrotheca stalk is narrowest, its breadth increasing slightly from there until it passes over into the somewhat obliquely set hydrotheca; the latter is a little broader at the aperture than at the diaphragm; opening margin not outward curved.

Gonothecæ of medium size, proceeding from the apophyse of the primary hydrothecæ. The

males are very elongated oval, the females elongated oval to sausage-shaped, highly curved, with a short cylindrical neck in the middle or on the basal half of the gonotheca, and on the concave side of the same. Opening margin level; in the opening itself a pair of hydranths.

Material:

"Thor" 63°30′ N., 20°14′ W., depth 80 metres.

The Faroe Islands: Borönæs 13 miles in N·75W., depth 30 fathoms.

On a previous occassion (1913 p. 13) I stated that *Halecium Beanii* should be regarded as a variant of *Halecium halecinum*; further investigations have, however, shown that this is not correct, even though the two species, more particularly in a sterile state, may often enough be difficult to distinguish. Fertile female colonies are not easily confused, the form of the gonothecæ being typically different; in comparison with the following species it should be noted that the aperture in *Halecium Beanii* lies roughly in a line with the basal and distal end of the gonotheca, and that the neck axis closely approaches, if not entirely coinciding with, this line. (Fig. XIII). The branches are, in *Halecium Beanii*, often slenderer than in *Halecium halecinum* and *Halecium scutum*, and the apophyse is somewhat more marked; in addition, the basal chamber of the secondary hydrotheca is symmetrically developed, and not asymmetrical as in *Halecium halecinum*; finally also, the oblique position of the hydrotheca aperture as towards the axis serves to distinguish *Halecium Beanii* from the two related species mentioned.

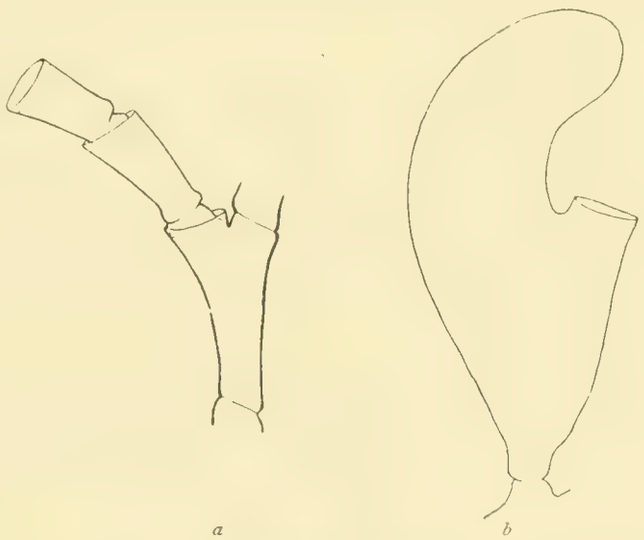

Fig. XIII. *Halecium Beanii.*
a. Internode with hydrothecæ. *b.* Gonotheca ♀. From the Faroe Islands, Borönæs 13 miles in N.75W. (× 60).

The geographical data for *Halecium Beanii* are extremely unreliable as regards the northern waters; the species is, as I have frequently been able to perceive, often confused with *Halecium scutum* in arctic, with *Halecium halecinum* in boreal areas. In all probability, it is a heat-loving form, which exceptionally penetrates into the northern waters.

Halecium scutum Clark.

1876 *Halecium scutum*, Clark, Report on the Hydroids ..... Alaska and the Aleutian Islands, p. 210, pl. 10, figs. 13—14.

Robust colonies with polysiphonic main stem. The outermost small branches exhibit an almost regular pinnate ramification in the same principal plane as that in which the branching of the colony falls; more rarely, the colonies may be quite irregularly bushy. The minor branches are divided up into internodia, the length of which is about twice the distal breadth (apophyse included). The primary

hydrothecæ are low, often hardly more than an opening in the apophyse, which is distally placed, and distinctly marked. The secondary hydrothecæ are likewise small, with a fairly large basal chamber, which is almost always symmetrically developed. The hydrothecæ have a thin, but well-developed diaphragm; they expand towards the aperture, but have no outward curving margin.

The gonothecæ are small, and attached to the apophyse at the base of the primary hydrothecæ The males are cylindrical to elongated oval, tapering downwards, broadly rounded distally, or cut off transversely. The female gonothecæ have a laterally placed opening with a pair of hydranths; the opening margin has on its inner (adthecal) side a short, broadly lingueform protuberance. The gonotheca openings are situated between the middle and the distal end of the gonotheca, rarely quite distally. The gonotheca is often somewhat irregularly bent.

Material:

"Ingolf" St. 31, 66°35′ N., 55°54′ W., depth 88 fathoms 1,6°
— - 34, 65°17′ N., 54°17′ W., — 55 —
Greenland: Sukkertoppen (without further details)
Davis Strait, depth 100 fathoms (without further details) [labelled *Halecium Beanii*]
Iceland: Vadlavik, (depth not stated) [labelled *Halecium Beanii*]
Between Iceland and The Faroe Islands: 63°15′ N., 9°35′ W., depth 270 fathoms [labelled *Halecium Beanii*]
The Faroe Islands: Deep hole at north point of Nolsö, depth 100 fathoms
61°40′ N., 7°40′ W., depth 135 fathoms
Kara Sea: "Dijmphna" [labelled *Halecium Beanii*].

It is not without a certain doubt that we can admit *Halecium scutum* as a distinct species and not as an arctic form of *Halecium halecinum*. From a geographical point of view, as also with regard to most of the variational features, it stands in almost exactly the same relation to the last-named species as the arctic forms of several other more or less cosmopolitan hydroids. And it is also *Halecium scutum* which has formerly (Broch 1909 p. 144) been noted as forma *gigantea* of *Halecium halecinum*.

A comparison of the two species reveals various points of resemblance. Bonnevie's statement (1899 p. 57) "ramification in all planes" as a characteristic feature cannot be admitted; it applies as a matter of fact far more to the exceptions, the great majority of the colonies exhibiting a decided main plane in which the ramification takes place. On the other hand, the short and broad internodia (fig. XIV *a*) are typical, and differ not a little from *Halecium Beanii*, with which the species has especially been confused. The secondary hydrothecæ differ normally from *Halecium halecinum* in having a symmetrical and proportionately lower basal cavity, and from *Halecium Beanii* in having the plane of the aperture perpendicular to the longitudinal axis. — The frequent confusion of *Halecium scutum* with *Halecium Beanii* is due to the great variability of the female gonothecæ (figs. XIV *b—h*) which not infrequently (*e—f*) resemble strongly those of the latter species. We should, however, note that in *Halecium scutum* the aperture and its short neck are as a rule obliquely placed, diverging widely from the line between the stalk of the gonotheca and its top; in addition, the gonotheca has an

adthecal lingueform protuberance which is lacking in *Halecium Beanii*. The extreme variants in the other direction, (*b* and *c*; *h*) are markedly suggestive of broadly built gonothecæ in *Halecium halecinum*, so that fertile colonies likewise may here often be confused. The illustration *c* shows a gonotheca which has arisen as a heteromorphotic renovate.

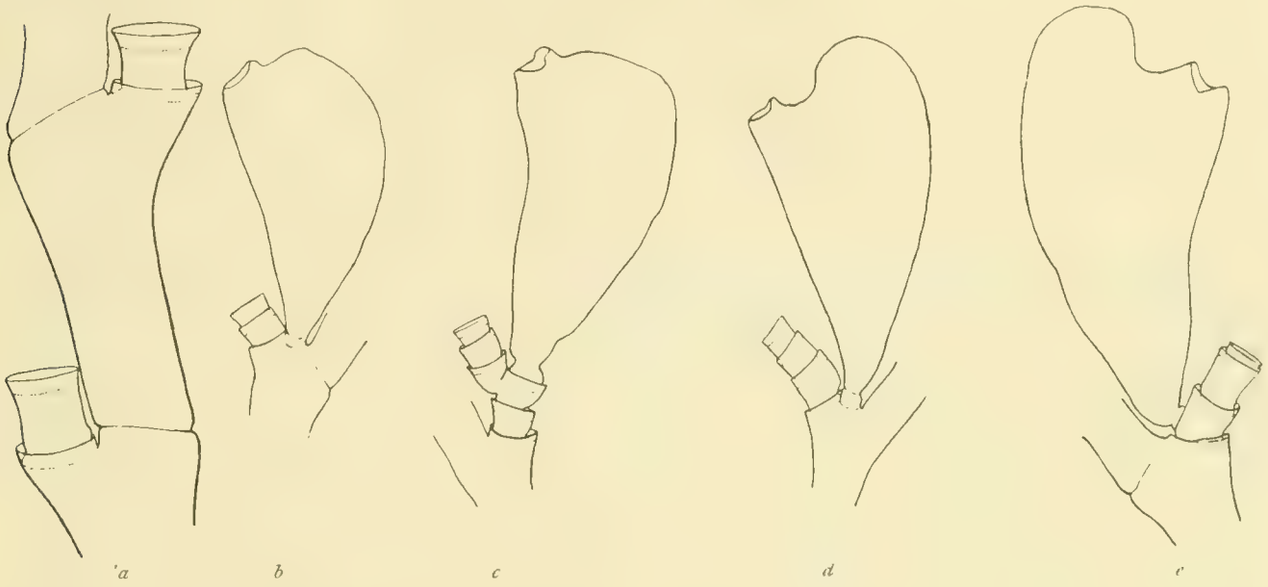

Fig. XIV *a—h*. *Halecium scutum*.
a. Internodium and secondary hydrotheca. Davis Strait 100 fathoms (× 60).
b—e. Gonothecæ from a colony (♀) in Kara sea (× 30).
f—h. Gonothecæ from a colony (♀) in Davis Strait depth 100 fathoms (× 30).
Every gonotheca contains fully developed planula larvae.

The material includes several specimens of *Halecium scutum* which had previously been determined as *Halecium Beanii*; this shows, that extreme caution should be observed in dealing with records in literature of the last-named species, the occurrence of which under arctic conditions is, as above mentioned, doubtful. *Halecium scutum*, on the other hand, is an arctic character form, with circumpolar distribution. In the waters investigated (fig. XV) it is found in the lower part of the littoral region, but quite exceptionally, as at the Faroe Islands, does it penetrate to any considerable extent into the warmer boreal waters.

Halecium curvicaule v. Lorenz.

1886 *Halecium curvicaule*, v. Lorenz, Polypomedusen von Jan Mayen, p. 25, pl. 2, figs. 1—2.

Colonies creeping or upright, with irregular, more rarely almost dichotomic ramification, monosiphonic hydrocaulus. Hydrothecæ terminal: the next hydrotheca stalk or branch internodium proceeds

from an almost spherical apophyse situate close under the terminal hydrotheca. The hydrotheca itself is low, somewhat broader at the aperture than at the faint diaphragm, more rarely with margin slightly bent over. Secondary hydrothecæ occur in smaller numbers. The hydrotheca stalks are as a rule fairly long, as a rule with a couple of rings below.

The gonothecæ proceed from the hydrotheca stalks close under the polyp, and are attached by a short, often almost quite rudimentary stalk, or are exceptionally formed as heterorenovates in the hydrothecæ. The males are elongated oval or narrowly egg-shaped, attached to the colony by their narrower end. The female gonothecæ are practically pear-shaped, laterally compressed, and with a pair of hydranths in the distal, asymmetrically placed opening; on the side opposite this aperture, the

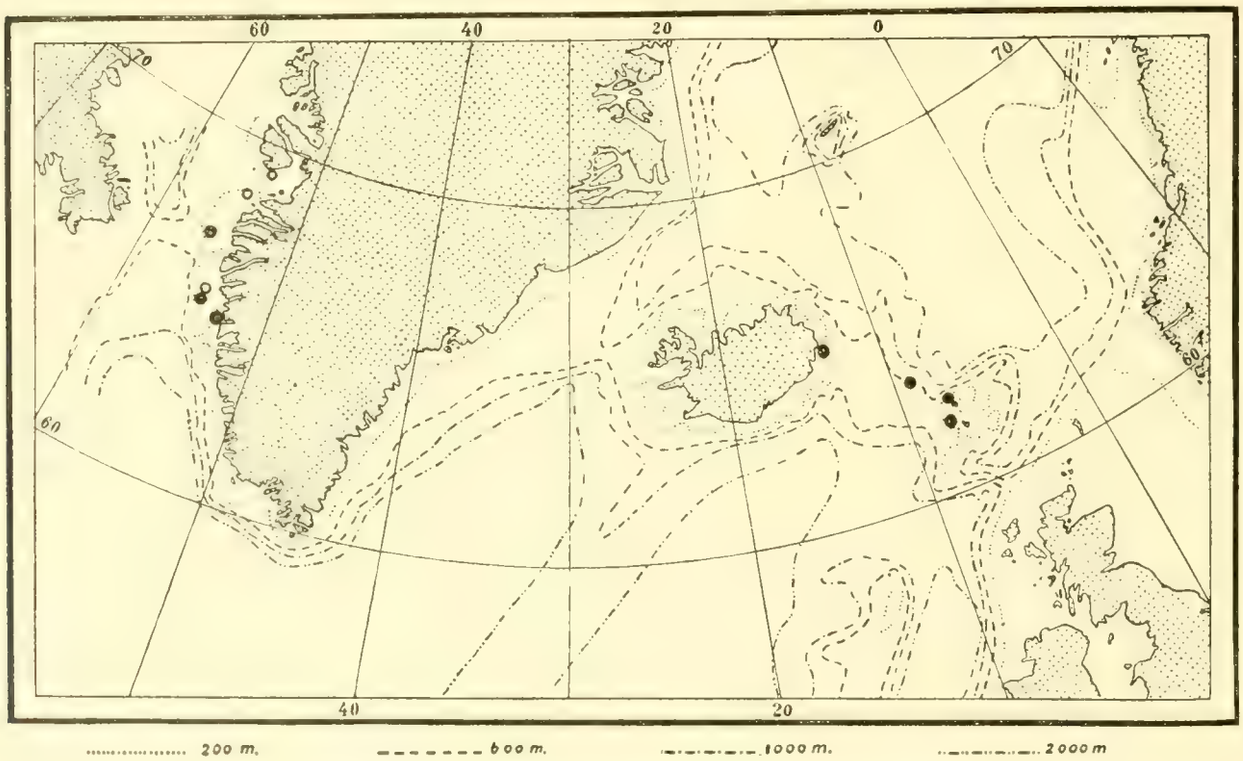

Fig. XV. Finds of *Halecium scutum* in the Northern Atlantic.
o Localities of *Halecium Beanii* after Kramp (1914), referring to *Halecium scutum*.

gonotheca has 2—9 transverse furrows, more or less pronounced, at times almost imperceptible; they never reach right round the gonotheca.

"Ingolf" St. 29, 65°34′ N., 54°31′ W., depth 68 fathoms, 0,2°
Greenland: Egedesminde (without further details)
Iceland: Bakkefjord, depth 10 fathoms
Hvalfjord, — 46 metres.

A detailed description of *Halecium curvicaule* has been given by Dons (1912 p. 61) who shows, that *Halecium mirabile* Schydlowsky and *Halecium repens* Jäderholm are synonyms to this species.

Examination of a large amount of material leaves no doubt as to the correctness of this. The species is enormously multifarious in its power of variation, and has a remarkable capability of changing its appearance; an examination of the branches, however, will always reveal the characteristic, almost spherical apophyse typical of the species, and the distinguishing characters established are seen to be founded on growth stages.

Dons does not appear to have noticed that his figure D. 5 shows how the male gonotheca can be formed in hydrotheca as a heteromorphotic renovate. This is particularly interesting in the case of the present species, since other heteromorphotic renovates likewise appear in the same in nature, as tendril-like stolon formations in place of hydranths. Dons mentions such renovates, with illustra-

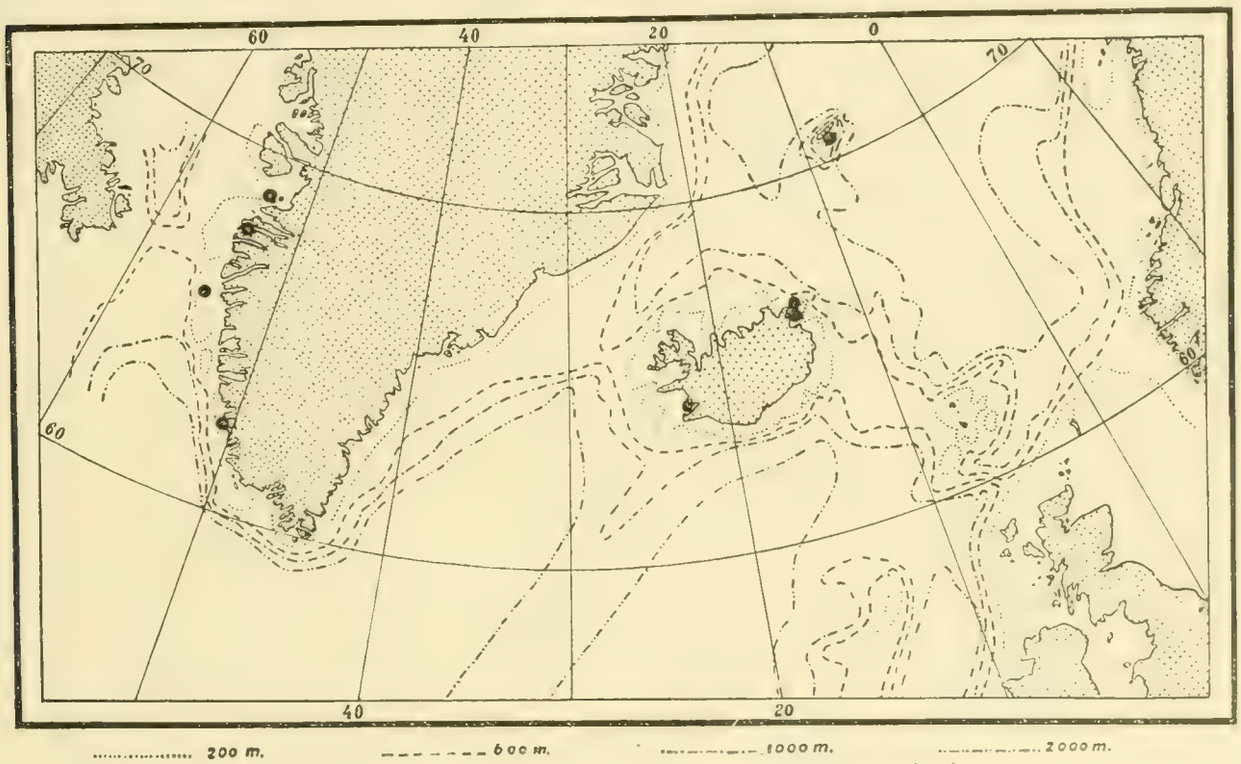

Fig. XVI. Localities of *Halecium curvicaule* in the Northern Atlantic.

tions, and points out that these very features have served as the basis on which the species *Halecium mirabile* was established. The species is thus characterised by a less lively hydranth renewal, but has on the other hand a more marked tendency to form heteromorphotic renovates than most other forms of *Halecium*.

Halecium curvicaule is a markedly high-arctic species, belonging to the littoral region. Only quite exceptionally does it penetrate into boreal waters (fig. XVI) as for instance at Iceland. Off the coast of Norway it has not yet been met with south of Bjarkøy.

Halecium muricatum (Ellis and Solander) Johnston.

1786 *Sertularia muricata,* Ellis and Solander, The natural history of many curious an uncommon Zoophytes, p. 59, pl. 7, figs. 3—4.

1847 *Halecium muricatum*, Johnston, A history of the British Zoophytes, p. 60, pl. 9, figs. 3—4.

Upright colonies with polysiphonic, irregularly ramified main stem, and regular singly or doubly pinnate branches; the outer, minor branchlets regularly alternating. The hydrothecæ small, with expanded margin, especially on the adcauline side; the basal cavity is large, somewhat asymmetrically developed, with a markedly convex adcauline wall and a straight or slightly concave abcauline wall, inserted asymmetrically on a laterally placed apophyse at the distal end of the internodium. The branches are divided into internodia, which often exhibit one or two basal constrictions.

The gonothecæ proceed from the tubes of the stem. They are large, somewhat flattened, and furnished with spiny longitudinal ribs on the flat side.

Material:

"Ingolf" St. 29 65°34′ N., 54°31′ W., depth 68 fathoms 0,2°
- 34 65°17′ N., 54°17′ W., — 55 —
— - 84 62°58′ N., 25°24′ W., — 633 — 4,8°
"Thor" 65°52′ N., 23°58′ W., — 62 metres
— 64°16′ N., 22°17′ W., — 50 —
— 64°16′ N., 11°15′ W., — 378 —
Greenland: Egedesminde (without further details)
Store Hellefiskebanke (— — —)
Store Hellefiskebanke depth 24 fathoms
Davis Strait (— — —) — 100 —
Ingmikertok, Angmagsalikfjord (East Greenland Expedition)
Iceland: Mouth of Hornafjord (depth not stated)
Rodefjord, depth 80 fathoms
Djupivogr — 8 —
Vestmanö — 10—15 —
10 miles W. of Akranes (depth not stated)
Stykkisholm, depth 30 fathoms
Bredebugt 65°17′ N., 23°32′ W., depth 7—12 fathoms
Adelvik (depth not stated).
The Faroe Islands: 7 miles N. by E. of Myggenæs point, depth 57 fathoms
6 miles N. by W. of Store Kalsö, — 60 —
Deep hole at north point of Nolsö — 100 —
5 miles SSE. of Bispen — 50 —

Forma *abyssalis*:

"Ingolf" St. 125, 68°08′ N., 16°02′ W.; depth 729 fathoms, —0,8°

Halecium muricatum, with its asymmetrically developed hydrotheca stalks or basal cavities and its slenderer form, stands out distinctly from the remainder of the northern *Halecium* species, and is not easily confused. It is as a rule finely built, but may occur in large colonies with highly ramified polysiphonic main stem; the ramification then mostly proceeds in a main plane, but can also be altogether irregular, so that the colonies assume a quite bushy appearance. The margin of the hydro-

theca can vary with regard to curvature, and may in extreme cases somewhat resemble *Halecium labrosum*; in *Halecium muricatum* however, we always find that the adcauline margin of the hydrotheca is more markedly curved, the abcauline less so.

Normally, the length of the internodium is about three times its distal breadth (including the apophyse); we have, however, from the "Ingolf" St. 125, a colony which, from its extremely long internodia, must be regarded as a deep-sea variant (fig. XVII *b*), forma *abyssalis* nov. It is not unusual among hydroids to find that the colonies from greater depths exhibit an extension of the single branch parts; in this case, however, the tendency is pushed to an extreme, and at a first glance, the colony presents an altogether alien appearance. It is probably due to the fact that the species here occurs in the cold area, at the considerable depth of 729 fathoms. The colonies are very slender, about 10 cm high, with polysiphonic stems. The internodia of the minor branches are 3—4 mm long, about five times the distal breadth incl. apophyse. The apophyse itself is very distinctly marked and bears a slender hydrotheca. The hydrotheca has close under the diaphragm the typical adcauline thickening of the wall, the "pseudodiaphragm" which as a rule is also found in the typical form. The hydrothecæ exhibit the form typical for the species; the secondary hydrothecæ are comparatively short-stalked, but otherwise of the same shape as the primary. The colonies are sterile. From the features mentioned it follows that the colonies cannot be taken as representatives of a distinct species; they should, however, be distinguished as the type of a particular forma *abyssalis* of the original species.

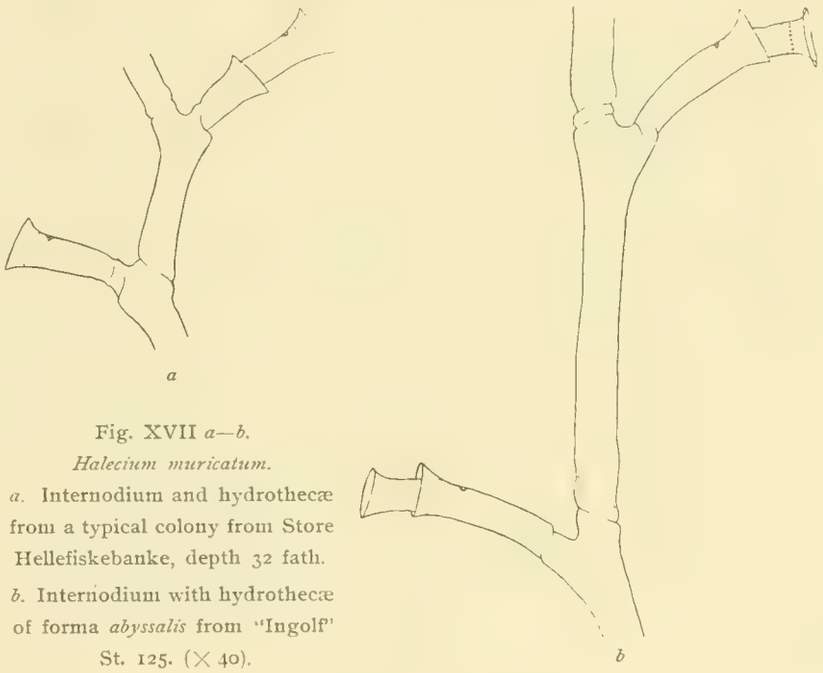

Fig. XVII *a—b*.
Halecium muricatum.
a. Internodium and hydrothecæ from a typical colony from Store Hellefiskebanke, depth 32 fath.
b. Internodium with hydrothecæ of forma *abyssalis* from "Ingolf" St. 125. (× 40).

Halecium muricatum is a circumpolar arctic species, able to penetrate into the boreal region and out to the limits between this and warmer layers (fig. XVIII). Its principal occurrence is restricted to the upper part of the littoral region, but it may, as seen from the foregoing, penetrate far down into the abyssal. It was met with already by the Norwegian North-Atlantic Expedition at a depth of 1350 metres.

Halecium labrosum Alder.

1859 *Halecium labrosum*, Alder, Descriptions of three new species of Sertularian Zoophytes, p. 351, pl. 13.

Robust, upright, and irregularly branched colonies with polysiphonic main stem. The hydrothecæ are short, symmetrical, with markedly recurvate aperture margin. The basal cavity is very large, and bounded above by the base of the hydranth; the diaphragm rudimentary or entirely lacking. The

branches are divided into fairly short internodia, having a hydrotheca on the distal apophyse; the latter is often, though not always, separated from the basal cavity of the hydrotheca by a joint.

The gonothecæ are very large, and proceed from the tubes of the stem and branches, or from the apophyse. They are irregularly oval, flattened, without spines or ribs, the females are much larger than the males, often more flattened in proportion, but otherwise of the same shape.

Material:

"Ingolf" St. 33 67°57′ N., 55°30′ W., depth 35 fathoms 0,8°
Greenland: Egedesminde (without further details)
Store Hellefiskebanke (— — —)
Davis Strait, depth 100 fathoms (— — —)
— — 67°34′ N., 55°20′ W., (depth not stated)
Iceland: Vadlavig, depth 46 fathoms
Vestmanö, — 28 —

Halecium labrosum is an arctic species capable of penetrating into the boreal areas (fig. XIX). In strictly arctic waters it is of very robust build, perhaps the coarsest of all arctic *Halecium* species, and can hardly be confused with others. In warmer parts, it assumes a somewhat finer structure, but should even here be reckoned among the robust forms. Bathymetrically, the species belongs to the upper part of the littoral region, and has very rarely been observed below this. The few records of its occurrence in the Mediterranean and Atlantic south of the boreal region demand renewed investigation, as much would seem to suggest that confusion has taken place.

Halecium tenellum Hincks.

1861 *Halecium tenellum*, Hincks, A catalogue of the Zoophytes of South Devon, p. 252, pl. 6, figs. 1—4.
?1911 *Halecium textum*, Kramp, Report on the Hydroids ..... the Danmark Expedition, p. 368, pl. XXI, figs. 5—6.

Colonies upright, with monosiphonic hydrocaulus, and typical, somewhat irregularly sympodial growth. The branches — the new hydrotheca stalks — proceed from close beneath the basis of the terminal primary hydrotheca, not infrequently in pairs, so that dichotomic ramification takes place; more rarely several branches from the same point. Pseudohydrocauli are of minor importance in the colonies, the renewal of hydrothecæ is not particularly active. The hydrothecæ are of medium size, broadening upward from the slight diaphragm and terminating in an often recurvate opening margin. The stalk of the secondary hydrothecæ is ringed, the branches are often ringed throughout their entire length, and exhibit at any rate distinct rings above their origin.

The gonothecæ proceed from the base of the primary hydrothecæ, or more rarely, they may be formed as heteromorphotic renovates in the hydrothecæ themselves. The gonotheca is somewhat flattened; viewed from the broad side they are elongated oval, with the distal part cut off transversely or broadly rounded; seen laterally, they are more egg-shaped, with a pointed distal part. They lack hydranth pairs.

Material:

"Ingolf" St. 87 65°02,3′ N., 23°56,2′ W., depth 110 fathoms

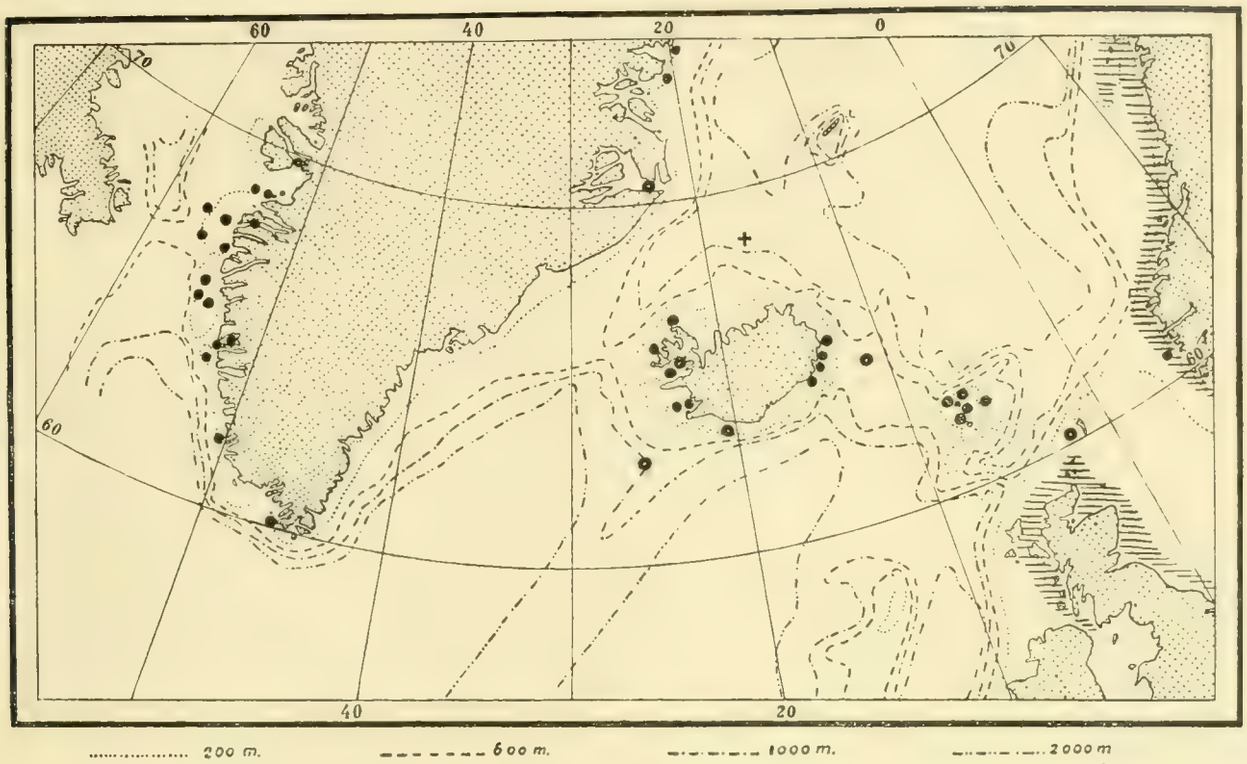

Fig. XVIII. The distribution of *Halecium muricatum* (forma *abyssalis* +) in the Northern Atlantic.
In the hatched regions the literature notes a common, although scattered occurrence.

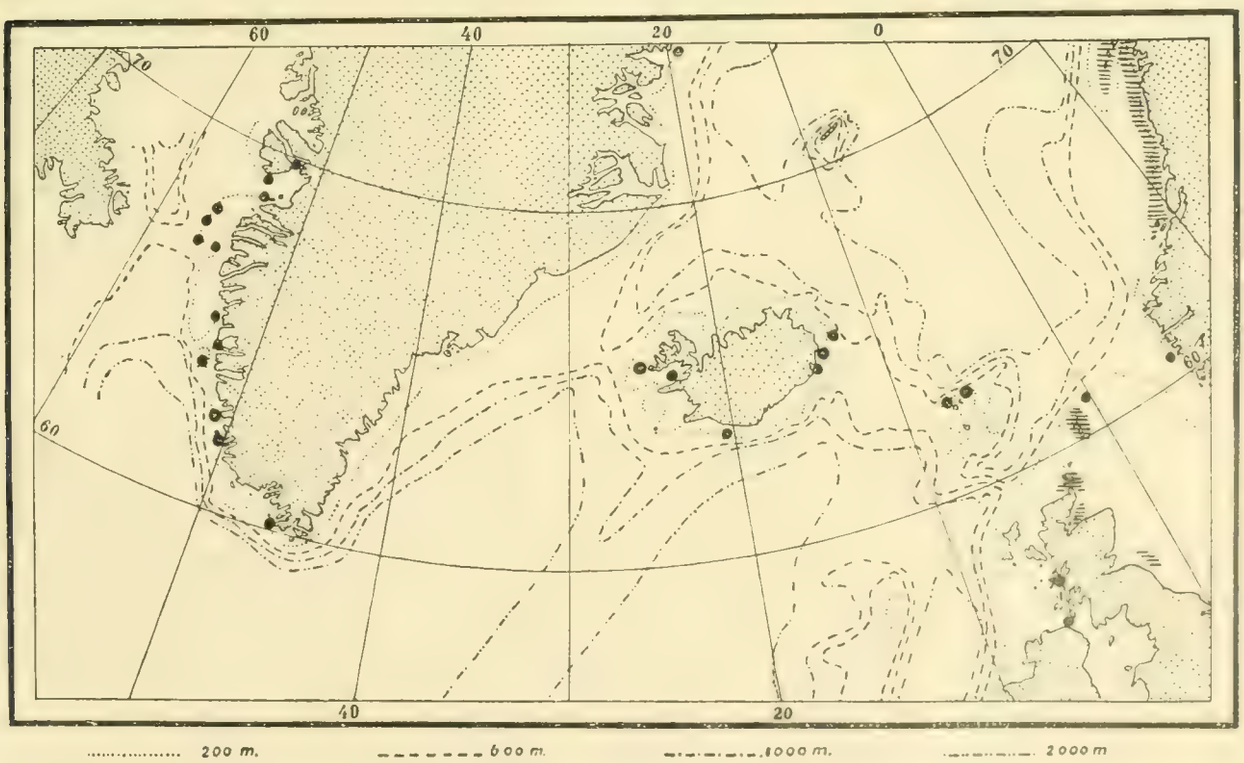

Fig. XIX. The occurrence of *Halecium labrosum* in the Northern Atlantic.
In the hatched parts the occurrence according to literature is scattered, no accurate details as to localities are given.

Greenland: Sukkertoppen, on *Boltenia* (without further details).
Iceland: Brunnes, depth 4 fathoms
Seydisfjord — 6 —
Hvalfjord — 46 metres
Stykkisholm — 30 fathoms.
The Faroe Islands: 6 miles N. by W. of Store Kalsö, depth 60 fathoms
Deep hole at north point of Nolsö — 100 —
Glyversnæs near Thorshavn, on red algæ.

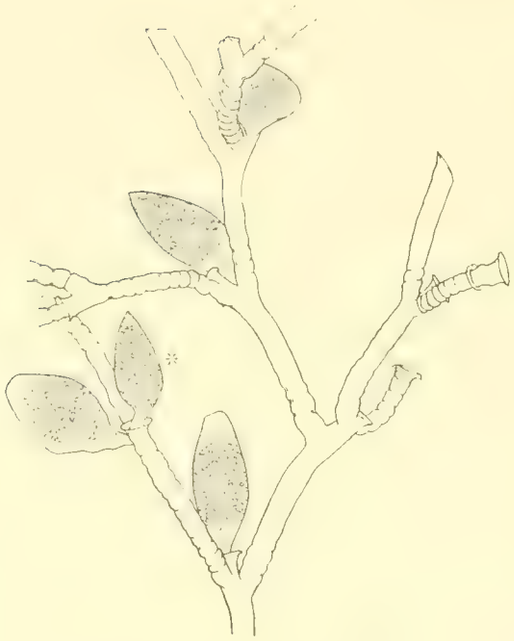

Fig. XX. *Halecium tenellum*.
♀ from "Ingolf" St. 87.
By * a gonotheca formed as heterorenovate.
(× 20).

There may be some possibility that the colony here shown (fig. XX) from the "Ingolf" St. 87 does not altogether agree with *Halecium tenellum*. On comparing with the descriptions given by Hincks (1868 p. 226, pl. 45, fig. 1 c.), Ritchie (1907 p. 525), and Jäderholm (1909 p. 14) the gonothecæ do not agree with those shown. Hincks describes them as follows: "the capsules vary in form, being broadly ovate, or slender and somewhat pointed above; they contain a single, large gonophore". His figure shows us a slenderly oval or more pear-shaped gonotheca broadly rounded at the distal end. Ritchie's description is as follows: "The gonangia are ovate, broad in the proximal region, obtusely pointed in the distal. They are supported on short stalks, which arise from the sides of the hydrotheca, and always from the lowest segment in any hydrotheca tier". Jäderholm writes: "Gonotheken eirund, unter den Hydrotheken ausgehend und (nach Thornely) auch von der Hydrorhiza und aus der Hydrothekenmündung. Distale Zähne fehlen". From the statements here quoted, it is not easy to gain a clear impression of the gonangia, and none of them will altogether cover the present fertile colonies, of which there are not a few in my material, and which agree with the specimen shown.

The gonothecæ are here set on short stalks, close under the primary hydrothecæ, or may exceptionally arise from the interior of the same; this agrees with the statements given above, as also with a later observation by Ritchie (1911 p. 30) where however, nothing new is stated as to their shape. The gonotheca contains, as Hincks points out, a single large gonophore, but the state of preservation of the material did not permit further investigation of this. On the other hand, the shape of the gonotheca agrees but ill with Hincks's drawing, and forms rather a cross between the description given by Ritchie and that of Jäderholm, not improbably because the gonothecæ are somewhat flattened. In lateral view, they are egg-shaped, with a broad basal part, and pointed distal end; viewed from the flat, on the other hand, they are more elongated oval, more or less transversely cut off at the distal end. On comparing this with the passage from Hincks's description quoted above, we find that his expression "broadly ovate, or somewhat pointed above" agrees after

all, as long as we bear in mind that the two statements refer to the gonotheca as viewed in the one case from the flat, in the other from the side. Consequently, all things considered, I regard the colonies in question as representatives of *Halecium tenellum*.

Jäderholm (1909 p. 55) notes *Halecium Schneideri* (Bonnevie) (1898 p. 10) as synonymous with *Halecium tenellum*; this, however, requires further justification. The shape of the colony, and the lively formation of pseudohydrocauli in *Halecium Schneideri*, agree rather with *Halecium minutum*, but the identity of the species is altogether doubtful, from the data we possess. Should the female gonothecæ prove to correspond with Schneider's *Halecium nanum* (1898 p. 481) then we have here a species entirely distinct from *Halecium tenellum* and *Halecium minutum*. Similarly, it may be doubtful

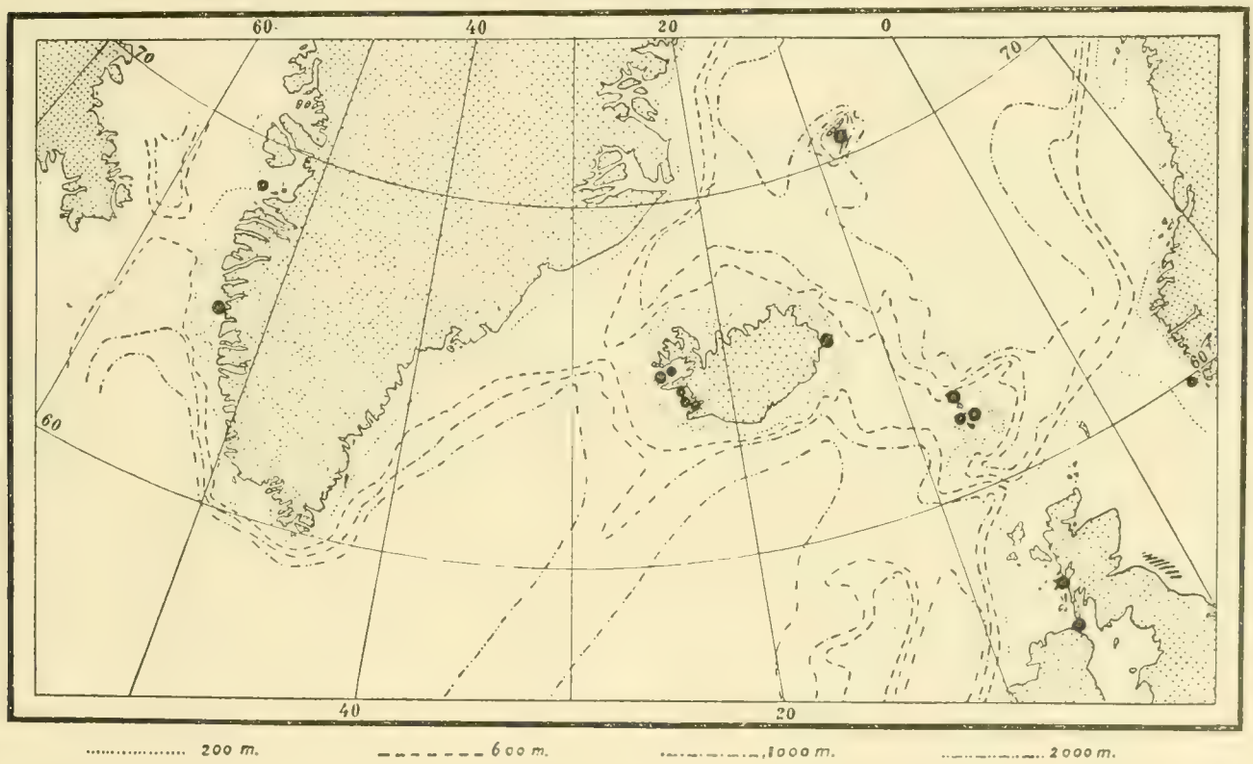

Fig. XXI. Finds of *Halecium tenellum* in the Northern Atlantic.

whether the species noted by me (1913 p. 17) as *Halecium tenellum*, from the Adriatic, really belongs here; the method of growth of the colony, and its dimensions, differ to such a degree from what is found in northern specimens of *Halecium tenellum*, that we must await demonstration of the gonothecæ in the Adriatic form before we can determine with certainty whether it belongs to this species.

The colonies agree on the other hand very well with the *Halecium textum* described by Kramp (1911 p. 368); the marked curvature of the hydrotheca margin in this species is not more pronounced than is frequently met with in *Halecium tenellum*; here, however, we must also await the finding of gonangia. It would also seem likely, as Kramp (1914 p. 1003) points out, that the *Halecium crinis* described by Stechow (1913 p. 79) belongs under *Halecium tenellum*; Stechow's interpretation of the manner of ramification in the colony is based upon an entirely erroneous appreciation

of the actual conditions; a point which has likewise been demonstrated by Kramp. Stechow's drawings in the mentioned work are sadly schematic, and thus afford but poor support.

Halecium tenellum belongs to the littoral region, and appears to occur but rarely deeper down in northern waters. From records in the literature, the species is altogether cosmopolitan, penetrating far into the Arctic waters, albeit it must here evidently have been frequently confused with the related *Halecium minutum*. Despite the fact that it is cosmopolitan, its occurrence in the boreal waters (fig. XXI) is remarkably scattered, and apparently irregular. It is probably considerably more common than appears from the chart, but occurs often in insignificant little colonies which may easily escape notice.

Halecium minutum Broch.

1903 *Halecium minutum*, Broch, Die von ... "Michael Sars" ... gesammelten Hydroiden, p. 4, Taf. I, figs. 1—4.

Colonies upright, generally with small, monosiphonic hydrocaulus, with regular, zigzag shaped sympodial growth; these small colonies arise as a rule from creeping stolons, but at times the stolons may collect together into well developed, branched and polysiphonic rhizocaulome-like formations, from which small branches with sympodial ramification proceed. New branchlets arise from under the base of the primary hydrothecæ, normally only one branch at the hydrotheca. The renewal of the hydrothecæ is lively, and gives rise to pseudohydrocauli, which may more rarely serve as the base for secondary sympodial formations. The hydrothecæ are fairly large, expanding considerably upwards from the slightly developed diaphragm, and have as a rule a highly curved margin; the stalks of the secondary hydrothecæ are ringed; the branches have distinct rings under the uppermost hydrothecæ, rarely elsewhere.

The gonothecæ arise from the creeping stolons or from the tubes of the polysiphonic parts of the colony. The females are very large, up to 3 mm. long, broad oval to round, and may not infrequently even be broader than long; they are highly flattened, with spines along the edge, especially in the distal part. The male gonothecæ are smaller, elliptical, and smooth; they may also proceed from beneath the base of the primary hydrothecæ.

Material:

"Thor" 66°19′ N. 23°14′ W.; depth 115—120 metres
Greenland: Egedesminde (without further details)
Iceland: 9 miles N.74°E. of Hornet, depth 38 fathoms

Vadlavik,	— 80 —	[labelled *Halecium tenellum*]	
Djupivogr	— 8 —	[—	— —]
64°17′ N., 14°44′ W.	— 75 metres	[—	— —]
Skagi	— 40 —		
Hvalfjord	— 46 —	[—	— *Schneideri*]
Skjalfandi Bay	— 28 fathoms.		

Kramp's studies (1913 p. 5) of *Halecium minutum* are highly interesting. He has succeeded in finding fertile female colonies, the identity of which is thus placed beyond doubt, but where the

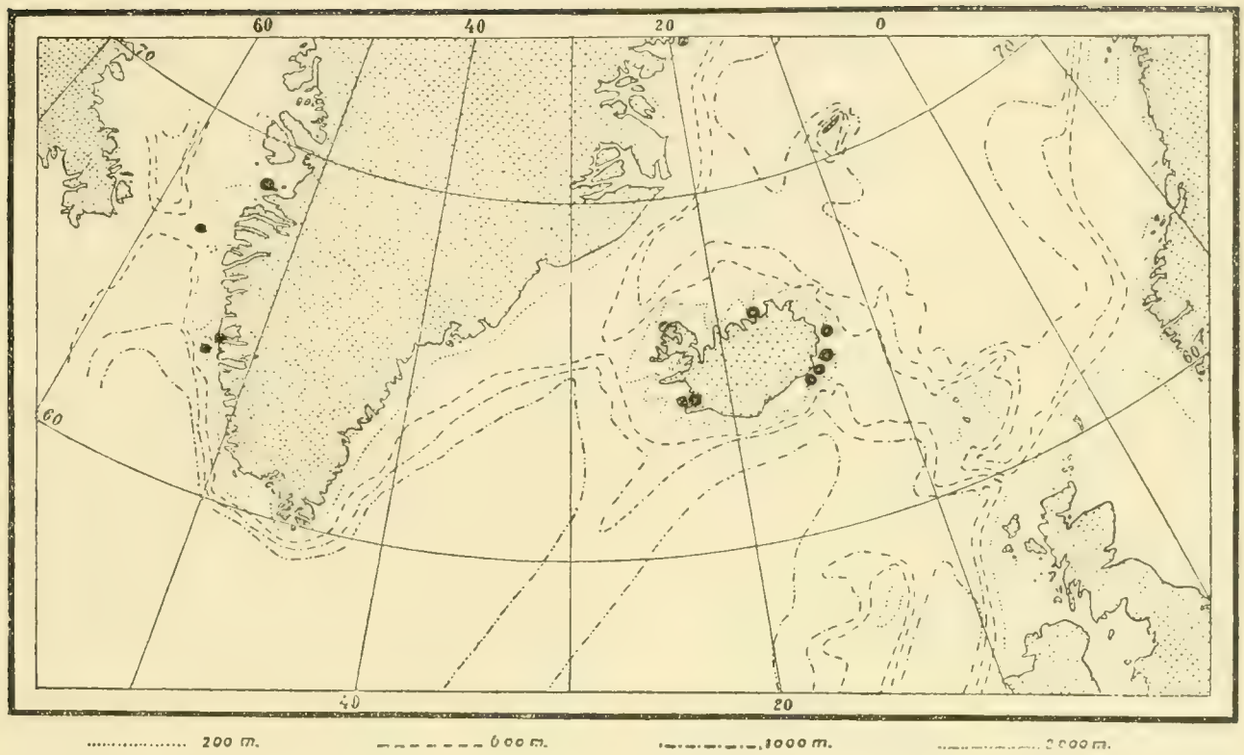

Fig. XXII. Finds of *Halecium minutum* in the Northern Atlantic.

small sympodial parts, normal in appearance, arise from enormous rhizocaulome formations instead of from creeping stolons. This, as Kramp also points out, places the question of growth conditions as generic character in a remarkable light; and what is worse, it shows us that the shape of the colony can even in specific limitation only be applied with great discretion, a point which has also been noted here under the heading of *Lafoëidæ*. Kramp thus supports my supposition (1909 p. 153) that the colonies which Jäderholm (1907) mentions from the Bering Sea under the name of *Halecium telescopicum* should more probably be ascribed to *Halecium minutum*.

Halecium minutum is an arctic species which has doubtless a considerable distribution in the Polar Sea, but which is often confused with others, and especially with *Halecium tenellum*, as is also clearly evident from the list of investigation material given above. Apart from the Bering Sea, the species has been recorded at Spitzbergen, the Murman coast, east and north coasts of Iceland, northern east coast of Greenland, and several places along the west coast; finally also Fraser (1913 p. 168) has met with it at Nova Scotia, on the Canso Bank. The species penetrates but very slightly into the boreal region, as far as can be seen from the finds made up to now.

Family Plumulariidæ.

The hydrothecæ are small, sessile, approximately radially symmetrical, one side partly or entirely fused with the branches (tubes); the diaphragm is somewhat asymmetrical. The large polyps can practically speaking never be drawn entirely into the hydrothecæ. The sarcothecæ are two-chambered,

stalked and mobile, or small, rudimentary or entirely effaced, being represented merely by holes in the periderm, at times with slightly raised, asymmetrical edges. The margin of the hydrotheca is almost always without teeth. The colonies are monopodial with terminal growth point. The gastral endoderm of the polyp is divided into a fore stomach and a digestive stomach part, the limit between them appearing as a constriction round the body of the polyp.

As thus defined, the family covers the group *Eleutheroplea* auctt. but it also further includes such primitive forms as *Kirchenpaueria*, which lacks true sarcothecæ. What have been taken for such are in reality merely low, as a rule somewhat asymmetrically developed margins round the aperture in the periderm through which the sarcostyle passes out. This formation cannot be altogether regarded as a parallel to the sarcotheca, which forms the fixed point of support for the sarcostyle, and is as a rule furnished with a diaphragm in *Plumulariidæ*.

On the other hand, it must be admitted that there are certain transition forms which render the limit between *Plumulariidæ* and *Aglaopheniidæ* somewhat indistinct at times, as we find species with both stalked mobile, and immobile, sessile sarcothecæ; these forms must be regarded as primitive *Aglaopheniidæ*. Such transition forms are also met with as against *Haleciidæ*, though it has not in this case been found advisable to unite the two families. We find, as a matter of fact, in almost every hydroid family such intermediate forms, the position of which is more or less a matter of doubt. If entirely definite boundary lines had to be drawn, it would very possibly involve the reduction of the entire group of hydroids to one or two families. But the heterogeneity would then be too great. In the same way, the *Plumulariidæ*, as viewed by Nutting (1900) and Stechow (1913) make a too heterogeneous group, which as both writers also admit, really comprises two very well defined main groups. As these two main groups differ in principle, as much as any two families in the other family series of thecaphore hydroids, and as, moreover, the intermediate forms here are neither more numerous nor more marked than elsewhere, it will be correct to keep the two groups apart as separate families.

Gen. Kirchenpaueria (Jickeli).

Upright pinnate colonies, the stem bearing on its apophyses only undivided branches (hydrocladia) with several hydrothecæ, these being unilaterally arranged, and fused with the branch. Beside the nutritive polyps appear the sarcostyles, which proceed from holes in the periderm; these holes are often surrounded by a slightly raised, as a rule somewhat asymmetrically developed periderm collar. Paired sarcostyles lacking.

Bedot (1916) reintroduces this genus, and defines it further in such a manner that the old *Sertularia pinnata* Linné appears as its typical species.

In the list published in 1915, "Nomina conservanda. Unter Mitwirkung zahlreicher Spezialisten herausgegeben von Prof. C. Apstein" (Sitzungsberichte der Gesellschaft naturforschender Freunde, Berlin, Mai 1915) we find under polyps (p. 126—127) as type for *Plumularia* the *Plumularia pinnata* L. This is well calculated to show that a list such as the one mentioned may easily manage to defeat its own ends. Within the very large number of species which are referred to the genus *Plumularia*, the *Plumularia pinnata* takes up a quite exceptional position, owing to its reduced sarcothecæ,

which are partly or entirely lacking. If we were to follow the list, we should then be obliged, as Professor M. Bedot writes me in a letter on this matter, to alter the generic name for all the over 200 species which have hitherto been noted under genus *Plumularia*. There is, as Professor Bedot further writes, nothing to suggest that Lamarck, the founder of the genus, ever regarded *Plumularia pinnata* as the type species in preference to any other then known species of the genus. There would seem much more reason to establish *Plumularia setacea* as type species. That a generic distinction should be made between *Plumularia pinnata* and the remaining species, where the sarcothecæ are far more highly developed, and generally appear partly paired, is beyond all doubt; this Stechow (1913 p. 25) also points out, and suggests *Kirchenpaueria* as generic name for the group, but without going further into the matter.

There are indeed several objections to be made to the mentioned list as regards the hydroids. That the authors note the genera *Clytia*, *Gonothyraea*, *Pasythea*, *Podocoryne*, and *Schizotricha*, may be taken for a party contribution to the dispute as to leading fundamental principles in systematics, which has no place in such a list, given without justification or explanation; the effect here is merely to create confusion, not to form a basis for firm and tenable conditions. Here again there is no question of names rendered so familiar through the medium of the handbooks as to have any claim to acknowledgement on that count. Furthermore, the revival of a name such as *Monocaulus* is more confusing than the retention of the later, generally employed appellation *Branchiocerianthus*. The authors have here evidently failed to realise that the type species given, *imperator*, does not as a matter of fact occur at all in Allman's original *Monocaulus* genus, which was founded on northern *Corymorpha* species with sessile gonophores, while the mentioned species was not found until later, by the "Challenger", and incorrectly placed in the genus *Monocaulus*, with the original diagnosis of which the species does not agree at all. We may further note the question as to whether *Antennularia* or *Nemertesia* should be retained. The latter name is generally adopted in later works by Stechow, Broch and Billard, and is likewise recognised in Bedot's eminent historical nomenclature studies, and neither of the names can be said to be of over frequent occurrence in the handbooks; the retention of *Antennularia* is here less due to sound defensible reasons than it is a matter of taste. — But we cannot here go farther into details with regard to this list; the foregoing will be sufficient to show that in its present form it is far from attaining the end proposed by discussion as to the retention of names whose alteration would bring about confusion in zoological handbooks and teaching works.

As regards the generic name *Kirchenpaueria*, there may be some little hesitation. The name in question first appears as a synonym in Kirchenpauer's paper Neue Bryozoen, Catalog IV des Museum Godeffroy, Hamburg 1869, where we find *Kirchenpaueria elegans* Greeff in litt. = *Reichornia Greeffei* Kirchenpauer. In the Bryozoa literature it occurs again only in E. C. Jelly, Synonymic catalogue of the recent Bryozoa, London 1889, as *Kirchenpaueria elegans* Graeffe, Kirch. in litt. — Jickeli introduces the name in 1883 for a hydroid which, as Bedot points out (1916 p. 641) is identical with *Plumularia pinnata*. Strictly speaking then, we should according to the precise rules of nomenclature perhaps rather have taken another name, but I regard it nevertheless as most correct for the present to follow Bedot, as there can hardly be any risk of confusion thereby. The generic name *Kirchenpaueria* is therefore here maintained for the genus whose type is *Sertularia pinnata* Linné.

Kirchenpaueria pinnata (Linné) Bedot.

1758 *Sertularia pinnata*, Linné, Systema naturæ, ed. 10, p. 813.

1916 *Kirchenpaueria pinnata*, Bedot, Sur le genre Kirchenpaueria, p. 645.

Upright, singly pinnate colonies with monosiphonic or more rarely, in the basal part polysiphonic stem. Hydrocaulus divided into internodia with one or several apophyses alternating to either

side. The apophyses have each an unbranched hydrocladium, divided by transverse joints into segments with numerous hydrothecæ. Each, or more rarely, every alternate internodium on the hydrocladium has on its distal half a hydrotheca entirely fused down its one side with the internodium, or more rarely having a low free adcauline edge. The hydrotheca-bearing internodia are also distally furnished with a median pore, proximally with a median pore having raised edges, through which the naked sarcostyles pass. The length of the hydrotheca varies between $^1/_2$ and $^1/_8$ of that of the internodium.

The gonothecæ are situated on the stem or on the basal parts of the hydrocladia, without

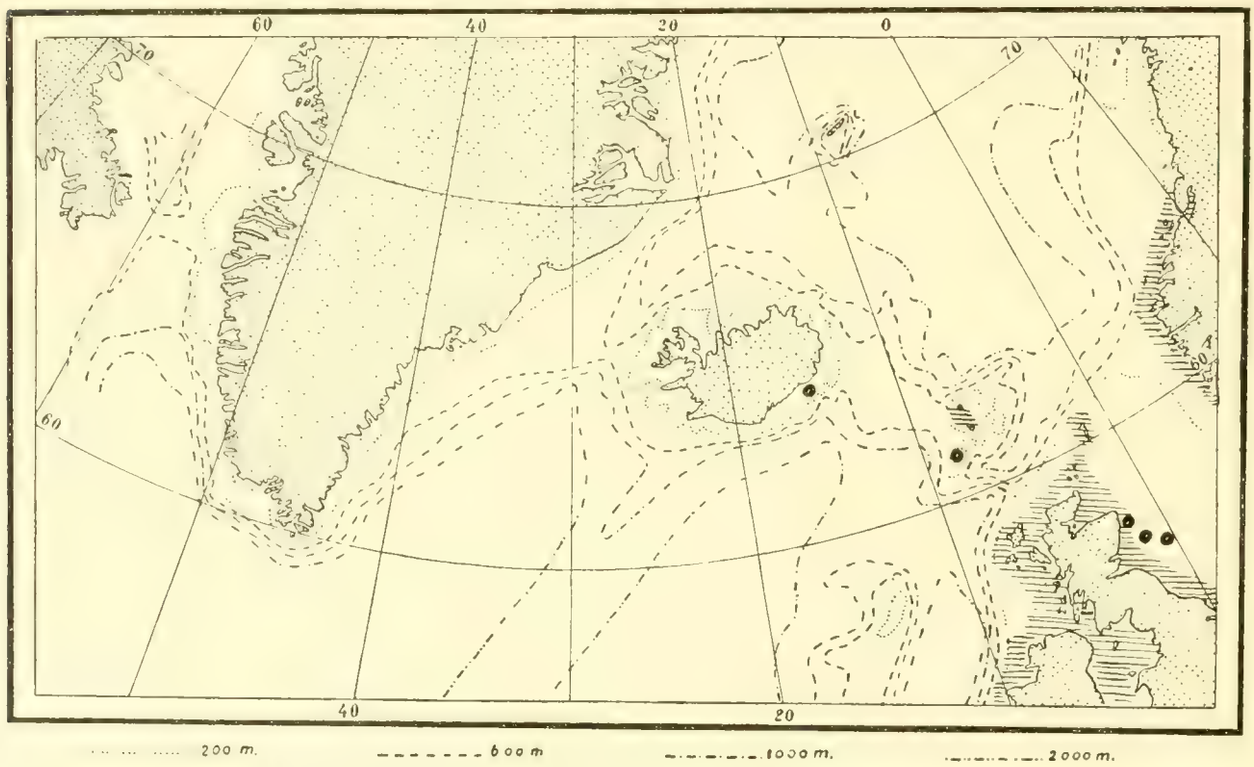

Fig. XXIII. The distribution of *Kirchenpaueria pinnata* in the Northern Atlantic.
In the hatched regions a common occurrence is stated by the literature.

special protective organs. They are oval to pear-shaped, smooth or spiny, often much flattened from the side.

Forma *typica*. Short internodia with hydrothecæ in length from $^1/_3$ to $^1/_2$ the internodium.

Forma *elegantula* (G. O. Sars) slender internodia with small hydrothecæ, length as a rule from $^1/_5$ to $^1/_8$ of the internodium.

Material (forma *typica*):

Greenland? (without further details).

The Faroe Islands: (without further details) |= *Plumularia echinulata* Winther|.

The synonymy of the species has recently been worked out by Bedot (1916). It gives us an interesting insight into the variability of a species, and throws a sharp light upon several of the

distinguishing features which have hitherto been regarded as good specific characters in *Plumulariidæ*. There are undoubtedly, among the numerous recorded species of *Plumularia*, synonyms in abundance, and the new species and varieties which are constantly being described do not make matters better. New forms demand not only morphological but also other justification, as is the case with the forms here noted. The variant group indicated as forma *typica* penetrates exceptionally (*Plumularia Helleri*) right into the Mediterranean, but has otherwise its main distribution in the boreal waters and in subantarctic regions, thus exhibiting a tendency to bipolar occurrence (cf. Broch 1914). Forma *elegantula* on the other hand, which is remarkable for its fine slender build, predominates under tropical-subtropical conditions, and is only on rare occasions met with in the temperate seas.

The area of distribution for *Kirchenpaueria pinnata* forma *typica* in northern waters coincides in the main with the fields on the chart (fig. XXIII); it is likely, however, that new finds will be made off the coast of Iceland, and we must wait until the species has been further localised in Greenland waters, before the query on the label can be erased. *Kirchenpaueria pinnata* appears in the northern waters as less susceptible to diminished salinity, and thus penetrates far up into the fjords; lower temperature, however, soon sets a limit to its progress. In the northern seas, it belongs to the littoral region, especially the upper half of the same, and only exceptionally occurs down in the abyssal.

Gen. Plumularia (Lamarck).

Upright, single or double pinnate colonies, the stem bearing on its apophyses undivided branches (hydrocladia) with hydrothecæ unilaterally arranged, and partly or entirely fused with the branch. The apophyse lacks sessile large sarcothecæ; the sarcostyles are situated in two-chambered mobile sarcothecæ, generally a pair at the mouth of each hydrotheca.

Plumularia setacea (Linné) Lamarck.

1758 *Sertularia setacea*, Linné, Systema naturæ, ed. 10, p. 813.
1816 *Plumularia setacea*, Lamarck, Histoire naturelle, vol. 2, p. 129.

Single pinnate colonies with monosiphonic main stem. The stem is divided into short internodia, each with a distal apophyse, turned alternately to either side. Each apophyse has a hydrocladium divided by transverse joints into internodia, of which latter every alternate one bears a hydrotheca and three sarcothecæ, and every other one or exceptionally two sarcothecæ in the median line; the hydrotheca-bearing internodium has a proximal, median sarcotheca, and a supracalycine pair at the opening of the hydrotheca. The length of the hydrotheca varies between $^1/_2$ and $^1/_5$ the length of the internodium. The hydrotheca is fused throughout its whole length with the hydrocladium.

The gonothecæ arise from the branch apophyse on the stem. They are elongated oval, with a cylindrical, narrow, often somewhat curved neck; the males are smaller than the females. The colonies are as a rule hermaphroditic, with the male gonangia on the basal part.

Forma *typica*: length of hydrotheca $^1/_2$—$^1/_3$ the length of the internodium; the internodia comparatively coarsely built.

Forma *microtheca*: length of hydrotheca $^1/_4$—$^1/_5$ the length of the internodium; the internodia of slender build.

Material (forma *typica*):

"Thor" 35°57′ N., 5°35′ W., depth 740 metres
Iceland: Vestmanö, depth 50 fathoms.

Plumularia setacea divides in the same manner as the foregoing into a widely distributed warm water variety, forma *microtheca*, and a temperate forma *typica*, occurring both in subantarctic and boreal waters. *Plumularia setacea* is in northern waters a denizen of the middle and upper parts of the lit-

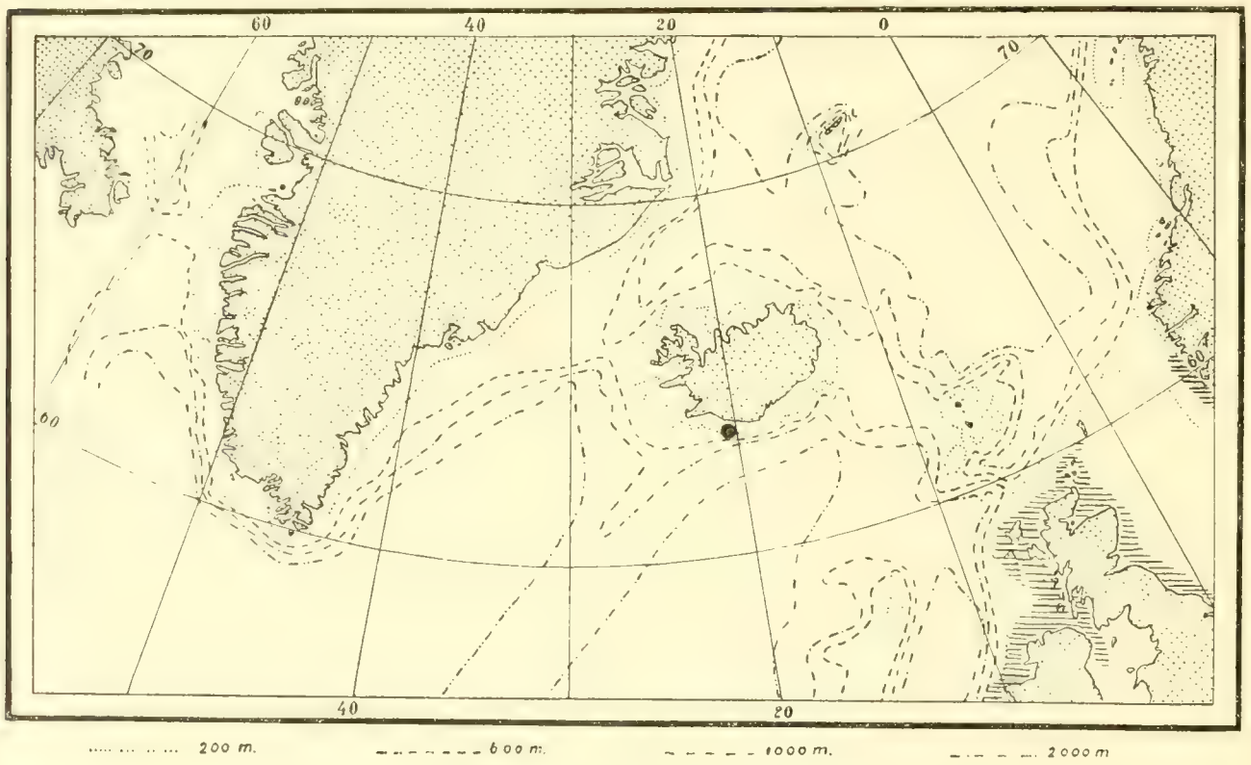

Fig. XXIV. The occurrence of *Plumularia setacea* in the Northern Atlantic.
In the hatched parts the occurrence according to the literature is common, although scattered.

toral region, whereas in warmer seas it goes fairly deep down into the abyssal region. The species is altogether somewhat rare in the boreal area (fig. XXIV) and penetrates in considerable numbers only into the southern and warmest parts of the same.

Plumularia Catharina Johnston.

1833 *Plumularia Catharina*, Johnston, Illustrations in british Zoology, p. 497, figs. 61—62.

Upright, pinnate colonies with simple or branched, monosiphonic, little pronounced stem. The branches proceed from the base of the hydrothecæ on the stem, and are as a rule placed oppositely, more rarely alternating. Stem and hydrocladia are divided into internodia by alternating transverse

and oblique nodes; above a transverse joint there is an internodium bearing one or two unpaired sarcothecæ in the median line, then the highly oblique joint, and an internodium furnished with a proximal, unpaired median sarcotheca, a large hydrotheca, and two supracalycine pairs of sarcothecæ. Of the supracalycine pairs of nematothecæ, the outermost is placed on small projecting apophyses, the inner pair arises from the internodium on the inner side of these sarcotheca apophyses. All the sarcothecæ are mobile. The hydrotheca is very slightly fused with the internodium, the adcladial side has a free portion, in length equal to the hydrotheca opening or a little less, between $^1/_2$ and $^3/_4$ the length of the hydrotheca. The hydrotheca is somewhat expanded towards the opening, and is able to accomodate the contracted polyp almost entirely.

The gonothecæ arise from the stem or the hydrocladia close beneath the hydrothecæ. The gonotheca is oval to pear-shaped, as a rule somewhat curved, the males a little more slender than the females. The female gonothecæ have basally two sarcothecæ, which, (according to Hincks) are lacking in the males.

Material:

The Faroe Islands: 6 miles N. by W. of Store Kalsö depth 60 fathoms
Deep hole at the north point of Nolsö, — 100 —
Borönæs 13 miles in N. 75 W. — 30 —

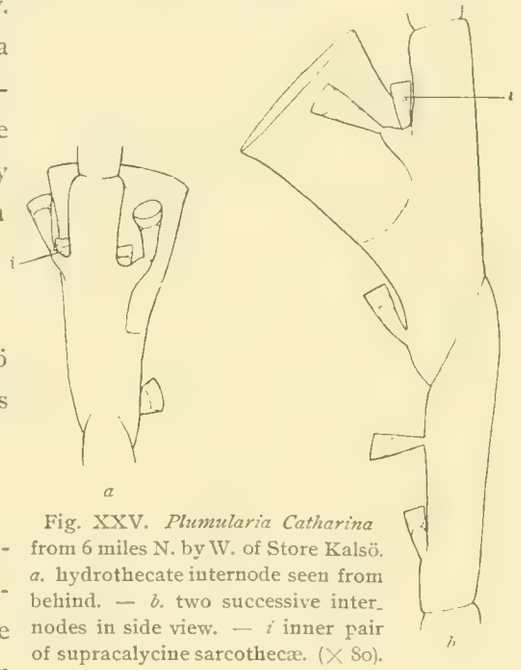

Fig. XXV. *Plumularia Catharina* from 6 miles N. by W. of Store Kalsö. *a.* hydrothecate internode seen from behind. — *b.* two successive internodes in side view. — *i* inner pair of supracalycine sarcothecæ. (× 80).

The inner pair of supracalycine sarcothecæ in *Plumularia Catharina* (fig. XXV) appears to have escaped the attention of most investigators; it is probably this pair of sarcothecæ which has given rise to the distal median sarcotheca so often ascribed to the species. Such median (unpaired) distal sarcothecæ I have been unable to find in the colonies at my disposal; not infrequently, however, one or both of the sypracalycine may have fallen away, rendering it difficult even to trace where they had been. It is remarkable that it should be the inner pair which exhibits such a marked tendency to fall off, exceeding that of the other sarcothecæ; the ones in question are, however, also the smallest. In view of the abundance of the present material, and the fact that I found occasion also to investigate material from other parts of the Atlantic, we must regard the statements as to occurrence of an unpaired distal sarcotheca on the hydrotheca-bearing internodium in *Plumularia Catharina* as based on incorrect interpretation of the inner pair of supracalycine sarcothecæ. There can be no doubt that the species *Plumularia geminata* Allman, *Plumularia alternata* Nutting and *Plumularia Clarkei* Nutting should be included under *Plumularia Catharina*, as I have already pointed out in a previous work (1912 p. 4); it is impossible to attach any weight to the characters given for specific distinction when once a larger material has been closely investigated.

Plumularia Catharina is a southern visitor to the boreal waters (fig. XXVI); round the British Isles it still seems to be of fairly frequent occurrence, but off the coast of Norway it is but little met with, and has only once been recorded from the south coast of Iceland. At the Faroe Islands, the

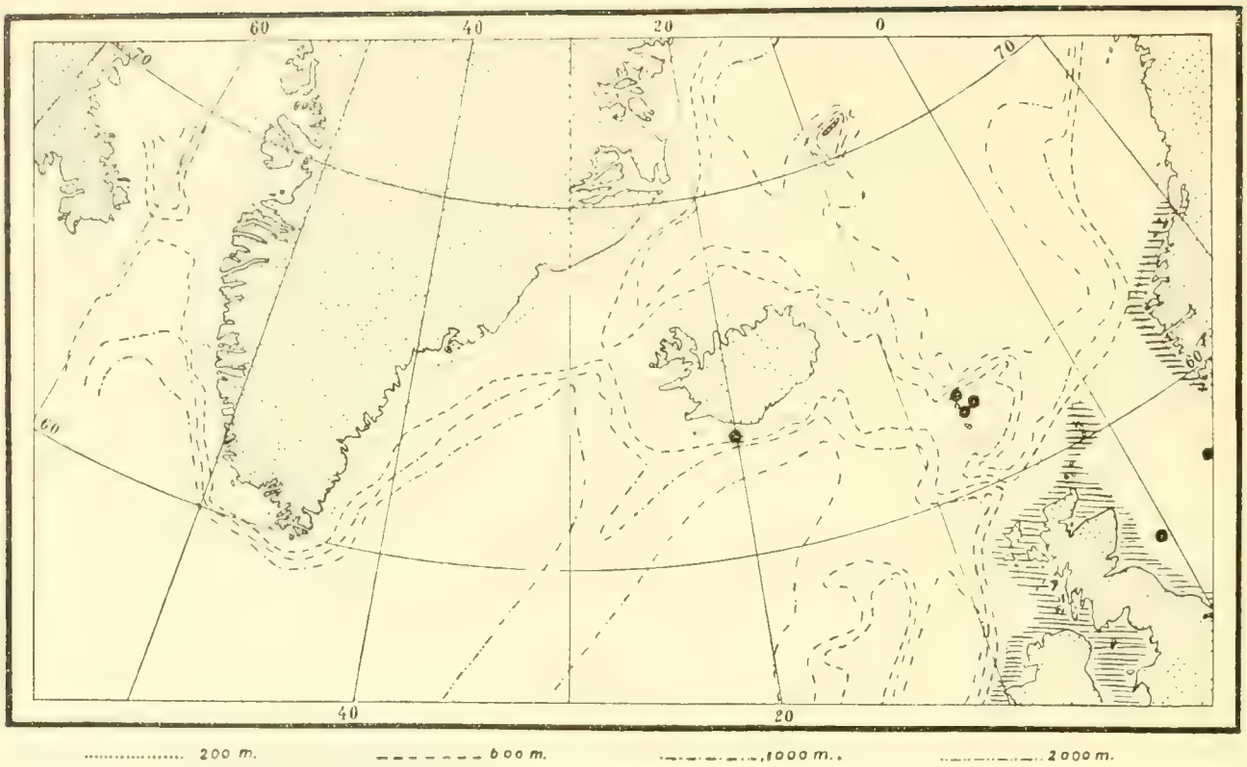

Fig. XXVI. The distribution of *Plumularia Catharina* in the Northern Atlantic.
In the hatched parts the literature notes a common, although scattered occurrence.

species seems to be somewhat more common than would appear from earlier records; at the two localities noted here, it was present in great numbers. In Greenland waters, *Plumularia Catharina* has not yet been found. It belongs especially to the upper half of the littoral region.

Gen. Polyplumaria[1] G. O. Sars.

Upright, composite pinnate colonies with polysiphonic branched stem. The apophyses of the stem (the primary tube) bear hydrocladia from which secondary hydrocladia proceed, as a rule from the first hydrotheca-bearing internodium. The apophyse lacks sessile sarcotheca. All the sarcothecæ are mobile and two-chambered.

It is not without hesitation that I retain this genus beside *Plumularia*, with which it is closely related; it may be a question whether we should here, more than in other cases, base the generic division upon the form of ramification. That I have retained it for the present as a separate genus is due to the fact that its species, from their peculiar appearance, form a well-defined group, sharply distinguished from the remaining ones which have been included in the genus *Plumularia*. My material is not so extensive as to suffice for a revision of the entire family, a task which becomes more and more imperative as further species continue to appear in the literature. A work such as

[1] Nutting has (1900 p. 83) by a slip of the pen called the genus *Polyplumularia*.

that of Nutting (1900) shows more than most how absolutely indispensable such critical revision really is. It is therefore most correct here for the present to retain a genus such as *Polyplumaria*.

Polyplumaria frutescens (Ellis et Solander).

1786 *Sertularia frutescens*, Ellis and Solander, The natural history of many curious and uncommon Zoophytes, p. 55, pl. 6, fig. *a*, *A*, pl. 9, fig. 1.

The colonies are upright and singly or doubly pinnate, with polysiphonic hydrocaulus. The primary stem tube bears on its front a series of hydrothecæ, one to three on each internodium; at the base of each hydrotheca, the tube has an apophyse, which is directed obliquely forward and to the side, alternating to either edge. The apophyse bears a hydrocladium, as a rule secondarily branched, which is at first directed obliquely upward and forward, but gradually turns into the broad plane of the colony. The hydrocladium is divided by transverse nodes into internodia, bearing one to several hydrothecæ, and around this a pair of supracalycine sarcothecæ, and one median, unpaired, under the base of the hydrotheca. The hydrotheca is fairly large, slender, and fused throughout the whole of one side with the internodium. The secondary hydrocladia proceed from under the base of the basal hydrotheca of the primary hydrocladia, and assume the same appearance as the primary hydrocladia.

The gonothecæ are set on the branches without special protective organs. They are pear-shaped, cut off obliquely distally, with a large lid-bearing opening.

Material:

"Ingolf" St. 54 63°08′ N., 15°40′ W., depth 691 fathoms 3,9°
— - 55 63°33′ N., 15°02′ W., — 316 — 5,9°
The Faroe Islands: 61°40′ N., 7°40′ W., — 135 —
16 miles E. by S. of the south point of Nolsö, depth 80 fathoms.

Polyplumaria frutescens has its chief occurrence in the lower parts of the littoral region, and in the upper portion of the abyssal. It is a southern visitor to the boreal seas, having only on a single occasion been encountered in colder water layers, viz. east of Iceland (fig. XXVII). In Greenland waters, the species has not yet been found, and its occurrence at the Faroe Islands is here recorded for the first time.

Polyplumaria flabellata G. O. Sars.

1874 *Polyplumaria flabellata*, G. O. Sars, Bidrag til Kundskaben om Norges Hydroider, p. 93, pl. 2, figs. 16—22.

Upright, doubly pinnate colonies with polysiphonic branched main stem. The primary tube bears on its internodia alternating apophyses, directed obliquely forward and upward. From the apophyse proceed the primary hydrocladia, which soon curve into the broad plane. The hydrocladia are divided by almost transverse nodes into internodia, each bearing a large hydrotheca, a pair of supracalycine sarcothecæ, a larger, unpaired proximal, and a smaller unpaired distal sarcotheca in the median line. The hydrothecæ are fairly large, about half as long as the internodium; the adcauline wall has a free portion in length about equal to the opening diameter, between one and two thirds of the length

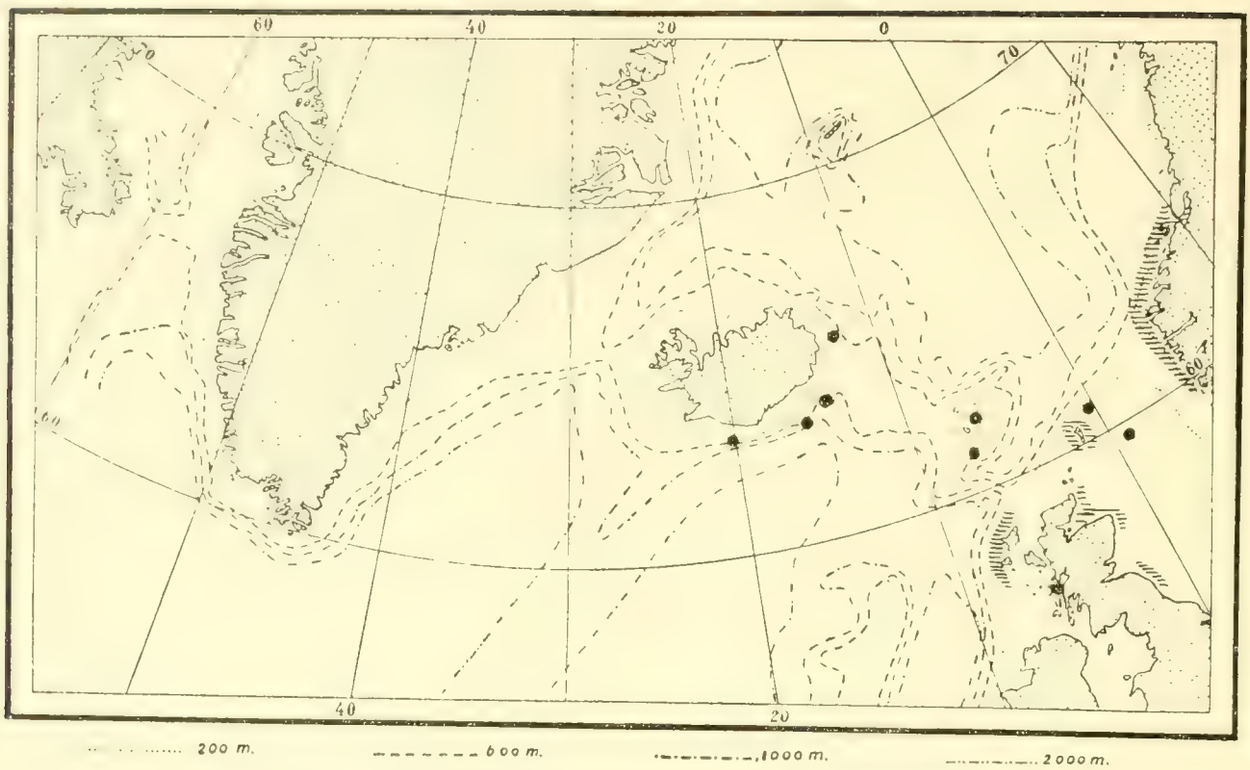

Fig. XXVII. Localities of *Polyplumaria frutescens* in the Northern Atlantic.
In the hatched parts the literature notes a scattered occurence without further data.

of the hydrotheca. The secondary hydrocladium proceeds from beside the basal hydrotheca of the primary hydrocladium, and is of the same appearance as this.

The gonothecæ are fastened to the stem or the branch apophyses by a very short stalk. They are oval, with a large, somewhat asymmetrical distal opening, and with four sarcothecæ at the base. Material:

"Thor" 35°57′ N., 5°35′ W., depth 740 metres
Iceland: Vestmanö, — 510 —

According to Ritchie (1911 p. 223) the number of unpaired small distal sarcothecæ on the internodium should vary from one to three. No such variation could be discerned in the colonies investigated by me.

Polyplumaria flabellata is a very rare visitor in the northern waters (fig. XXVIII) and occurs here only in the deeper water layers. The species has altogether its main distribution in the upper parts of the abyssal region. The Vestmanna Islands mark the most northerly point where it has been found up to now; in Greenland waters it would seem to be entirely lacking.

Polyplumaria profunda (Nutting).

1900 *Plumularia profunda*, Nutting, Plumularidae, p. 66, pl. 8, figs. 2—3.

Upright, composite pinnate colonies with branched polysiphonic main stem. The primary tube which is seen in the outer parts of the colony is divided by transverse nodes into internodia, bearing

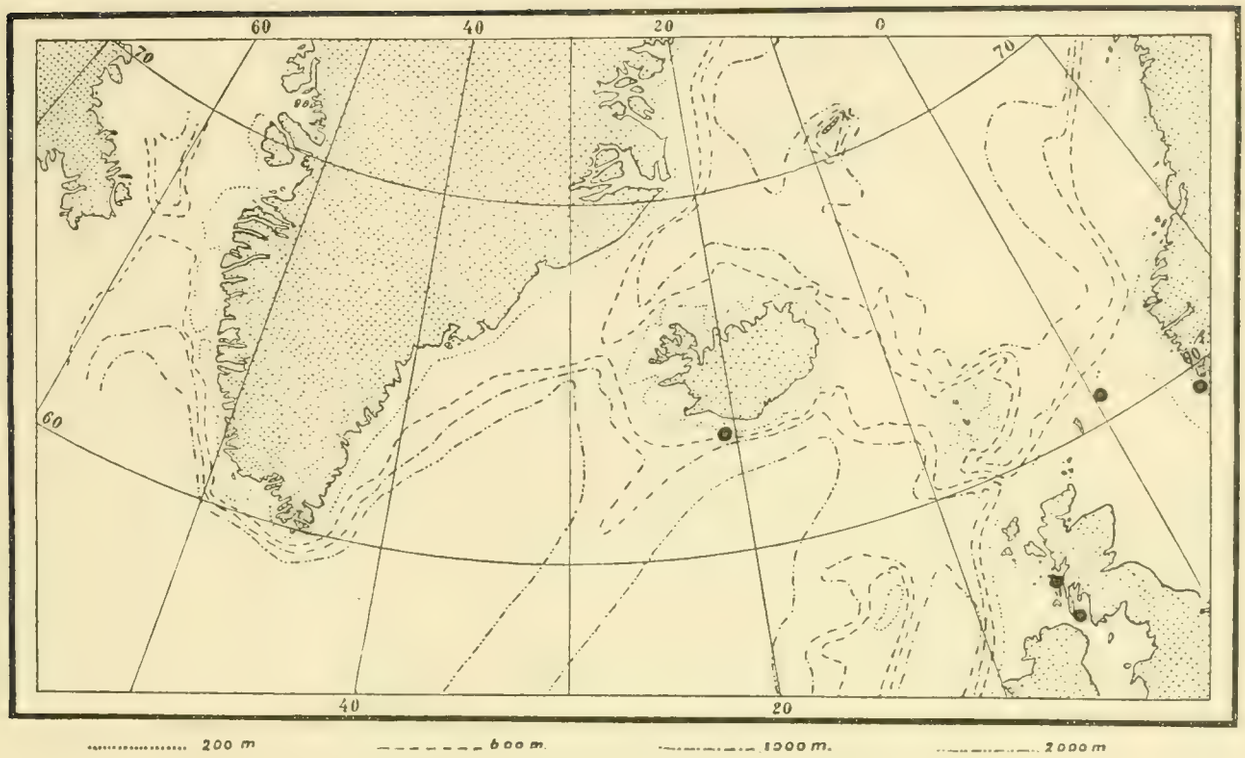

Fig. XXVIII. Finds of *Polyplumaria flabellata* in the Northern Atlantic.

one or two alternating apophyses. The apophyse proceeds asymmetrically from the base of a cauline hydrotheca; this is surrounded by a pair of supracalycine sarcothecæ, and a third sarcotheca situate proximally and a little to the side of the median line, somewhat removed from the base of the hydrotheca, on the side of the median line opposite to the apophyse. The hydrocladia are divided by transverse nodes into internodia, which have about the middle a hydrotheca with a supracalycine pair of sarcothecæ, on low apophyses near the opening of the hydrotheca, and a proximal, unpaired sarcotheca in the median line near the proximal end of the internodium. The basal internodium on the primary hydrocladium has two proximal unpaired sarcothecæ in the median line; at the base of this internodium's hydrotheca there appear, in fertile colonies, apophyses to the secondary hydrocladium, which is of the same structure as the primary. The hydrothecæ are on the hydrocladium about twice as long as broad; on the stem somewhat shorter; they have a somewhat outward curving opening margin, and are fused throughout their whole length with the internodium.

The gonothecæ are situate on the stem or close under the base of the proximal hydrothecæ on the primary and secondary hydrocladia; they have a short, often rudimentary stalk. The gonothecæ are pear-shaped, often curved, rounded off somewhat asymmetrically distally, with a broad opening; they have two sarcothecæ basally.

Material:

"Ingolf" St. 24	63°06′ N.,	56°00′ W.,	depth	1199	fathoms		2,4°
— - 55	63°33′ N.,	15°02′ W.,	—	316	—		5,9°
— - 98	65°38′ N.,	26°27′ W.,	—	138	—		5,9°

That Nutting (1900 p. 66) should refer this species to *Plumularia* must be due to his having had small or poorly developed colonies to deal with. From the "Ingolf" St. 55 we have a couple of splendid colonies showing the typical secondary hydrocladia of *Polyplumaria* in practically every branch, and richly furnished with gonangia. These are situated on the basal part of the hydrocladia — both primary and secondary, and partly also on the tubes of the stem.

It might be imagined that the present specimens, with their typical *Polyplumaria* colonies, were specifically different from Nutting's *Plumularia profunda*. We found, however, besides the two mentioned, extremely luxuriant colonies, also a smaller, single pinnate colony, where only the basal hydrocladia were furnished with secondary hydrocladia, all the remaining hydrocladia being simple. Nevertheless, this colony is likewise fertile, and a further investigation of the larger colonies shows that here also the secondary hydrocladia are lacking on several branches. In all these colonies, the stem is polysiphonic. But from the "Ingolf" St. 24 we have a quite young, sterile colony, where the whole stem is monosiphonic; only at the bottom of the basal part is a secondary tube developed. Here then, we have the complete transition from Nutting's description to the typical *Polyplumaria* which the species represents in its fully developed form. The resemblance in detail will furthermore be seen from a comparison of the illustrations here given (fig. XXIX).

a Fig. XXIX. *b*

Polyplumaria profunda "Ingolf" St. 24. *a*. Hydrocladial internodium. *b*. Internodium of the primary stem tube, with apophyse. (×60).

The finding of *Polyplumaria profunda* in the northern Atlantic is highly interesting. The species is a typical deep sea form, previously known only from West Indian waters. We now find, that it penetrates in deep water right up into Davis Strait and Danmark Strait, and to the southern slope of the Iceland region, where the warm and salt Atlantic water predominates. It is evidently not able to pass over the submarine ridges or into strictly boreal waters.

Nemertesia Lamouroux.

Upright colonies with as a rule pronounced main stem, which may be branched or unbranched, generally articulated and furnished with strong apophyses bearing finely built hydrocladia. The hydrocladia are single, unbranched. The colonies are furnished with stalked, two-chambered and mobile sarcothecæ, and have in addition, on each apophyse at its upper side where it proceeds from the stem, a large sessile sarcotheca ("mamelon"). The hydrocladia are segmented, and have several hydrothecæ, which as a rule are fused throughout their entire length with the branch. The hydrocladia are generally situated in several rows in fully developed colonies.

Formerly, in drawing the limits for this genus, the principal stress was laid on the fact that the hydrocladia are in multiserial arrangement, not merely in two rows as in *Plumularia*. This cannot

however, be admitted as a particularly important feature in generic distinction, as will be seen from a closer study of the *Nemertesia* species and their development. A species such as *Nemertesia tetrasticha* (Meneghini) differs in reality but little from the pure *Plumularia* type, its four-rowed appearance being due to a slight alternating displacement of the apophyses on the two sides; we have here then, as a matter of fact, two-rowed colonies, which have probably when younger been of the pure *Plumularia* form. In *Nemertesia ramosa* (Lamarck) I have in a previous work (1912 p. 5) pointed out that the distal parts of the colony not infrequently exhibit a purely biserial arrangement of the hydrocladia; the present material shows that small colonies both of this species and of *Nemertesia antennina* (Linné) are altogether biserial. Here, as a matter of fact, it is quite another character which warrants the generic identity, to wit, the large sessile sarcotheca ("mamelon") of the apophyse, which occurs in the colonies from the earliest stages onwards.

The development of the colonies, and the grown colonies themselves, clearly show that the multiserial arrangement of the hydrocladia is a secondary adaptation which is, moreover, in many species, subject to great variation within one and the same colony. The number of branch series is even variable in the single species, as in *Nemertesia ramosa*, where it varies from two to eight, or *Nemertesia antennina*, where we find from four to twelve. It is not easy to see why it should be more reasonable and effective to draw the limit between biserial and multiserial than for instance between quadriserial and multiserial. On the other hand, there is one constant feature in all the species hitherto noted under this genus; to wit, a peculiar large sessile sarcotheca on the apophyse. A comparison with other species (see for instance more particularly *Aglaophenopsis cornuta*) suggests that this formation should in reality be regarded as an abortive hydrotheca. In most cases, it forms a rounded raised portion, with circular opening, happily described by the French writers as a "mamelon". This sarcotheca occurs in colonies from the smallest to the largest in the same manner, whether the species is biserial or multiserial. It must thus be regarded as of generic importance. Consequently, we must reject from *Plumularia* those species which are furnished with a "mamelon" on the apophyse and have unbranched hydrocladia, placing them instead under *Nemertesia*.

We thus obtain, in this genus, biserial and multiserial forms. It is impossible to determine, from the data available, whether a species like *Nemertesia caulitheca* (Fewkes) (= *Plumularia caulitheca*, Nutting 1900 p. 63) is a young stage or not; its gonangia have not yet been discovered, and it may possibly be found to go through a development similar to that of our northern species, passing gradually from a biserial type over into the multiserial form. If not, then it must be regarded as a primitive species. The next stage is represented by *Nemertesia tetrasticha* (Meneghini), with its alternately displaced apophyses in the two branch rows; *Nemertesia ramosa* undergoes this stage, and probably also *Nemertesia antennina*, the former, however, at any rate soon proceeding further with a marked twist of the internodia, so that the apophyses in one internodium are perpendicular to those of the previous and subsequent ones. Not until later do further apophyses appear at the same level as the first, and from now onwards we regularly find, owing to the revolved position, a number of branch series divisible by two.

The nature of the stem has also served as basis for a division of the genus; here again, however, there is no real difference of principle to work on. The younger stages of *Nemertesia ramosa*

have monosiphonic stem; not until later does it become canaliculate, and finally, in fully developed colonies, we find purely polysiphonic basal parts of the stem, where secondary tubes cover the canaliculate central tube. Thus the limits between *Nemertesia* and *Antennopsis* become effaced, and these genera must in consequence, as I have previously maintained (1912 p. 28), and as Stechow also points out (1913 p. 25) be united into one. Similarly it follows, that Stechow is correct in placing *Sibogella* under *Nemertesia*.

Bedot, in a work which has just appeared (1917) treats of the genus *Nemertesia* at length, unfortunately, however, without giving any synopsis of the generic characters. It is nevertheless clear that Bedot inclines to regard the canaliculate ("pluricanaliculée") stem as a family trait. The character is developed, as mentioned above, only in somewhat larger colonies — generally at least 5 cm high — it is moreover often lacking in large distal parts of the colony in the northern species, where the stem frequently retains its primary ("unicanaliculée") character. And finally, the primary "pluricanaliculée" stem tube is secondarily covered, as in *Nemertesia ramosa*, by tubes "unicanaliculées" to a greater or lesser extent. This in itself detracts from the value of the character in question. But in addition, it is also found to stand in a certain relation to the dimensions of the stem tube; thick, single stems are "pluricanaliculées" in species within the same genus, where the thin ones are constantly "unicanaliculées" (cf. for instance *Tubularia*). As a matter of fact, the two types "fasciculée" (polysiphonic) and "pluricanaliculée" (canaliculate) represent parallel processes of development towards the same end. And as we are unable to take the former as basis for generic distinction, so also the latter character must be considered quite inadequate as a means of distinguishing between genera (or families).

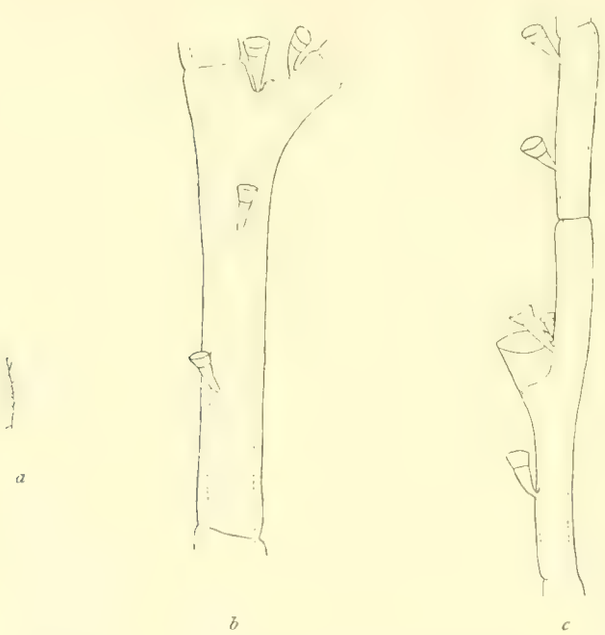

Fig. XXX *a—c*. *Nemertesia antennina*, juv. "Ingolf" St. 98. *a*. The entire colony (nat. size). — *b*. Internodium of the hydrocaulus with the hydrocladial apophyse, showing the sessile sarcotheca. — *c*. Two successive internodes of a hydrocladium (*b* and *c* × 80).

Nemertesia antennina (Linné) Lamouroux.

1758 *Sertularia antennina*, Linné, Systema naturæ, ed. 10, p. 811.

1812 *Nemertesia antennina*, Lamouroux, Extrait d'un mémoire sur la classification des polypes coralligènes, p. 184.

Colonies with unbranched or quite exceptionally slightly branched canaliculate and segmented stems. The apophyses are set in circles on the internodium, each circle containing three to six or even more apophyses; the internodia are revolved, so that the stem has twice the number of longitudinal rows of apophyses. Near its point of origin, the apophyse has on its upper side a comparatively small, sessile sarcotheca ("mamelon") and two or three irregularly arranged, stalked and two-chambered

mobile sarcothecæ. The hydrocladia are divided by transverse nodes into internodia of which normally every second one bears one or two unpaired sarcothecæ in the median line, the alternate ones having a small hydrotheca with a supracalycine pair of sarcothecæ at the mouth, and an unpaired median sarcotheca on the proximal part of the internodium. The hydrotheca is about $^1/_5$ to $^1/_3$ the length of the internodium, and is on one side entirely fused therewith.

The gonothecæ are attached by an almost rudimentary stalk to the apophyses; they are oval to pear-shaped, with a distally laterally placed asymmetrical opening.

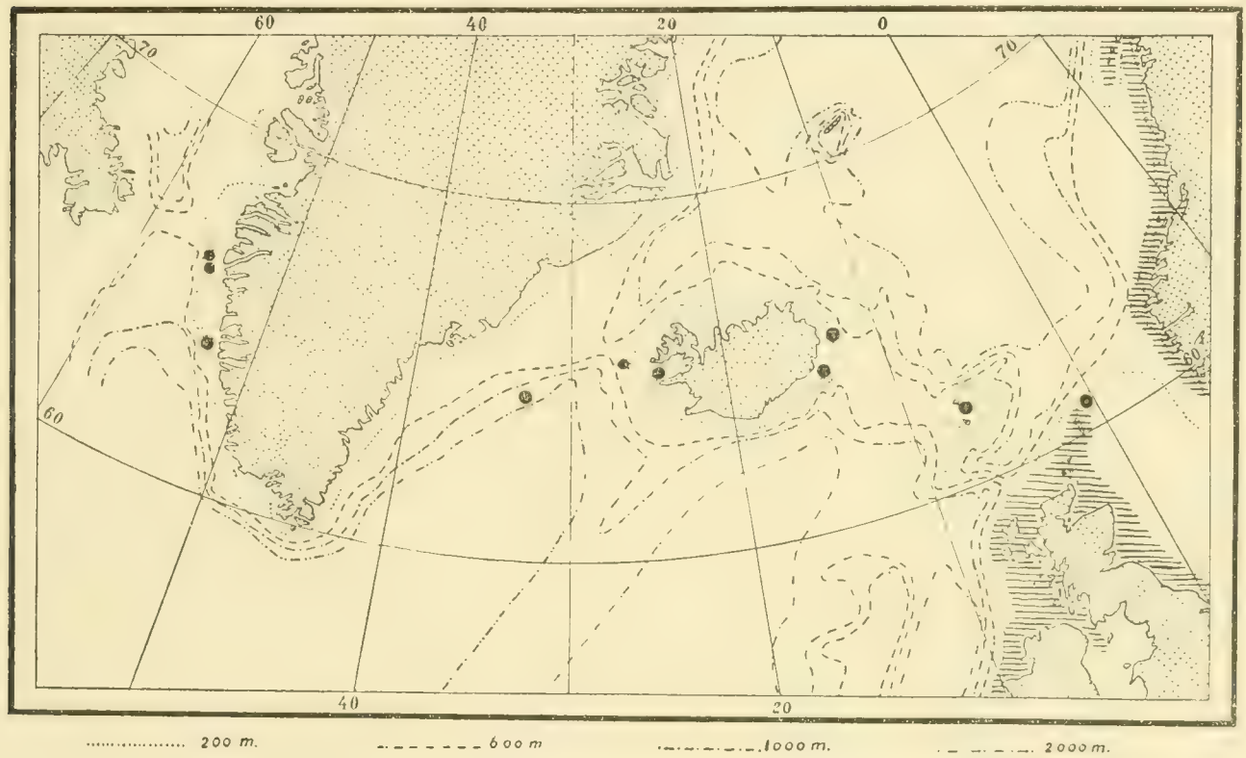

Fig. XXXI. The distribution of *Nemertesia antennina* in the Northern Atlantic.
In the hatched parts the literature notes a scattered although common occurrence.

Material:

"Ingolf" St. 87, 65°02,3′ N., 23°56,2′ W.; depth 110 fathoms
— - 92, 64°44′ N., 32°52′ W.; — 976 — 1,4°
— - 98, 65°38′ N., 26°27′ W.; — 138 — 5,9°
Greenland: Davis Strait, — 80 — (without further details)
— — 65°27′ N., 54°45′ W.: — 67
Iceland: 5 miles E. of Seydisfjord, — 135 —
The Faroe Islands: Deep hole at the north point of Nolsö, depth 100 fathoms.

Some luxuriant colonies from Davis Strait exhibit interesting variations in the number of hydrocladia. The nodes of the stem are slightly marked, and each internodium bears but three apophyses; owing to the revolution of the internodia therefore, these colonies or parts of colonies are six-rowed; among these colonies again there are others, or in the single colony, other parts, which in a

similar manner appear eight-rowed, with four apophyses in the circle. The same octoserial type was met with at the "Ingolf" St. 87, and from St. 92, we have for the first time specimens with six apophyses in each circle, giving a twelve-rowed colony. The revolution of the segments is thus characteristic of grown colonies, and calls to mind the features noted in *Nemertesia ramosa* (cf. Broch 1912 p. 5).

From St. 98, the "Ingolf" brought a young specimen of *Nemertesia antennina* which is of considerable interest (fig. XXX). The colony is still quite biserial, and can only be distinguished from *Plumularia* by the sessile "mamelon" of the apophyses. As however, the arrangement of the sarcothecæ and hydrothecæ entirely agrees with *Nemertesia antennina*, I have no hesitation in referring the colony to this species, the more so since altogether parallel stages occur in the following species together with later phases of development.

Nemertesia antennina is a southern form with wide distribution in the boreal region (fig. XXXI). Towards the south, it goes at any rate as far as Madeira, and is common in the Mediterranean; it belongs to the middle and lower parts of the littoral region, but may exceptionally, as shown by the finds from the "Ingolf" St. 92, go deep down into the abyssal. It has not yet been met with in purely arctic waters, unless the one find from the east coast of Iceland should be so described.

Nemertesia ramosa Lamouroux.

1816 *Nemertesia ramosa*, Lamouroux, Histoire des Polypiers coralligènes, p. 164.

1903 *Antennularia variabilis*, Broch, Die von dem norwegischen Fischereidampfer "Michael Sars" ..... gesammelten Hydroiden, p. 10, Taf. IV, figs. 22—25.

Colonies with branched main stems, polysiphonic in their lower parts, canaliculate in the upper. Apophyses form circles about the internodia of the stem, two to four in each circle, and the internodia are revolved, giving twice the number of longitudinal rows. In the lower parts of the colonies, where secondary tubes cover the primary stem, the circular arrangement of the branches is less distinctly marked. The apophyse has on its upper side a strong, narrow, but high sessile sarcotheca ("mamelon") and 3—4 irregularly placed, mobile sarcothecæ. The hydrocladia are divided by transverse nodes into internodia, each of which has a median hydrotheca with a supracalycine pair of sarcothecæ at the opening, and one proximal and one distal unpaired sarcotheca in the median line; exceptionally, the distal part with its sarcotheca may be divided by a slight joint from the main internodium. The hydrotheca is entirely fused with the hydrocladium, and is $^1/_6$ to $^1/_3$ the length of the internodium.

The gonothecæ are attached to the apophyse by a short, almost rudimentary stalk. They are oval to pear-shaped, with a distally lateral asymmetrical opening.

Material:

"Ingolf" St. 55	63°33′ N.,	15°02′ W.;	depth	316 fathoms, 5,9
— - 85	63°21′ N.,	25°21′ W.,	—	170 —
"Thor"	61°15′ N.,	9°35′ W.;	—	872 metres
Iceland: Vestmanö,			—	50 fathoms
The Faroe Islands:	62°16′ N.,	6°06′ W.;	—	110 metres
	60°55′ N.,	8°56′ W.;	—	840 —

6 miles N. by W. of Store Kalsö,	depth	60 fathoms	
Deep hole at the north point of Nolsö,	—	100	—
1,5—2 miles off the mouth of Borövig,	—	20—30	—
Prövenæs 13 miles in N.75°W.,	—	30	—
Borönæs in N.75°W.,	—	30	—
The Faroe Islands,	—	30	— (without further details).

Nemertesia ramosa is extremely variable as regards arrangement and number of the hydrocladia, as I have previously (1912 p. 5) had occasion to explain. In the revolution of the internodia, however, it follows the same regular principles as *Nemertesia antennina*. The structure of the stem presents

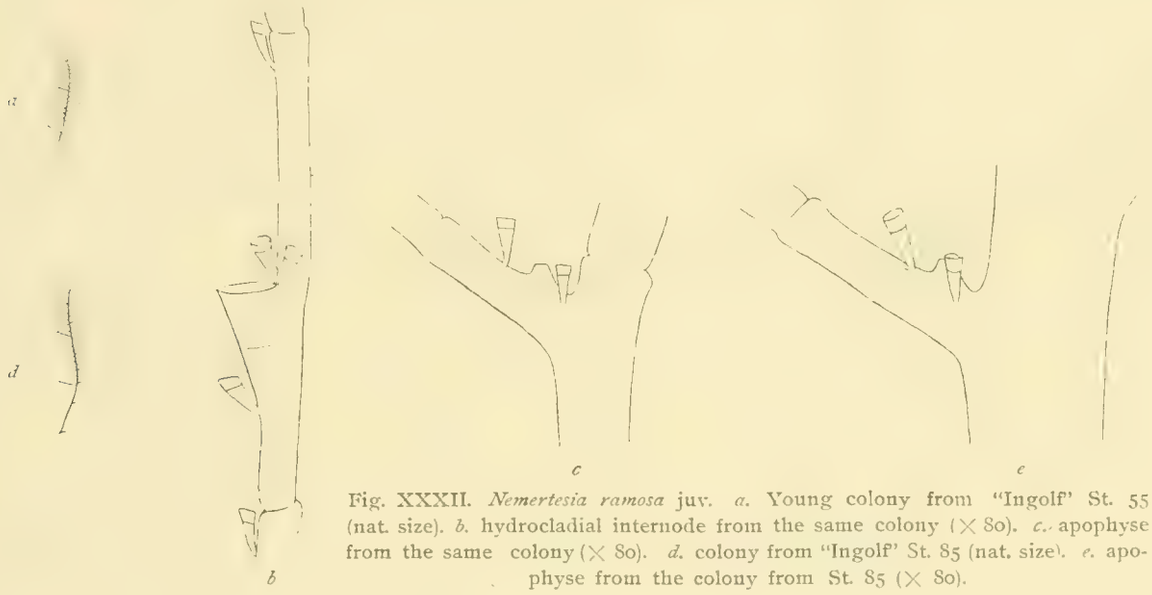

Fig. XXXII. *Nemertesia ramosa* juv. *a*. Young colony from "Ingolf" St. 55 (nat. size). *b*. hydrocladial internode from the same colony (× 80). *c*. apophyse from the same colony (× 80). *d*. colony from "Ingolf" St. 85 (nat. size). *e*. apophyse from the colony from St. 85 (× 80).

features of considerable interest. The distal part of its ramifications exhibits the same structure as *Nemertesia antennina*, having, inside the homogeneous peridermal chitinous sheath, coenosarc strings; these parts of the stem are thus canaliculate. Farther down, however, we find secondary tubes closely arranged about the primary stem tube, and the nearer we come to the base, the closer is the network and the thicker the stem. Where these secondary tubes occur, they cover the apophyses more and more, finally burying them altogether, while the hydrocladia here also fall away. Consequently, the basal part of well-developed colonies of *Nemertesia ramosa* lacks hydrocladia, whereby the colony assumes a highly peculiar appearance.

At a couple of the "Ingolf" stations, some quite small colonies of *Nemertesia ramosa* were found; these serve well to show the difficulty of distinguishing the young stages from *Plumularia* (fig. XXXII). The smallest colony (*a*) is altogether pinnate; the thin stem is divided into irregular internodia with a varying number of apophyses, but closer investigation shows that the apophyses do not form two regular longitudinal rows, being as a matter of fact alternately somewhat displaced to one side or the other, so that we have here a slight approach to quadriserial arrangement. A somewhat larger colony (*d*), where the stem is slightly thicker, reveals more clearly the displacement of

the apophyses, which is here evident at the first glance. In this case, it would scarcely be possible for anyone to doubt that the specimen is a young *Nemertesia*, the more so since the stem is strikingly thick. Further confirmation is in both instances afforded by the branch apophyses (*c* and *e*); in both colonies we find the characteristic "mamelon" on the upper side of the apophyse, close to the stem, which proves that they belong to the *Nemertesia*. The entire arrangement of the hydrothecæ and sarcothecæ also shows that the species is *Nemertesia ramosa*.

The stages found already show that the younger *Nemertesia* are throughout constructed after the *Plumularia* type, with biserial apophyses, and that *Nemertesia* must be derived from *Plumularia*. It would further seem to suggest that *Plumularia caulitheca* Fewkes is probably a young stage of a

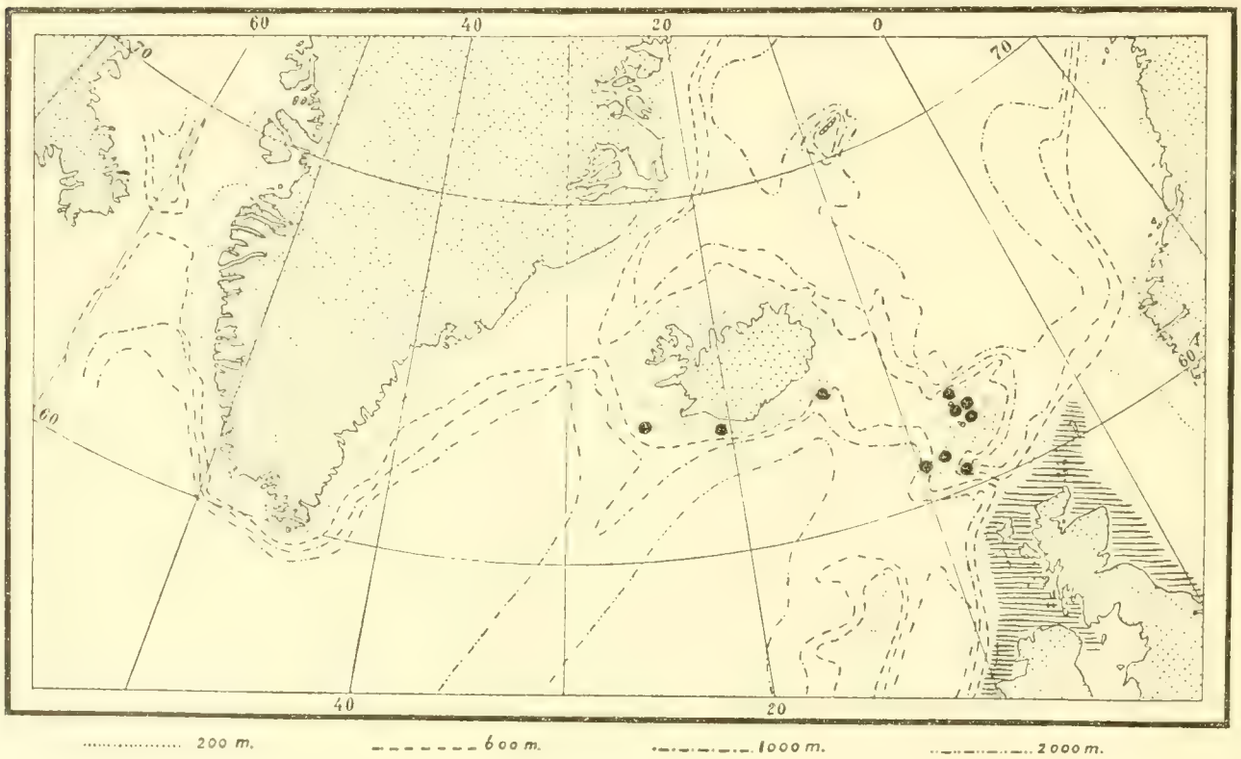

Fig. XXXIII. Occurence of *Nemertesia ramosa* in the Northern Atlantic.
In the hatched region the literature notes a common occurrence.

Nemertesia. And it is likely that also other *Plumularia* species in reality cover young *Nemertesia* species, and should, from the presence of a "mamelon", be transferred to that genus.

Among the synonyms of *Nemertesia ramosa* should also be reckoned *Antennularia variabilis* Broch. The defective specimens, where only the chitinous parts are preserved, have lost all their sarcothecæ, so that only a hole in the periderm, or a slightly raised part here and there, shows where the sarcothecæ have been. The difficulty of discerning these remains has led to their being regarded as variable in number, and the remains or traces of supracalycine sarcothecæ had altogether escaped attention. Otherwise the colonies agree entirely with *Nemertesia ramosa*, and must thus be referred to that species.

Nemertesia ramosa has its chief occurrence in the littoral region, especially in the middle and

lower parts of the same; it has been met with once or twice quite deep down in the abyssal region, as for instance on the "Thor" expedition, when it was taken near the Faroe Islands at 872 metres, probably the greatest depth from which the species has hitherto been recorded. *Nemertesia ramosa* belongs to the warmer parts of the Atlantic, and penetrates thence (fig. XXXIII) in great numbers into the southern part of the boreal region. The species has not hitherto been found in Greenland waters, but is recorded from one or two places on the south coast of Iceland. Round the Faroe Islands, it is seen to be of very frequent occurrence, and is said by Hincks (1868 p. 283) to be more numerous even than *Nemertesia antennina* on the coasts of Scotland. The species has not yet been located with certainty on the Norwegian coasts, but its occurrence in the Skagerak (Broch 1905 p. 24) and Bohuslän (Jäderholm 1909 p. 105) suggests that it will probably be found to occur there.[1]

Polynemertesia nov. gen.

Upright colonies with distinct, branched main stem, exhibiting segmentation in its monosiphonic parts; the stem is furnished with alternating strong apophyses which bear finely built hydrocladia. The hydrocladia are secondarily branched. The apophyses — both those of the primary and those of the secondary hydrocladia — are furnished on their upper side, near the point of origin, with a short sessile sarcotheca, "mamelon"; all the remaining sarcothecæ are mobile. The primary and secondary hydrocladia are segmented, and bear several hydrothecæ, which are as a rule fused throughout their entire length with the branch.

It is with considerable hesitation that I have established this new genus for *Plumularia gracillima* G. O. Sars. Previous investigators have overlooked the presence of a "mamelon" on the apophyses, in virtue of which the species must be separated from the *Plumularia*. With its secondary ramification of the hydrocladia, however, the species stands in the same relation to *Nemertesia* as *Polyplumaria* to *Plumularia*. A separation of the two latter genera therefore logically demands a like separation between the parallel groups of *Nemertesia* and *Polynemertesia*. The fact that the primary apophyses in the only known species are biserially arranged on the hydrocaulus must be regarded as of minor importance.

[1] It might be thought more reasonable here to revive an older name for the genus in question; it should then be *Diplopteron* or *Schizotricha*. The former, however, has already been withdrawn by Allmann himself (1883 p. 30) as synonymous with *Polyplumaria*; Nutting's attempt to revive it (1900 p. 81) can only be explained as due to his having taken as basis for the generic division a character which should otherwise be used only with caution even in distinction between species, as in all probability, it would seem that the type species for *Polyplumaria* and *Diplopteron* are very nearly identical. And with regard to *Schizotricha* it should be borne in mind that both the two species originally placed by Allman (1883 p. 28) in this genus must be referred to *Polyplumaria*. It would thus be incorrect to take as the type a species which has not from the first been ascribed to this genus; *Plumularia gracillima* G. O. Sars is first placed under this head by Nutting (1900 p. 80). Of the remaining species which have been referred to this genus, *Schizotricha bifurca* Hartlaub and *Schizotricha*

[1] After the close of the manuscript a find of the species in the Trondhjem fjord has proved the correctnes of this supposition.

antarctica Jäderholm must doubtless be removed to a genus of their own, more closely related to *Kirchenpaueria*. It would thus not be advisable to introduce a new diagnosis for *Schizotricha*; the genus should rather be allowed to disappear definitely as synonymous with *Polyplumaria*, which latter generic appellation is older, and originally better defined. For *Plumularia gracillima* G. O. Sars therefore, it will be best to take an entirely new generic name.

Polynemertesia gracillima (G. O. Sars).

1873 *Plumularia gracillima*, G. O. Sars, Bidrag til Kundskaben om Dyrelivet paa vore Havbanker, p. 86.
1893 *Plumularia groenlandica*, Levinsen, Meduser, Ctenophorer og Hydroider, p. 63, tab. VIII, figs. 10—12.

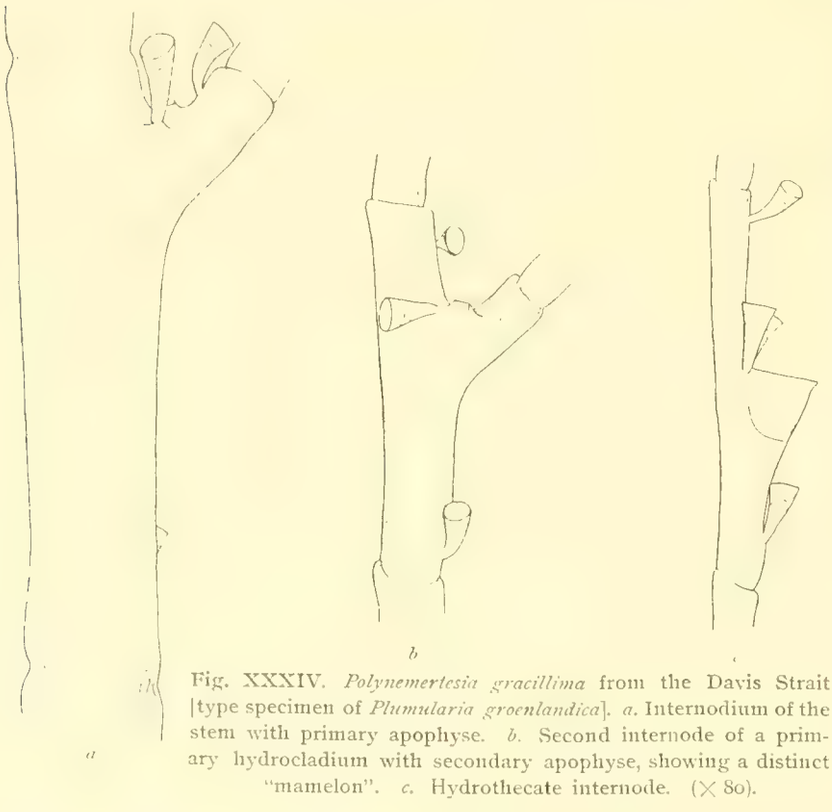

Fig. XXXIV. *Polynemertesia gracillima* from the Davis Strait [type specimen of *Plumularia groenlandica*]. *a*. Internodium of the stem with primary apophyse. *b*. Second internode of a primary hydrocladium with secondary apophyse, showing a distinct "mamelon". *c*. Hydrothecate internode. (× 80).

Single pinnate colonies with monosiphonic or in the basal parts polysiphonic main stem. The monosiphonic stem is divided by transverse nodes into internodia, which bear distally a short apophyse, directed obliquely forward, turning alternately to either side of the median line. The stem has no hydrothecæ, but bears mobile sarcothecæ, two unpaired, somewhat asymmetrically arranged on the basal part of each internodium. The apophyse has a "mamelon" on its upper side near the stem; beside this on the rear side a mobile sarcotheca, and also an unpaired mobile sarcotheca distally in the median line. The apophyse bears a secondarily branched hydrocladium; the hydrocladium is divided by transverse nodes into irregular internodia, of which every alternate one bears two unpaired sarcothecæ in the median line, every other a median hydrotheca, a supracalycine pair of sarcothecæ at the opening of the same, and an unpaired proximal, and as a rule an unpaired distal sarcotheca in the median line; on the distal parts of the hydrocladia the hydrothecaless internodium often melts into the hydrotheca-bearing internodium. The basal internodium of the hydrocladium is hydrotheca-bearing; the following small internodium is furnished at the middle with an apophyse directed obliquely forward and bearing the secondary hydrocladium; from the second segment of the latter there proceeds as a rule a further hydrocladium in the same manner; these secondary (tertiary) apophyses also are provided with a "mamelon" and two mobile sarcothecæ, as in the case of the primary apophyse. The secondary hydrocladia are of the same structure as the primary. The hydrothecæ are small, with slightly outward curving opening margin, and are throughout their entire length fused with the internodium.

The gonothecæ are attached to the apophyse beside the sessile sarcotheca. Fully grown gonangia have not yet been found.

Material:

"Ingolf" St. 27 64°54′ N., 55°10′ W., depth 393 fathoms 3,8°
— - 34, 65°17′ N., 54°17′ W., — 55 —
Greenland: Davis Strait (without further details) [type specimens of *Plumularia groenlandica*].
Iceland: Ingolfshöfdi 9½ miles in N. by E. ½ E., depth 53 fathoms.

Levinsen (1893 p. 63) gives a very detailed description of this species, which he incorrectly regards as different from Sars's *Plumularia gracillima*. He has however, in common with others who

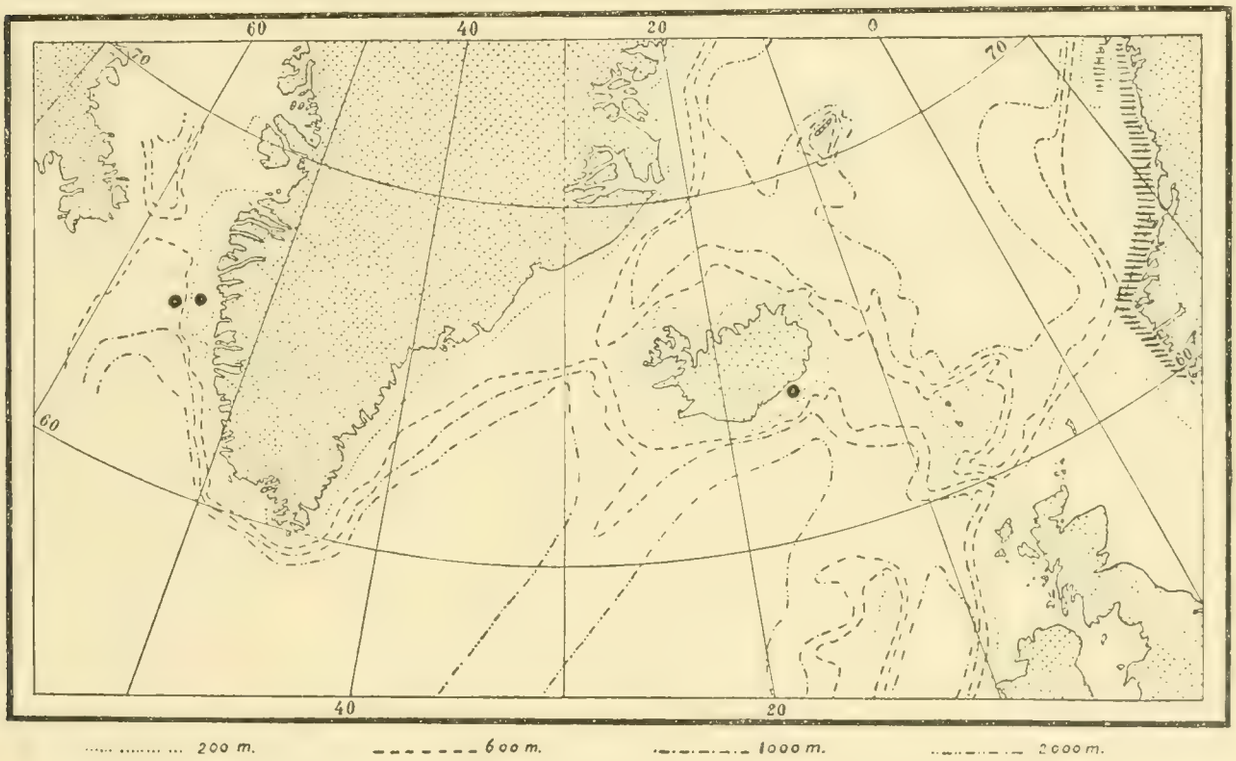

Fig. XXXV. The localities of *Polynemertesia gracillima* in the Northern Atlantic.
In the hatched region the occurrence according to the literature is common, although scattered.

have investigated the species, overlooked its typical sessile sarcotheca on the apophyses (fig. XXXIV) It is noticeable that a mamelon occurs not only on the primary but on all the apophyses in the colony. The idea that it should, as Nutting (1900) believes to be the case with other species, form the point of origin of the gonothecæ, is due to inadequate investigation; the gonothecæ have their point of attachment by the side of this sarcotheca. Levinsen's description incorrectly gives the impression that he has had grown gonothecæ before him at the time; they are, however, only quite young stages, and grown gonangia have thus not been described for this species.

Polynemertesia gracillima is plainly a southern visitor to the northern waters, and has strangely enough not yet been recorded in the British waters (fig. XXXV). The "Ingolf" was able to furnish

further data as to the occurrence of the species at West Greenland, where it penetrates right into the Lille Hellefiskebanke. On a single occasion it has been found in Iceland waters. On the coast of Norway it has been met with now and then between Lofoten and Stavanger. It has also been found off Bohuslän (Jäderholm 1909 p. 108). The species belongs to the lower part of the littoral region, and the upper parts of the abyssal.

Family Aglaopheniidæ.

The hydrothecæ are large, with distinctly bilateral structure, sessile, and with the one side wholly or partly fused with the branches. The diaphragma is assymmetrical or bipartite. The polyps can retire altogether into the hydrothecæ. The sarcothecæ are sessile, immobile and well developed; exceptionally we may find, in addition, also mobile, stalked supracalycine sarcothecæ. The hydrotheca margin is as a rule furnished with teeth. The colonies are monopodial with terminal growth point. The endoderm of the polyps is divided into a fore-stomach and a digestive part; the ectoderm often gives off an ectoderm lamella which fastens the polyp to the ribs of the hydrotheca.

The division of this family is based chiefly upon the nature of the gonangia and the protective formations which are richly and variously developed in the different genera. Primitive in this respect is *Halicornaria*, from which the remainder are derived. On the one side, there is a development towards *Nematocarpus*, where the hydrocladia are secondarily branched, though without discernible relation to the gonangia. On the other arise, in all probability separately, the phylactogonia-bearing genera *Aglaophenopsis* and *Cladocarpus*, typical deep sea genera, of which the former has hydrotheca-bearing phylactogonia, the latter, on the other hand, only sarcotheca-bearing phylactogonia. Possibly also, the corbula-bearing genera *Thecocarpus* and *Aglaophenia* should be derived from these, but their origin is not yet certain.

Gen. Halicornaria (Busk).

Upright colonies with branched or unbranched main stem, the apophyses of which bear unbranched hydrocladia with several hydrothecæ. All sarcothecæ are immobile. The gonangia are situate on the stem or branches without protective organs of any kind.

Halicornaria campanulata (Ritchie).

1912 *Cladocarpus* (?) *campanulatus*, Ritchie, Some Northern Hydroid Zoophytes, p. 226.

The colony is doubly pinnate, with polysiphonic branched main stem, which consists in its extreme portions of the primary segmented tube alone. This has internodia of medium length, which bear about the middle a short, but quite broad apophyse; the internodium is further provided with a pair of sarcothecæ at the upper side of the apophyse, and an unpaired median sarcotheca in front at its lower side; the sarcothecæ are almost tubulous, adcaulinally split. The hydrocladia have on each internodium a broad, and not particularly large hydrotheca and three sarcothecæ; a supracalycine pair at the opening, and a median proximally, which with its opening margin reaches up to the bottom

of the hydrotheca. All the sarcothecæ are adcaulinally split, and have a slightly dentate margin. The hydrotheca is broad, and has a very slightly curved opening margin; its basal part has a somewhat thicker wall than the distal two-thirds, and the boundary between the two portions is apparent as a fine line abcladially directed obliquely forward towards the opening; hydrothecal ribs or septa lacking. The internodium shows two to four inner ribs at the adcladial side of the hydrotheca; one such, which is three-branched, and markedly prominent, forms a boundary between the proximal sarcotheca and the internodium.

The gonothecæ are situate on the stem at the apophyses. The young gonotheca shows distally a peculiar oblique termination, the one side of which gradually projects further forward, suggesting that the fully developed gonotheca would be furnished with a roof-like upper lip. Phylactogonia lacking.

Material:

"Ingolf" St. 127 66°33′ N., 20°05′ W., depth 44 fathoms, 5,6°
Iceland: Tistil fjord, 66°43′ N., 14°53′ W., — 78 —

Ritchie (1912 p. 226) refers this species to *Cladocarpus*, but with a query, as he did not find gonangia in his specimens. These agree entirely with the present colonies (fig. XXXVI) which, from the comparatively short, broad hydrothecæ, can hardly be confused with other species from northern waters. The colonies in question show that the species should be placed under *Halicornaria*. The gonangia occur in several stages of development, but none fully developed. The series of phases represented in the colonies investigated are entirely parallel to what we find in *Cladocarpus integer* (G. O. Sars); the oldest stage also seems to show that it developes, as does the species mentioned, an "upper lip" which will dome out more or less over the opening; further investigations must determine, how far the development proceeds.

Fig XXXVI. *Halicornaria campanulata* from "Ingolf" St. 127. Hydrothecate internodium from a hydrocladium in side and front view. (× 60).

Phylactogonia are altogether lacking in the colonies here concerned, and the species must consequently be regarded as a *Halicornaria*; there is, however, the possibility that it may later prove to be a primitive *Cladocarpus*. The otherwise close resemblance of the species to *Cladocarpus integer* would also seem to point in the same direction; the last-named species has hitherto likewise been regarded as a *Halicornaria*, but, as is further explained below, it is as a matter of fact a primitive *Cladocarpus*, whose phylactogonia do not always or everywhere attain development. We cannot therefore altogether disregard the possibility that *Halicornaria campanulata* may also under normal conditions develope more or less regularly occurring phylactogonia. But as long as this has not been shown to be the case, the species must remain in the genus *Halicornaria*.

Ritchie (1912 p. 227) could not state the locality of origin of the species nearer than "from the neighbourhood of Iceland", which from a bio-geographical point of view is very meagre information indeed. The localities now recorded are the more surprising, since we should *a priori* suppose

that we have to deal with a form from the warmer Atlantic regions; both the finds are in fact from near the north coast of Iceland. At the same time, however, it should be noted that both are situate in water of positive temperature; at the "Ingolf" St. 127 no less than 5,6°; it is thus not impossible that the occurrence of the species here is due to larval transportation from the Danmark Strait. Arctic the species certainly cannot be; even the one *Aglaopheniid* hitherto found in any number in arctic water layers, *Thecocarpus myriophyllum* (Linné) is not indigenous there. We must therefore regard the *Aglaopheniida* on the whole as southern visitors in the colder northern seas. *Halicornaria campanulata* must likewise be placed in this category; its true home, however, has yet to be discovered.

Nematocarpus nov. gen.

Singly or doubly pinnate colonies, the apophyses of the primary stem tubes bearing hydrocladia, which in fully developed colonies are secondarily branched. All sarcothecæ immobile. The secondary hydrocladium is formed from the proximal sarcotheca branch on the primary, and stands in no relation to the gonangia. The latter are not surrounded by any protective organs.

This peculiar genus is known only in a single species, originally described as a *Halicornaria* by Allman (1874 p. 477). In Nutting's diagnosis of this genus (1900 p. 126) we find "Hydrocladia not branched; hydrocladial internodes without septa". The latter point is of minor importance even in distinction of species, but the first-mentioned character is also adopted by Stechow (1913 p. 43) "Hydrocladien einfach".

On the other hand, we may with some justification maintain that the genus *Aglaophenopsis* (Fewkes) is based on forms with branched hydrocladia. We must, however, here note a great difference in comparison with *Halicornaria ramulifera* Allman; the secondary branches in *Aglaophenopsis* are hydrotheca-bearing phylactogonia, and stand thus in definite relation to the gonangia; in this case, however, they have nothing to do with the gonangia, and do not develope into minor branches, as in *Aglaophenopsis*, but into secondary hydrocladia of the same structure and appearance as the primary. This difference is important, inasmuch as we should, as Bale already (1887) pointed out, establish a new genus on the basis of the same. The nearest related genera are *Halicornaria*, *Aglaophenopsis*, and *Cladocarpus*, where we often, especially in the two last, find the same structure of the gonotheca as in the known *Nematocarpus* species.

Nematocarpus ramuliferus (Allman).

1874 *Halicornaria ramulifera*, Allman, Report on the Hydroida .... Porcupine, p. 477, pl. 67, fig. 3.
1903 *Halicornaria pluma*, Broch, Die von dem norwegischen Fischereidampfer "Michael Sars" .... gesammelten Hydroiden, p. 8, Taf. IV, figs. 15—21.

Doubly pinnate colonies, with somewhat irregularly branched, polysiphonic main stem. The primary tube is segmented, and has on the middle of each internodium a strong apophyse, directed alternately to each side, and a pair of sarcothecæ at the upper side of the apophyse; the sarcothecæ are adcaulinally split. From the apophyse proceeds a hydrocladium, bearing a hydrotheca on each

internodium, surrounded by a pair of supracalycine sarcothecæ on the distal part of the internodium and an unpaired median proximally; between this and the base of the hydrotheca arises a sarcotheca-bearing branch, which bends forward over the hydrotheca, and has on its convex (outer) side a row of sarcothecæ. The sarcotheca-bearing branch of the basal hydrotheca developes into a secondary hydrocladium of the same appearance as the primary, but somewhat finer. Also in the exterior sarcothecal branches hydrothecæ may be developed. The hydrothecæ are fused throughout their basal half with the branch; the distal portion forms an angle with the basal, and widens somewhat towards the aperture. The margin is furnished with 9 or 11 teeth; a large median proximal (abcladial), beside this as a rule a couple of smaller ones, then two well marked, and finally there are distally (adcladially) a pair of large teeth of the same size as the proximal, and between them a couple of quite small ones.

The gonothecæ are attached by a short, often almost rudimentary stalk to the stem; viewed laterally, the gonotheca is asymmetrically egg-shaped or oval, with a distal lateral opening; seen from the front, they are oval, distally often broadly rounded; the aperture is round. At times there may be some approach to formation of an "upper lip" above the mouth.

Material:

"Ingolf" St. 44 61°42′ N., 9°36′ W., depth 545 fathoms 4,8°
— - 98 65°38′ N., 26°27′ W., — 138 — 5,9°

The new colonies brought home by the "Ingolf" show that the *Halicornaria pluma* Broch (1903 p. 8) described as distinct species is really only a somewhat older stage of *Nematocarpus ramuliferus* (Allman); we have now colonies showing the next stages through which they pass over to the possession of secondarily branched hydrocladia (fig. XXXVII *a*). Here also the species retains its peculiar nude posterior side, whereas the front appears even more furry than in young colonies. There are certain signs which seem to indicate that a primary hydrocladium may bear several secondary ones. *Halicornaria pluma* was established chiefly on the strength of the fact that the basal sarcotheca-bearing branch of the hydrocladium has a hydrotheca, whereas the remaining sarcothecal branches lack hydrothecæ. The present colonies now show that this was merely the forerunner of the secondary hydrocladium, which gradually developes new hydrothecæ with sarcotheca-bearing branches outside the first[1]. At the same time, however, we find a hydrotheca with its corresponding sarcothecal branch developed at the second, often also at the third hydrotheca, and it is therefore highly possible that in still larger colonies we may also here find developed secondary hydrocladia, showing that a primary hydrocladium can bear several secondary ones.

The gonothecæ are incompletely described both by Allman (1874 p. 477) and Broch (1903 p. 8) probably from imperfectly developed specimens. They are of very peculiar form (fig. XXXVII *b*). They are attached by a stalk which is not infrequently very short, almost rudimentary. The one (adcauline) side is somewhat flattened and short, the other however, highly curved and a good deal longer, so that the plane of the aperture is almost or entirely parallel with the longitudinal axis of

[1] In fig. XXXVII *a*, the secondary hydrocladium shows only one complete sarcothecal branch (the basal); this is due to the fact that the two next are broken off. Ordinarily, they appear in fully normal development at every single hydrotheca.

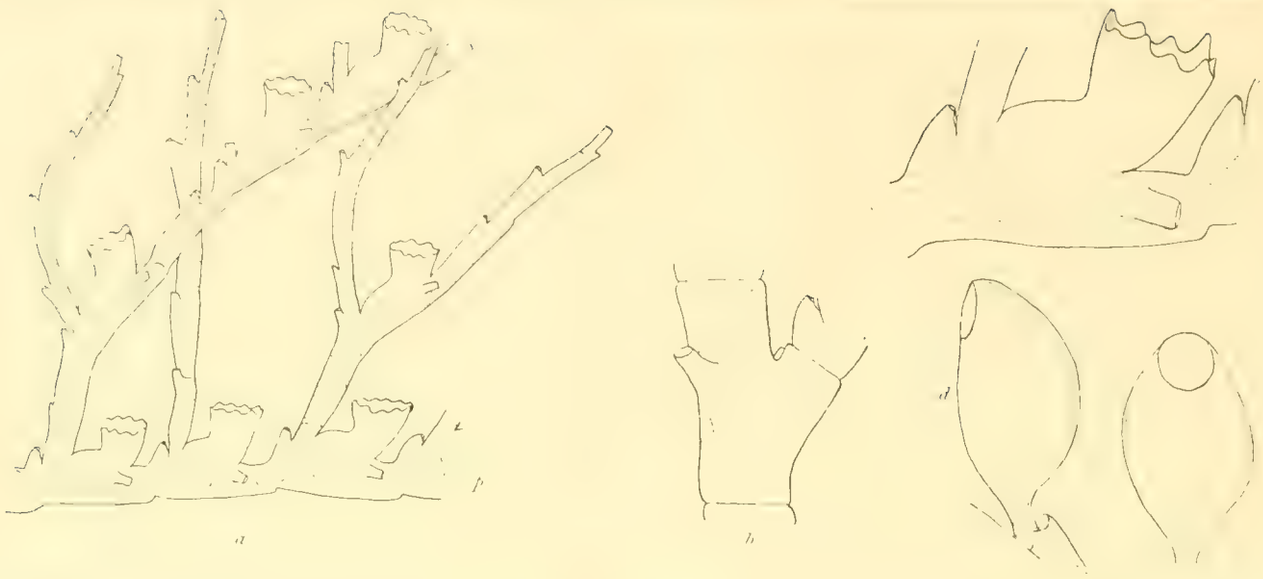

Fig. XXXVII. *Nematocarpus ramuliferus*. *a* basal part of a hydrocladium showing the development of the secondary hydrocladium [*p* primary, *s* secondary hydrocladium; the proximal, sarcothecal branch is a little abnormally developed]. "Ingolf" St. 44. *b* internodium of the primary tube of the stem of a young colony from "Ingolf" St. 98. *c* Hydrotheca, "Ingolf" St. 44. *d* Gonotheca in side view and front view, "Ingolf" St. 98. (*a* × 45, *b*—*d* × 90).

the gonotheca itself. The aperture is round or often somewhat broader, oval, and we thus find here a distinct approach to the remarkable form of gonotheca which occurs in all known forms of *Aglaophenopsis* and *Cladocarpus* species, save that a distinct upper lip is less often clearly discernible.

Nematocarpus ramuliferus was formerly only found in the cold area (fig. XXXVIII), but the two finds fall just in the zone where otherwise warmer atlantic, deeper-living visitors occur sporadi-

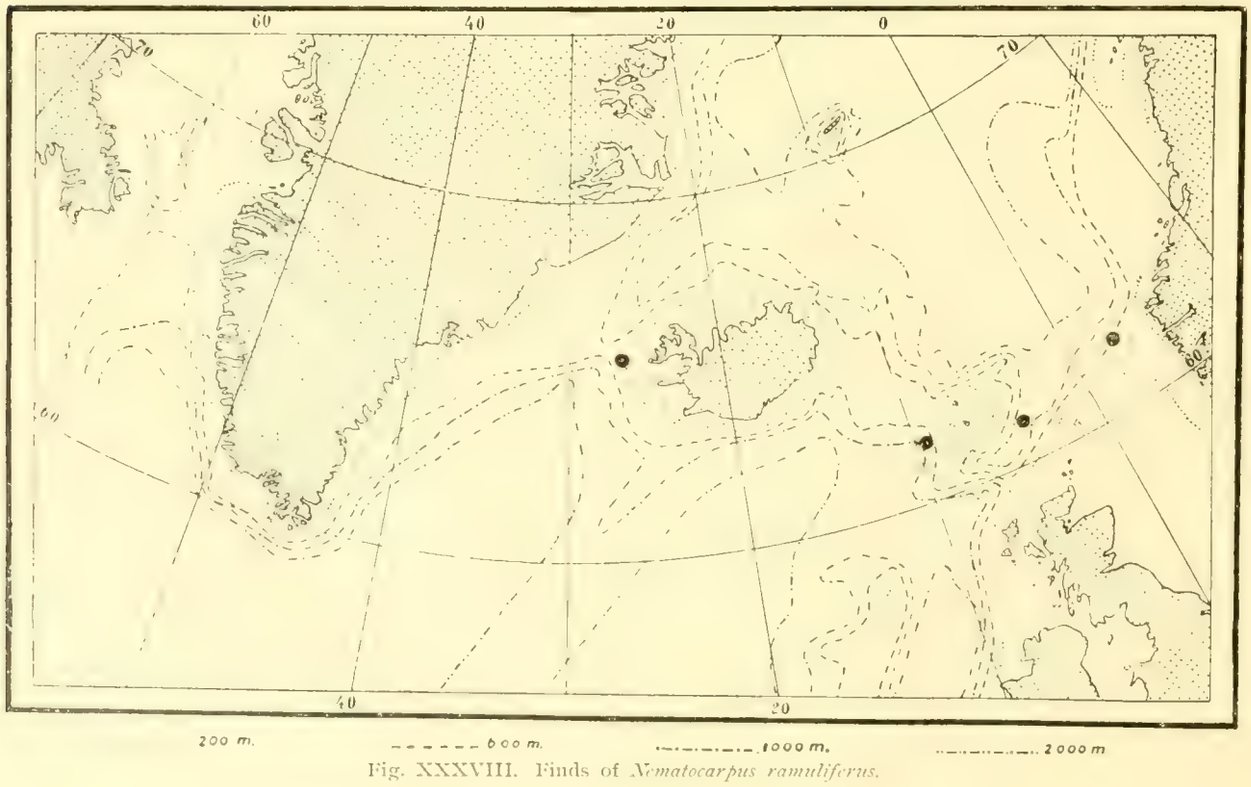

Fig. XXXVIII. Finds of *Nematocarpus ramuliferus*.

cally in the Norwegian Sea, and lie also comparatively near the submarine ridges. It was therefore most likely that the species should be reckoned, bio-geographically, as belonging to the class of such visitors, and the two new finds appear to confirm this supposition, both being situate in the warmer atlantic region; one on the slope down towards the Atlantic Deep, west of the Faroe plateau, and the other on the east side of the threshold in Danmark Strait, where several other warm-water species also come in. The last-named locality, with a depth of 138 fathoms, is the shallowest of the finds made; the others lie deeper down in the true abyssal region. We are therefore justified in concluding that the species belongs to the warmer and deeper atlantic communities.

Aglaophenopsis (Fewkes).

Upright colonies with branched or unbranched main stem, the apophyses bearing unbranched hydrocladia with several hydrothecæ. All the sarcothecæ are immobile. The gonothecæ are protected by minor branches forming a basal appendix to the hydrocladia, and with both hydrothecæ and sarcothecæ; the gonothecæ are situate on the stem or on the minor branches.

Practically speaking, this definition coincides with Nutting's limitation of the genus (1900 p. 118). Nutting also lays most stress upon the occurrence of the protective branchlets, but does not seem quite to have realised that the principal character for these lies in the fact that they bear hydrothecæ, not, as in the case of *Cladocarpus*, sarcothecæ only. *Aglaophenopsis* differs from *Nematocarpus* in principle by the fact that the minor branches do not develope into secondary hydrocladia of normal appearance, but merely appear as protective appendices in fertile colonies.

Aglaophenopsis-Cladocarpus form a pair of genera parallel with *Thecocarpus-Aglaophenia*. As a matter of fact, we cannot determine which of the two in each case is the more primitive; having regard, however, to the development of a species such as *Nematocarpus ramuliferus*, which appears to be more primitive than the others in the state of its gonangia, we must probably incline to the theory that *Cladocarpus* and *Aglaophenia* are the more primitive, rather than the more highly developed. Still, we can hardly in either case regard the one genus as derived from the other; it would seem more likely that each has arisen independently.

Aglaophenopsis cornuta (Verrill) Nutting.

1879 *Cladocarpus cornutus,* Verrill, Notice on recent additions to the marine fauna, p. 310.
1900 *Aglaophenopsis cornuta,* Nutting, Plumularidæ, p. 120, pl. 30, figs. 6–9.

Colonies doubly pinnate, with branched polysiphonic main stem, monosiphonic in its extreme portions. The primary stem tube is divided into short internodia, bearing in the middle an apophyse directed obliquely forward and sideways, and three sarcothecæ, one pair nearest the upper side of the apophyse, and an unpaired one medially on the lower part of the internodium; all are split along the upper side, and project far forward, especially the paired ones. At the base of the apophyse, between it and the unpaired sarcotheca, there appears a pattern which must be interpreted as an abortive hydrotheca. The hydrocladia have on the rear side a markedly prominent keel; they are divided into short internodia, each bearing a large hydrotheca and three sarcothecæ, a supracalycine pair at the

opening, and a median proximal sarcotheca, the opening margin of which hardly reaches up to the middle of the hydrotheca; the sarcothecæ have a dentate margin, and project far forward; they are adcaulinally split. The hydrotheca is laterally compressed; seen from the side, it is egg-shaped and pointed at the lower end. The hydrotheca has abcaulinally a median keel, running out into a large, hollow, generally sharply horn-shaped tooth, the free projecting part of which may reach a length of up to $^2/_3$ that of the hydrotheca; the cavity forms a continuation of the lumen of the hydrotheca. The hydrotheca margin has at the base of the mentioned projection a median abcauline tooth, and on either side four teeth, which become broader and less pronounced nearer the hydrocladium. The internodium has four to six inner ribs at the hydrotheca wall; an inner rib also bounds the lumen of the proximal sarcotheca on its lower end. The hydrotheca lacks inner ribs or septa.

Fig. XXXIX. *Aglaophenopsis cornuta*. "Ingolf" St. 25. — *a*. Cauline internodium of the primary tube, showing both sarcothecæ of the upper pair. — *b*. Front view of the internode, showing the abortive hydrotheca at the base of the apophyse above the proximal sarcotheca. (× 40).

The gonothecæ are set on the stem, or more often on short, once dichotomically divided branchlets proceeding from the basal internodium of the hydrocladium beside its proximal sarcotheca; the small branches bear as a rule a hydrotheca on each branchlet; more rarely the one may have two hydrothecæ, the other one. The gonotheca is broad oval to pear-shaped; seen from the side it is somewhat more slender, with subterminal opening on the adcladial side and with a short upper lip, formed by the abcladial wall, which is domed forward roofwise over the opening.

Material:

"Ingolf" St. 15,	66°18′ N.,	25°59′ W.,	depth	330	fathoms	+0,75°
— - 25,	63°30′ N.,	54°25′ W.,	—	582	—	3,3°
- - 98,	65°38′ N.,	26°27′ W.,	—	138	—	5,9°
Greenland: Davis Strait,			—	100	—	(without further details)
	65°30′ N.,	55°36′ W.,	—	289	—	

In Nutting's description of *Aglaophenopsis cornuta* (1900 p. 120) there is a misunderstanding as to the cauline sarcothecæ, which he describes as follows: "cauline nematophores very large, one just at the base of each hydrocladium, another immediately below this, and a third, long and spur-like opposite the base of each hydrocladium". As regards the last sarcotheca (fig. XXXIX *a*) this is as a matter of fact one of a pair situate nearer the upper side of the base of the apophyse; both of them project far out from the stem, but on viewing the colony from the front (fig. XXXIX *b*) the one is hidden by the basal part of the hydrocladium. The lower, proximal sarcotheca is very broad, and does not project quite as much. The sarcotheca which Nutting mentions as just at the base of the hydrocladium, i. e. practically on the apophyse itself, must on the other hand be regarded as an abortive hydrotheca which has been checked in its development by the growth of the apophyse and hydrocladium; it bears no resemblance to the remaining sarcothecæ, and does not seem to be provided with any sarcostyle or nematophore. A point of great importance in this explanation is also the fact that the basal portion of large pinnate parts may be formed of internodia with hydrothecæ, but without

apophyses and hydrocladia; here again we find the supracalycine sarcothecæ particularly well developed, in the same manner as over the apophyse, and more than on the normal cladial internodia; at the same time there is not the slightest indication of any such pattern as that which Nutting has taken for a sarcotheca. The abortive hydrotheca probably forms a parallel to the apophysal "mamelon" in *Nemertesia* and *Polynemertesia*, and would seem to throw some light on its origin.

There is considerable variation in the appearance of the hydrothecæ (fig. XL) especially owing to the fact that the abcauline keel and its prolongation vary very greatly both in length and breadth; the outgrowth may be broad and blunt, or more slender, and running out to a point. It forms an incurvation in the wall of the hydrotheca; at its base, the hydrotheca is furnished with a sharply cut tooth, directed obliquely inward and forward, and between this and the internodium the edge shows

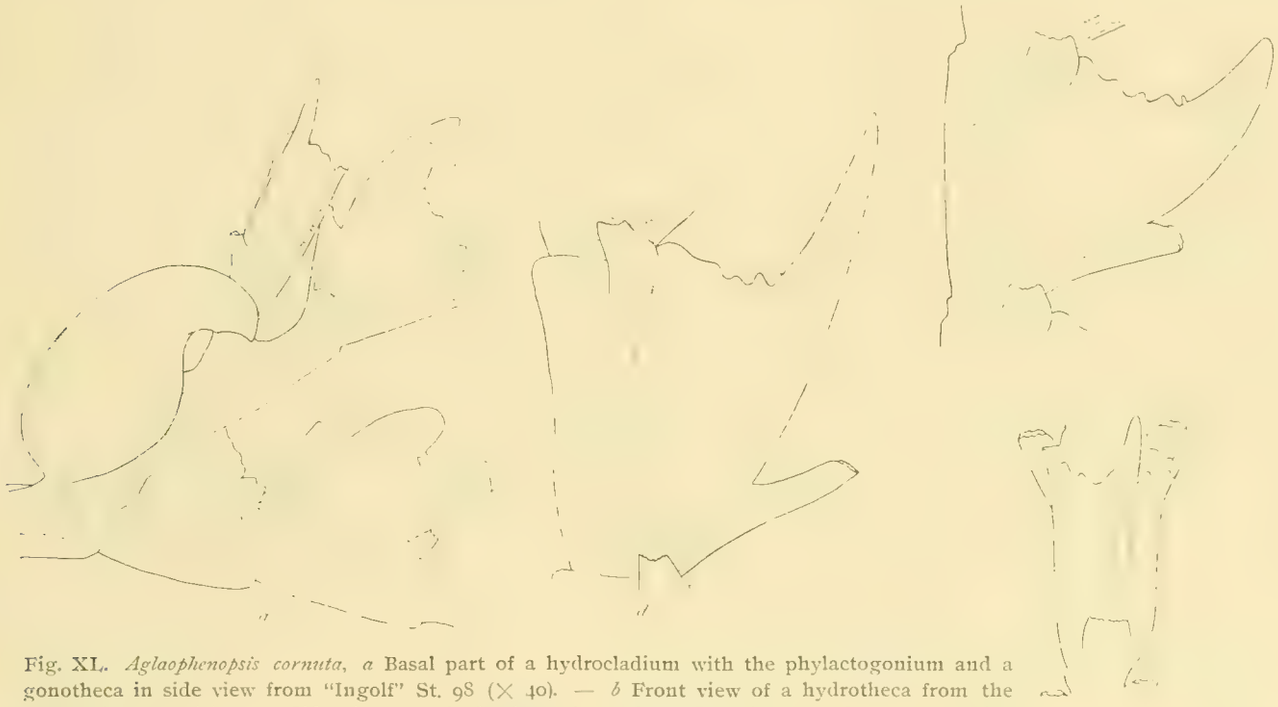

Fig. XL. *Aglaophenopsis cornuta*, *a* Basal part of a hydrocladium with the phylactogonium and a gonotheca in side view from "Ingolf" St. 98 (× 40). — *b* Front view of a hydrotheca from the same colony (× 60). — *c* Side view of a hydrotheca from the same colony (× 60). — *d* Hydrotheca from a colony from "Ingolf" St. 25, side view (× 60).

as a rule four teeth on either side, which become broader and lower nearer the hydrocladium. The innermost tooth on either side, and at times the one next to it, can even now and again be entirely effaced, so that only two abcauline teeth can be distinguished on either side. — The proximal sarcotheca also varies considerably, diverging now more, now less widely from the hydrotheca, and having a free portion of varying length.

The basal internodium of the hydrocladium has a different structure owing to the position of its proximal sarcotheca. This is shifted to the obliquely upward trending hydrocladium, — the side away from the stem — and is also somewhat smaller than on the following internodia. The cause of this must be sought in the growth of the phylactogonium.

The phylactogonium (fig. XL *a*) is segmented and has only hydrothecæ on two of its branches; on one of them at times two, but as a rule only one on each; they are surrounded by the usual three

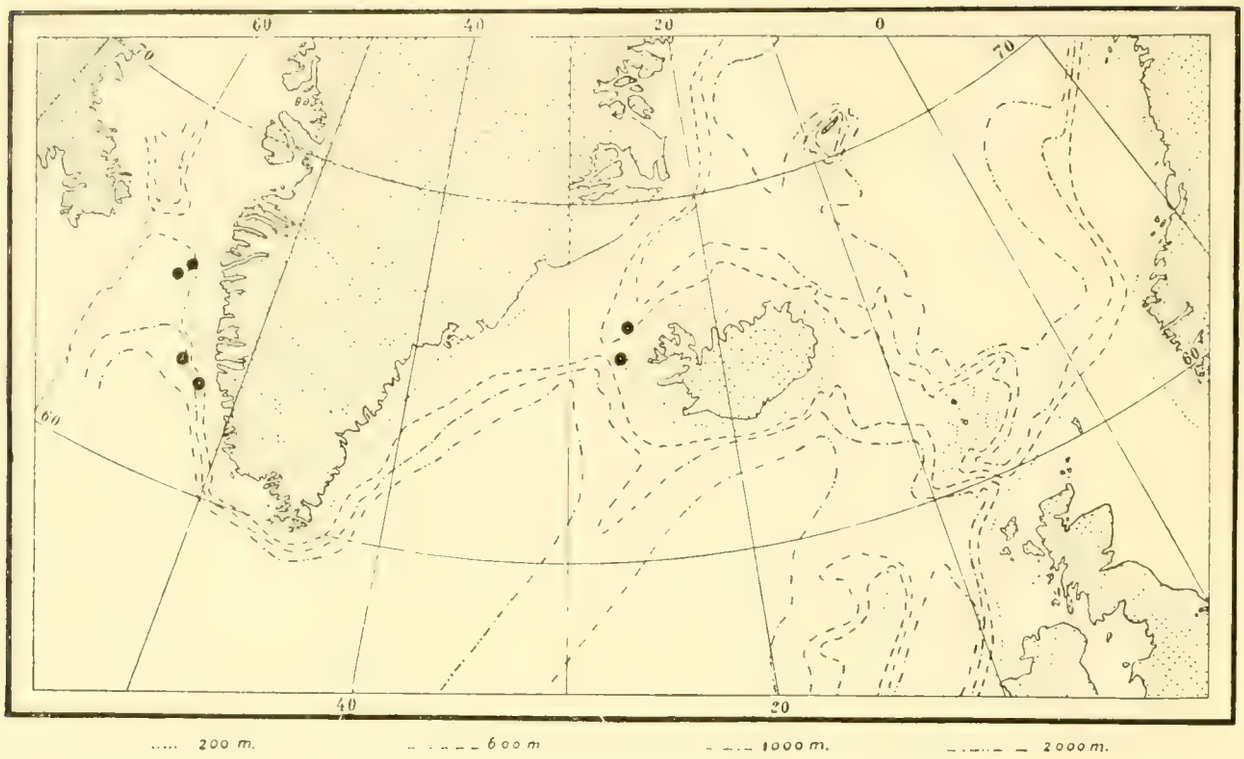

Fig. XLI. Finds of *Aglaophenopsis cornuta* in the Northern Atlantic.

sarcothecæ, which, however, are here generally somewhat smaller than on the hydrocladia. The gonotheca has a well developed upper lip, which does not appear clearly from Nutting's illustration and description. It is domed strongly forward, so that the aperture becomes turned down towards the base.

Aglaophenopsis cornuta is a typical deep-sea species which has only in Davis Strait been observed at 100, and in Danmark Strait at 138 fathoms depth; it can thus also penetrate up into the lower part of the littoral region. The species probably belongs strictly speaking to the warm, deep northern part of the Atlantic; it moves up into Davis Strait, where it appears to be of not infrequent occurrence (fig. XLI) and has now, as we see, also been recorded from Danmark Strait. As it is not known from other localities than those mentioned and the waters off Nova Scotia, we are justified in characterising it for the present as a west atlantic species.

Aglaophenopsis (?) pharetra n. sp.

The colony pinnate with polysiphonic stem, monosiphonic in the extreme portions, and having the primary tube indistinctly segmented. Each of the internodia of the stem bears at two thirds of its height a well defined, fairly short apophyse, and three unpaired sarcothecæ, two in the median line below the apophyse, and the third in the corner between the stem and the apophyse above the origin of the latter. The alternately placed hydrocladia form almost a right angle with the stem; they are divided into long internodia, each of which bears a hydrotheca, and three sarcothecæ, a supracalycine pair at the opening of the hydrotheca and an unpaired proximal about midway between the base of the hydrotheca and the proximal end of the internodium; the opening margin of the

proximal sarcotheca does not reach up to the base of the hydrotheca; all the sarcothecæ have a smooth margin and are adcaulinally split. The length of the hydrotheca is about three-fifths that of the internodium. The hydrotheca is of extremely slender build, not laterally compressed, somewhat expanded towards the opening; the opening margin is quite smooth. Numerous small inner ribs are found in the internodia along the hydrotheca wall; a rib also forms the lower boundary of the proximal sarcotheca.

Material:

"Ingolf" St. 81 61°44′ N., 27°00′ W., depth 485 fathoms, 6,1°.

Of this remarkable species we have only a single quite small colony, the height of which amounts to only about 2 cm. above the close rootlike network by which it was attached. The upper 6 mm. bear the hydrocladia, two fairly long on each side, and there is also, at the top of the colony on the left side, a third hydrocladium where the hydrotheca no 2 is still only indicated. On the lower part of the stem there is a secondary tube, which creeps upward along the lower 7 mm. of the primary, showing that the fully grown colony will exhibit a polysiphonic stem. The primary tube differs from that of most other species in the arrangement of the sarcothecæ (fig. XLII *a*); paired cauline sarcothecæ are lacking, but each internodium has three unpaired sarcothecæ; the two lower in the median line one above the other, and the third in the corner at the upper side of the apophyse.

Fig. XLII. *Aglaophenopsis (?) pharetra* from "Ingolf" St. 81. *a*. Internodium of the primary cauline tube with the apophyse. *b*. Internodium of the hydrocladium with hydrotheca in side view. *c*. Frontal view of hydrotheca and internodium. (× 60).

The hydrothecæ are very characteristic (fig. XLII *b*, *c*), in appearance not unlike a slender quiver, whence the species has been named *pharetra*. The opening margin is quite smooth, without indication of teeth or irregularities. The supracalycine sarcothecæ project somewhat up beyond the hydrotheca opening. The proximal sarcotheca is separated by a quite considerable interval from the hydrotheca.

As no indications of gonangia have yet been found, the systematic position of the species cannot yet be determined with certainty. It presents, however, a so considerable resemblance to *Aglaophenopsis Verrilli* Nutting that it should, for the present at any rate, be placed near this; the differences consist in the somewhat shorter and broader hydrothecæ of the latter species, where the opening is furnished with teeth, as also in the much shorter distance from the hydrotheca to the proximal sarcotheca. The species is therefore placed with a query in the same genus, under the name of *Aglaophenopsis (?) pharetra*. On the other hand, it also resembles not a little certain *Cladocarpus*

species such as *Cladocarpus tenuis* Clarke and *Cladocarpus flexuosus* Nutting. There is therefore the possibility that the species may have to be referred to this genus, and the query affixed to the generic name must remain for the present.

Only the one specimen was found, in the deep south west of Iceland. The locality suggests that we have here to deal with a warm-water form from the deep water of the Atlantic.

Cladocarpus Allman

Upright colonies with branched or unbranched main stem, the apophyses with unbranched hydrocladia with several hydrothecæ. All the sarcothecæ are immobile. The gonothecæ are protected by small branches, phylactogonia, which form a basal appendix to the hydrocladia, and are furnished with sarcothecæ, but lack hydrothecæ. The gonothecæ are set on the stem or on the phylactogonia.

Cladocarpus integer (G. O. Sars).

1874 *Aglaophenia integra,* G. O. Sars, Bidrag til Kundskaben om Norges Hydroider, p. 100, pl. 2, figs 11—15.

1879 *Cladocarpus Pourtalesi,* Verrill, Notice on recent additions to the marine fauna, p. 309.

1893 *Cladocarpus Holmi,* Levinsen, Meduser, Ctenophorer og Hydroider, p, 67, tab. VIII, figs. 15—18.

The colonies are doubly pinnate with branched polysiphonic main stem, exhibiting only in its very outermost parts the primary segmented tube alone; this has fairly short internodia, bearing on the basal third a strong but short apophyse; the internodium is also furnished with three adcaulinally split sarcothecæ, an unpaired median at the bottom, and a pair at the upper side of the apophyse. The internodium of the hydrocladium has a fairly large hydrotheca and three sarcothecæ, a supracalycine pair at the opening, and a median proximal sarcotheca, which with its opening margin hardly reaches up to the basal fourth of the hydrotheca; all the sarcothecæ approach the tubulous form, but are adcladially split. The hydrothecæ are laterally somewhat compressed, and slightly expanded at the opening; the opening margin, in the hydrothecæ as in the sarcothecæ, is quite smooth. The internodium exhibits one or two inner ribs at the hydrotheca wall, and two below the proximal sarcotheca.

The gonothecæ are fastened as a rule by a rudimentary stalk to the stem or to the phylactogonia, which are almost invariably unbranched, and have two irregular rows of sarcothecæ; the phylactogonium proceeds from the basal internodium of the hydrocladium, beside the proximal sarcotheca. The gonotheca is somewhat flattened; seen from the flat side it is broadly pear-shaped, broadly rounded distally; viewed laterally, it is a slender oval, with a distal lateral adcauline opening over which the abcauline wall domes out like an upper lip.

Material:

"Ingolf"	St.	25	63°30′ N.,	54°25′ W.,	depth	582	fathoms,	3,3°
—	-	27	64°54′ N.,	55°10′ W.,	—	393	—	3,8°
—	-	94	64°56′ N.,	36°19′ W.,	—	204	—	4,1°
—	-	98	65°38′ N.,	26°27′ W.,	—	138	—	5,9°

Greenland: Davis Strait, depth 80 fathoms (without further details) [type specimen of *Cladocarpus Holmi*]

Iceland: 5 miles E. of Seydisfjord, depth 135 fathoms [labelled *Cladocarpus Holmi*].

Cladocarpus integer has led a somewhat unsettled existence in various genera. G. O. Sars (1874 p. 100) regarded it as an *Aglaophenia*, and is followed by Bonnevie (1899 p. 93) who places all northern *Aglaopheniidæ* in this one genus. Jäderholm (1909 p. 109 and 110) refers to it either as *Halicornaria integra* or as *Cladocarpus Holmi* and *Cladocarpus Pourtalesi*, while Ritchie (1912 p. 228) classes the species under *Halicornaria*. A very rich material from the Trondhjem Fjord, where the species is found in great numbers, enabled me to study it further, and determine its systematic position. And it now turns out that the species must be regarded as a primitive *Cladocarpus*. The

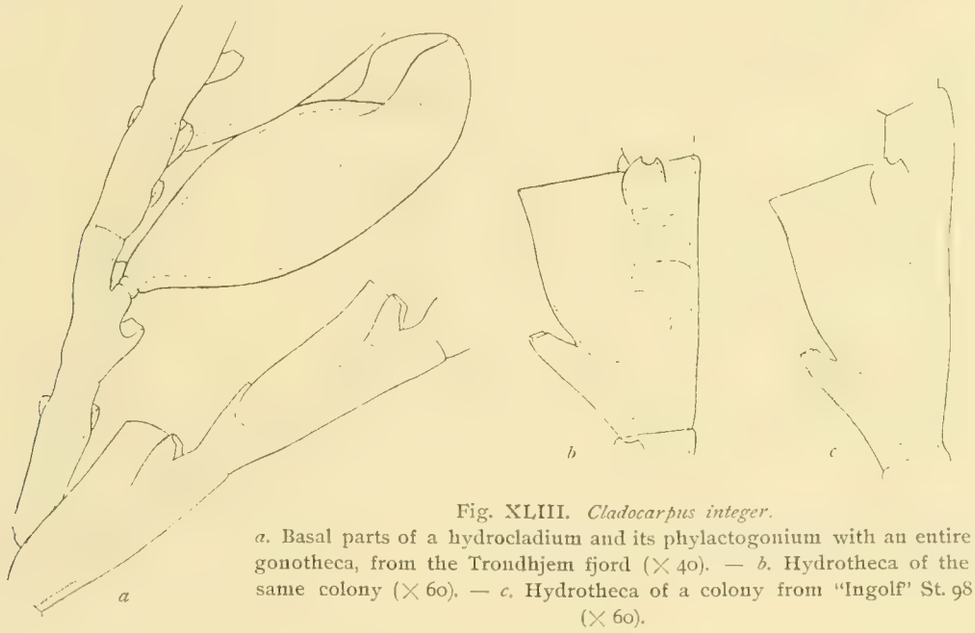

Fig. XLIII. *Cladocarpus integer*.
a. Basal parts of a hydrocladium and its phylactogonium with an entire gonotheca, from the Trondhjem fjord (× 40). — *b*. Hydrotheca of the same colony (× 60). — *c*. Hydrotheca of a colony from "Ingolf" St. 98 (× 60).

gonothecæ are very often fixed to the stem or more correctly, to the apophyses; Ritchie's descriptions show that this may often occur on the whole for an entire colony, and that the phylactogonia may in consequence be altogether lacking, which is also exceptionally found to be the case in some of the colonies from Trondhjem Fjord. The great majority of the colonies have, however, at any rate in considerable parts of each, developed primitive but typical phylactogonia (fig. XLIII *a*). These proceed from the basal internodium of the hydrocladium beside the proximal sarcotheca. The phylactogonia are practically always unbranched, and furnished with two somewhat onesidedly arranged rows of sarcothecæ, set either in pairs or irregularly placed; only once or twice have I found phylactogonia which had, by dichotomic division, developed a short lateral branch of the same structure. The phylactogonium also exhibits irregular segmentation. It has as a rule two or three gonothecæ on the same side as the sarcothecæ. The gonotheca is of the typical *Cladocarpus* form, with upper lip; this is, however, shorter than in most other species, so the opening is not yet directed downwards.

Ritchie's specimen (1912 p. 228) should, it would seem, be taken as the representative of a special variety *Ritchiei* nov. differing from the typical form in having the hydrotheca margin slightly

sinuous. The internodial ribs of this variety are also somewhat more strongly marked than in the common form, and it likewise shows a more pronounced indication of intrathecal septum.

The features mentioned, that the species can at times lack phylactogonia, show that *Cladocarpus Pourtalesi* must be considered as a synonym. The difference between this species and *Cladocarpus Holmi* is not apparent from Levinsen's description of the latter (1893 p. 67) and an investigation of the type specimens shows that the species has been founded on typical colonies of *Cladocarpus integer*.

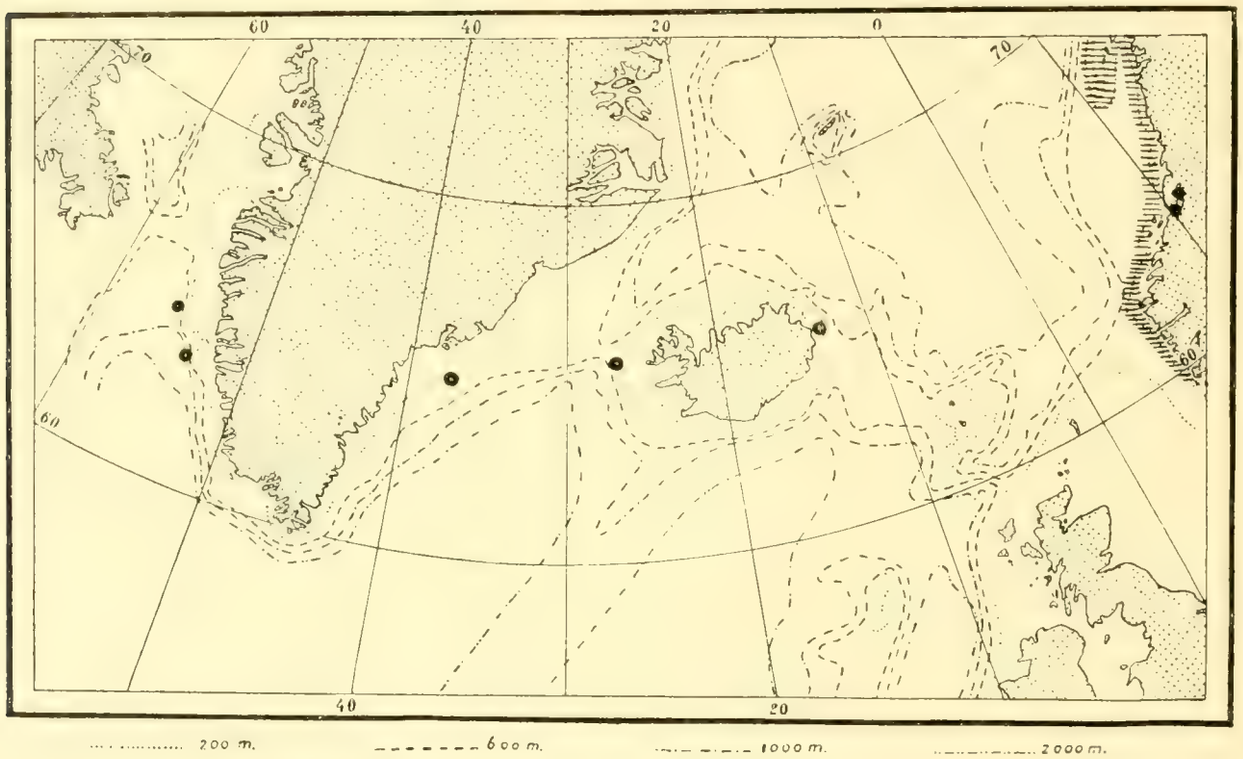

Fig. XLIV. The distribution of *Cladocarpus integer* in the northern Atlantic.
In the hatched regions the literature denotes a scattered occurrence.

The species is a typical warm atlantic form, which appears to have its chief occurrence in the western Atlantic, in the lower part of the littoral region and the upper part of the abyssal. In northern waters, it has long been known from the west coast of Norway, and is also found to be a not altogether infrequent visitor to Greenland, both in Davis Strait and up towards Danmark Strait (fig. XLIV). On one occasion, it was met with off the east coast of Iceland, at the boundary of the arctic deep region. That it has not yet been located with certainty between the British Isles and Iceland must be due to accident. Ritchie (1912 p. 228) had before him a specimen brought home by Hull trawlers, and we may doubtless presume that it would then have originated from the northern slope of the North Sea plateau or from the Faroe Islands Banks.

Cladocarpus formosus Allman.

1874 *Cladocarpus formosus*, Allman, Report on the Hydroida ..... Porcupine, p. 478, pl. 68, fig. 1.

1893 *Cladocarpus crenulatus*, Levinsen, Meduser, Ctenophorer og Hydroider, p. 68, pl. VIII, figs. 13—14.

The colonies have an unbranched or branched polysiphonic stem. The primary, foremost tube is divided into short internodia with a short apophyse directed obliquely forward and sideways, and three sarcothecæ, a pair at the upper side of the apophyse, and an unpaired median on the basal part of the internodium, all adcladially split. The internodia of the hydrocladium are short, and bear a large broad hydrotheca and three sarcothecæ, a supracalycine pair at the hydrothecal aperture, and

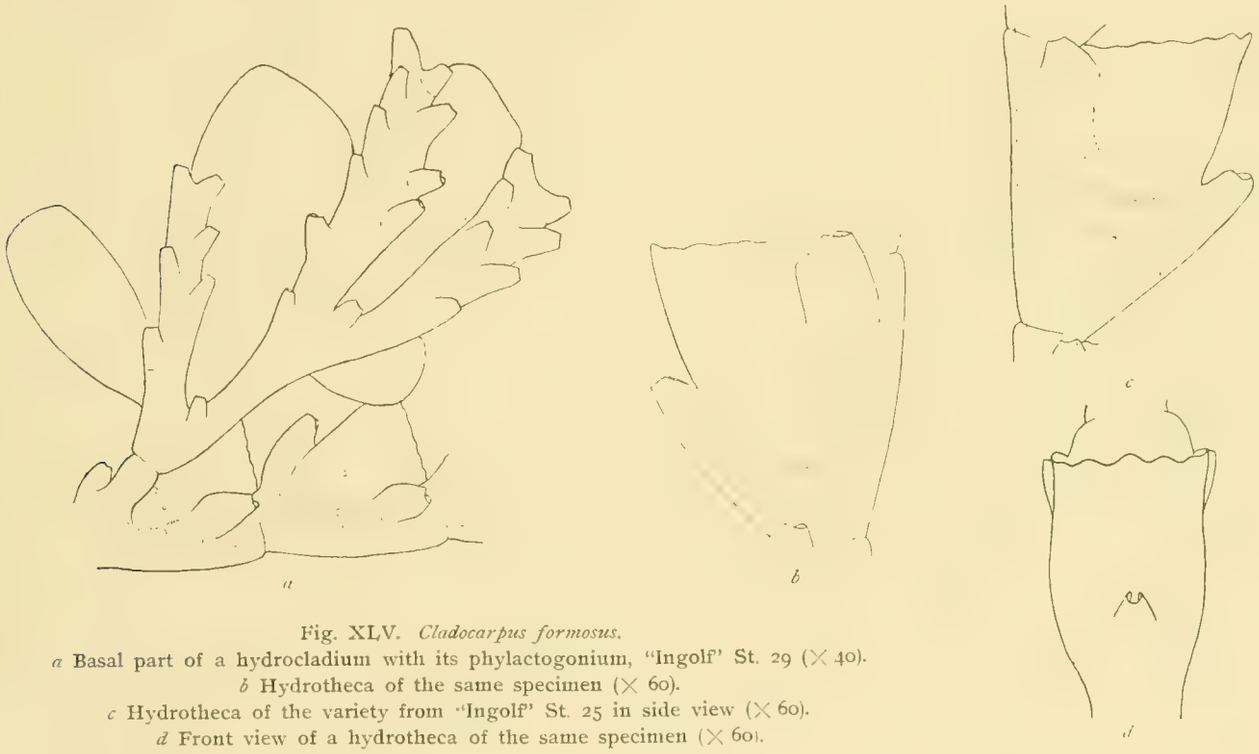

Fig. XLV. *Cladocarpus formosus.*
a Basal part of a hydrocladium with its phylactogonium, "Ingolf" St. 29 (× 40).
b Hydrotheca of the same specimen (× 60).
c Hydrotheca of the variety from "Ingolf" St. 25 in side view (× 60).
d Front view of a hydrotheca of the same specimen (× 60).

a median proximal, which reaches with its opening margin nearly up to the middle of the hydrotheca; the sarcothecæ have a slightly dentate margin, and are adcaulinally split. On the basal internodium of the hydrocladium, the proximal sarcotheca is divided off by an interval from the hydrotheca. The hydrothecæ are large, and nearly circular in transverse section, with an abcladial intrathecal septum; the opening margin is slightly sinuous, with more prominent teeth abcladially, and with a quite distinct abcladial median tooth.

The gonothecæ are situate on the stem or on the phylactogonia, which proceed from the basal internodium of the hydrocladium, at the interval between the hydrotheca and the proximal sarcotheca. The phylactogonia have, after two dichotomic divisions, three branches, and bear on their outer side two rows of paired or irregularly placed sarcothecæ. The gonothecæ are somewhat flattened, pear-shaped from the broad side, with transversely rounded distal part; seen from the side, with a terminal lateral opening over which one wall domes out in a markedly prominent upper lip.

Material:

"Ingolf" St. 25	63°30′ N.,	54°25′ W.,	depth	582	fathoms	3,3°
— - 29	65°34′ N.,	54°31′ W.,	—	68	—	0,2°
— - 34	65°17′ N.,	54°17′ W.,	—	55	—	
— - 93	64°24′ N.,	35°14′ W.,	—	767	—	1,46°
— - 97	65°28′ N.,	27°39′ W.,	—	450	—	5,5°
— - 127	66°33′ N.,	20°05′ W.,	—	44	—	5,6°

Greenland: Davis Strait, depth 80 fathoms (without further details) [type specimen of *Cladocarpus crenulatus*]

65°39′ N., 28°25′ W., depth 553 fathoms [type specimen of *Cladocarpus crenulatus*].

Cladocarpus formosus is described in detail by Ritchie (1909) from some colonies taken at about the same place as Allman's type specimens. Among the features which he here notes is the fact that the opening margin of the sarcothecæ is "serrate". Most of the present colonies fully agree with Ritchie's careful description. We have, however, from the "Ingolf" St. 25, in addition to many typical colonies, also some few of slightly different structure (fig. XLV). The hydrothecæ are here somewhat broader than the normal, the septum is set a little deeper down, and goes considerably farther in towards the adcladial side than in ordinary colonies of the species, while on the other hand the internodial ribs are less pronounced, and fewer in number. Furthermore, all the sarcothecæ here have smooth opening margin. The points of difference, as compared with the typical form of *Cladocarpus formosus*, are thus sufficiently marked; they are however, too slight to warrant our marking off a distinct species, since no other differences can be discerned. The colonies should thus merely be regarded as representatives of a special variety within the species.

Ritchie (1909 p. 314) points out that Levinsen's *Cladocarpus crenulatus* (1893 p. 68) must be regarded as a synonym of *Cladocarpus formosus*; and after having examined Levinsen's type specimens, I must entirely concur in this view. Bonnevie (1899 p. 95) mentions *Aglaophenia formosa* from a station near Spitzbergen; her description however, differs not a little from Allman's, and from those of later writers; in the first place, no mention is made of the intrathecal septum, in addition to which, the description of the hydrotheca as "almost cylindrical, regularly dentated round the margin" is hardly in accordance with what we otherwise know of the species; the published drawings (1898 Taf. 2, fig. 3) also differ somewhat, so that the identity of the colony seems doubtful. An investigation of the type specimen, however, shows that the intrathecal septum is present, and that the specimen only differs from the colonies here in question in the somewhat more distinct and regular dentition of the hydrotheca margin. In addition, one of the phylactogonia is pinnately branched, as in *Cladocarpus paradiscus* Allman, while the others are dichotomically branched.

Cladocarpus formosus is plainly one of the most common forms in the warmer tracts belonging to the upper part of the abyssal region in the North Atlantic (fig. XLVI) and penetrates thence up into the lower part of the littoral region. It is originally known from the southernmost part of the cold area, where the latter runs into the Faroe Channel, but should here be regarded as a visitor, brought in by larval transport with the Atlantic current. The species is previously known from

Davis Strait, from where the "Ingolf" brought back several colonies, and has now also been found in deeper water right up in the Danmark Strait. From here again, it may be transported into the waters along the north coast of Iceland, as shown by the find at the "Ingolf" St. 127, where the species occurs together with *Halicornaria campanulata.*

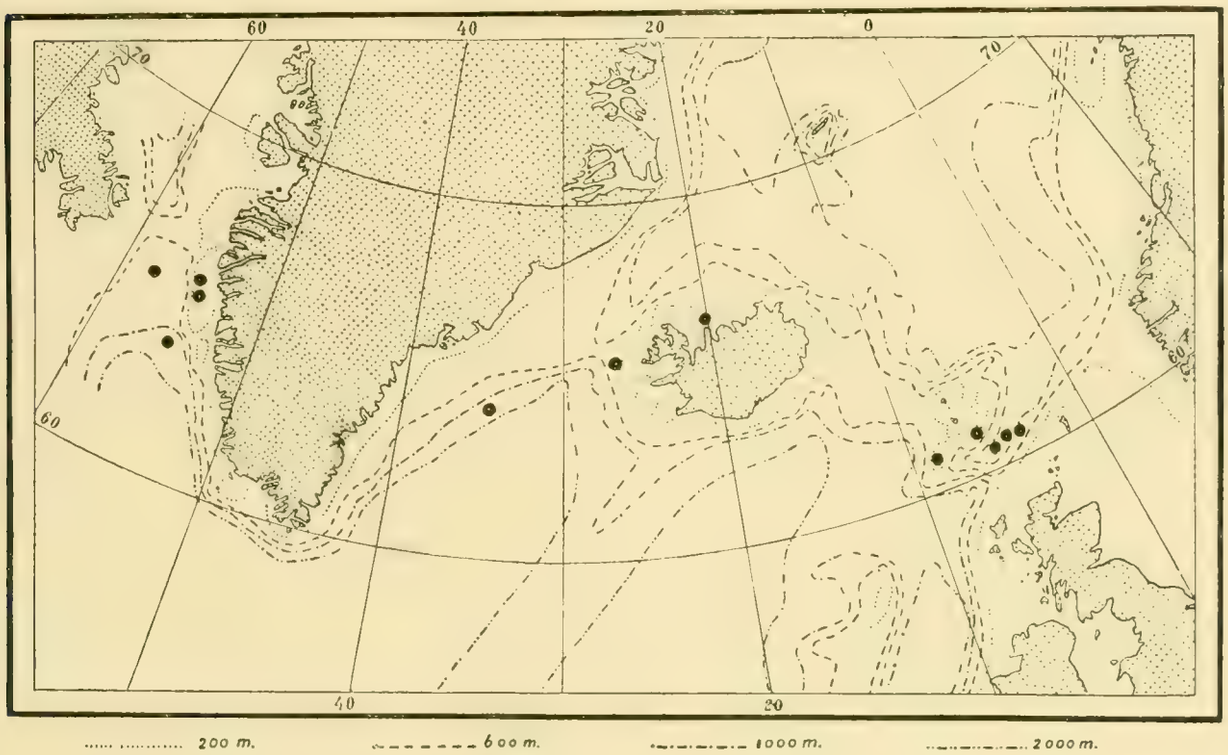

Fig. XLVI. Finds of *Cladocarpus formosus* in the Northern Atlantic.

Cladocarpus Diana nov. sp.

The colonies are singly pinnate with polysiphonic, in the upper parts monosiphonic main stem, which is not particularly strongly pronounced. The primary tube is indistinctly segmented, with long internodia, each having on its upper third an apophyse turned almost straight out to the side, alternately directed to either side of the stem. The internodium further has three or four sarcothecæ, a pair at the upper side of the apophyse, and one or two unpaired in the median line on the lower part of the internodium; all are adcaulinally split. The internodia of the hydrocladium have a large hydrotheca and three sarcothecæ, a supracalycine pair at the hydrotheca aperture, and an unpaired median proximal sarcotheca which reaches with its opening margin barely a little beyond the bottom of the hydrotheca. The supracalycine sarcothecæ approach the tubulous form, but are adcladially split; the proximal is of very typical shape, being much widened out laterally towards the opening, so that the latter is seen to be as broad as, or even slightly broader than, the lower part of the hydrotheca; the free adthecal wall has disappeared; the margin is slightly dentate. The hydrothecæ are large, somewhat compressed laterally, with expanded opening part; the margin of the aperture is armed with 9 strong teeth, an abcladial median, and between this and the internodium four on either side. There

is an indication of four to five faint inner ribs in the internodium at the hydrotheca; the proximal sarcotheca is bounded on the lower side by a strong rib.

The gonothecæ are situated on dichotomically branched phylactogonia proceeding from the basal internodium of the hydrocladia beside its proximal sarcotheca. The phylactogonia have three branches, which bear, on the side turned towards the stem, a row of sarcothecæ, and can be indistinctly segmented. The gonotheca is somewhat flattened; seen from the broader side it is a broad oval, or egg-shaped, fastened by the pointed end to the phylactogonium. The opening is broad, subterminal, and turned downwards owing to the fact that the abcladial side curves far out beyond the opening as a broad upper lip.

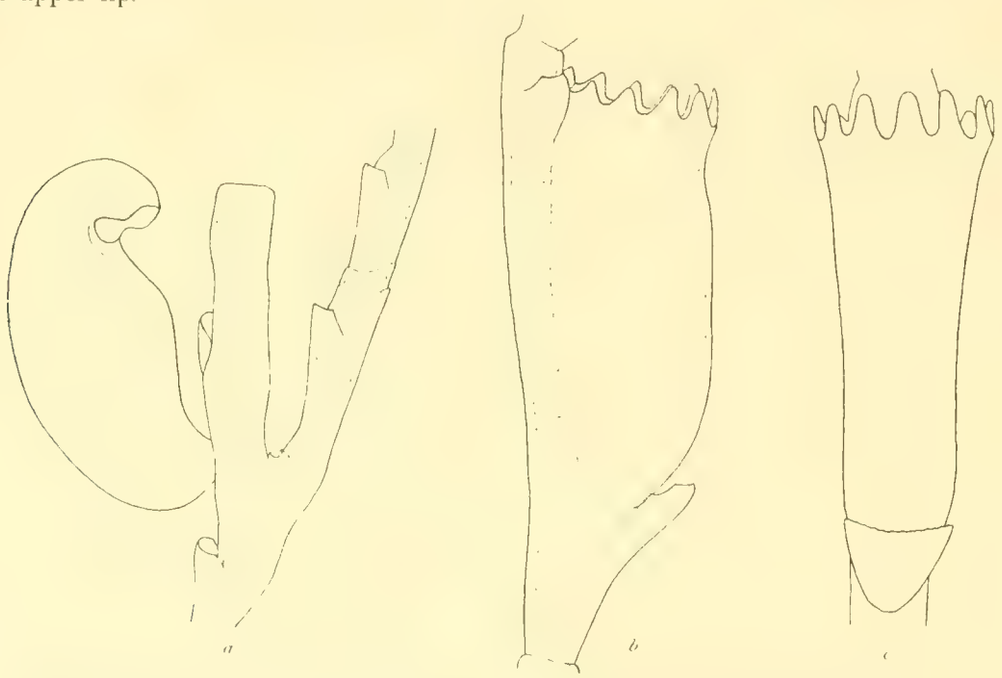

Fig. XLVII. *Cladocarpus Diana*. "Ingolf" St. 78. — *a* Phylactogonium with gonotheca (× 40). *b* Hydrotheca in side view (× 60). — *c* Hydrotheca in front view (× 60).

Material:

"Ingolf" St. 46, 61°32′ N., 11°36′ W., depth 720 fathoms 2,4°
— - 78, 60°37′ N., 27°52′ W., — 799 — 4,5°

Cladocarpus Diana has much stronger hydrothecal teeth (fig. XLVII) than most other species of the genus; nearest in this respect is *Cladocarpus compressus* Fewkes, but the teeth there are somewhat broader; in addition, the intervals between the teeth in *Cladocarpus Diana* are curved somewhat outwards. The most remarkable character, however, lies in the proximal sarcotheca. Seen from the side, this does not differ greatly from other previously known species, being only unusually short, so that the opening margin does not extend much beyond the bottom of the hydrotheca. But on examining the sarcotheca from the ventral side (fig. XLVII *c*) we find that it has its greatest breadth at the opening margin, which may even be slightly longer than the breadth of the lower and middle part of the hydrotheca. The sarcotheca has only one opening, which is correspondingly larger, the free wall turning towards the hydrotheca being entirely effaced.

Cladocarpus Diana exhibits also certain peculiarities in the gonosome (fig. XLVII *a*). The phylactogonium divides dichotomically a little above the base, and the outer branch, that farthest from the median line of the colony, soon divides again dichotomically into two, giving a slightly upward curving phylactogonium with three short branches. These have only a single open row of strong sarcothecæ on the side turned towards the median plane of the colony; each branch has from three to five sarcothecæ. The branches of the phylactogonium are richly furnished with inner ribs, and are also often irregularly segmented. The phylactogonia bear two or three gonothecæ of the same type as that usual in the genus, with a strongly developed upper lip domed out roofwise over the broad opening, which is turned towards the phylactogonium.

The colony from the "Ingolf" St. 46 exhibits the peculiarity of having the outer branch of the seventh phylactogonium from below on the left side prolonged; at the terminal point of the normal branch arises a further lateral branch; the outer branch is further prolonged, and has, outside the above-mentioned supernumerary branch, three hydrothecæ, and thus from here presents the appearance of a hydrocladium, which in addition to its basal hydrotheca further shows the incipient development of a secondary phylactogonium. The entire formation must be regarded as an abnormity.

Cladocarpus bicuspis (G. O. Sars) Jäderholm.

1874 *Aglaophenia bicuspis*, G. O. Sars, Bidrag til Kundskaben om Norges Hydroider, p. 98, pl. 2, figs. 7—10.
1909 *Cladocarpus bicuspis*, Jäderholm, Northern and Arctic Invertebrates, p. 110.

The colony is pinnate with polysiphonic, in the outer portions monosiphonic main stem. The primary tube is divided into short internodia, each bearing an apophyse directed obliquely forward and sideways, turned alternately to either side of the median line. The internodium is further provided with three sarcothecæ, a pair at the upper side of the apophyse, and an unpaired one in the median line of the internodium, close below the apophyse; all are adcaulinally split. The internodia of the hydrocladium have a very large hydrotheca and three sarcothecæ, a supracalycine pair at the hydrotheca aperture and an unpaired median proximal reaching up to the lower third of the hydrotheca; all sarcothecæ are adcladially split, and have quite smooth margins. The hydrothecæ are laterally much compressed, with outward curving opening margin, and with an abcauline pair of large teeth; the margin otherwise smooth; the sinus between the teeth is almost square. The teeth are concave, the incurvation strongest at the median line. From the sinus between the teeth an inner rib runs along the abcladial side of the hydrotheca to its middle, where it terminates in a strong S-shaped intrathecal septum, dividing the hydrotheca into a larger upper portion and smaller basal part, the latter half the size of the former. The internodium is furnished at the hydrotheca wall with four or five short ribs, the proximal sarcotheca is bounded on the lower side by a an oblique septum.

The gonothecæ are situate on the stem or on short, dichotomically three- to four-branched phylactogonia, proceeding from the basal internodium of the hydrocladium beside its proximal sarcotheca. The phylactogonia are furnished with sarcothecæ irregularly arranged, and not infrequently having indistinct segmentation. The gonotheca is somewhat flattened; from the broad side it is reversely

conical, broadly rounded distally, with a broad opening towards the phylactogonium; in lateral view, the abcladial wall is seen to dome out in a large upper lip over the opening, which is consequently turned downwards towards the base.

Material:

"Ingolf" St. 51 64°15′ N., 14°22′ W., depth 68 fathoms 7,32°
— - 98 65°38′ N., 26°27′ W., — 138 — 5,9°

Of this highly peculiar species, a couple of well developed colonies have been found; it resembles somewhat *Cladocarpus paradiscus* Allman, with its two strong abcladial teeth, but these are

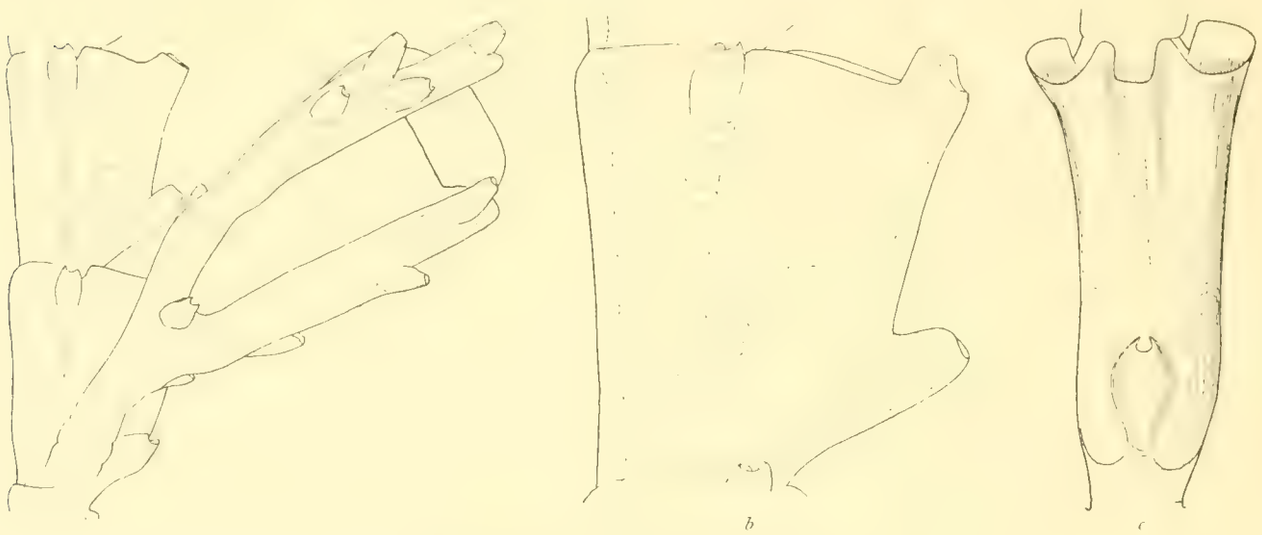

Fig. XLVIII. *Cladocarpus bicuspis* from "Ingolf" St. 98.
a Basal part of a hydrocladium with its phylactogonium (× 40).
b Side view of a hydrotheca (× 60). — *c* Front view of a hydrotheca (× 60).

more strongly developed in *Cladocarpus bicuspis* (fig. XLVIII) than in the species mentioned, and their appearance is the more striking from their marked incurvation, which renders the median sinus more prominent. The strong S-shaped septum is suggestive of *Cladocarpus sigma* Allmann; on the other hand, the inner longitudinal abcladial keel seems to be without parallel in the genus.

The phylactogonia are dichotomically branched, the ramification does not always take place once only, as in the one shown (fig. XLVIII *a*), but as a rule two or three times, so that we have three or four terminal branches. The gonothecæ shown by G. O. Sars (1874 pl. 2, fig. 8) are not yet fully grown. The full-grown gonotheca presents the same typical appearance as the remaining northern *Cladocarpus* species, with a much more strongly developed upper lip domed out over the opening; it is here as strongly developed as in *Cladocarpus Diana.*

Cladocarpus bicuspis is altogether a rare species in the regions investigated (fig. XLIX) and as it does not seem to have been found at all elsewhere, its true habitat is still a matter of doubt. In the northern waters, the species belongs to the typical visitors from the warmer atlantic waters, being previously known only from between Stavanger and Trondhjem Fjord on the west coast of

Norway; now the "Ingolf" has added two new localities, the one being off the south-east point of Iceland, the other in the eastern part of Danmark Strait, at a spot where several representatives of the heat-loving deep-water fauna of the Atlantic have been found. The bathymetrical position of the species is also somewhat doubtful: up to the present it has only been found in the middle and lower parts of the littoral region.

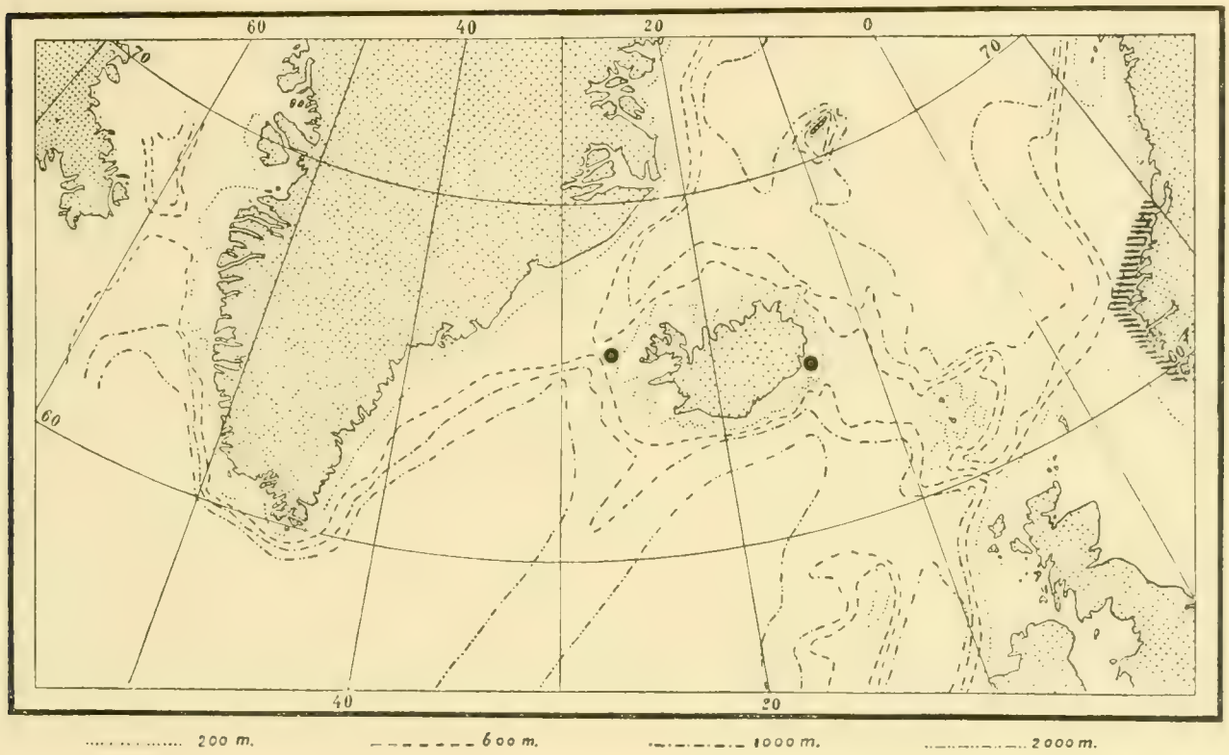

Fig. XLIX. The occurrence of *Cladocarpus bicuspis* in the Northern Atlantic.
In the hatched region the literature notes a scattered occurrence.

Gen. Thecocarpus Nutting.

Upright colonies with branched or unbranched main stem, the apophyses bearing unbranched hydrocladia with several hydrothecæ. All sarcothecæ immobile. The gonothecæ are set in a corbula formed by a metamorphosed hydrocladium; the blades of the corbula, or ribs, have each a hydrotheca near its point of origin.

Nutting (1900 p. 106) attaches primary importance to the question whether the stem is monosiphonic, a character which, even in distinction of species, is of subordinate weight; a species such as *Thecocarpus myriophyllum* (Linné) occurs in northern seas not infrequently fertile with monosiphonic stem, while other colonies have a polysiphonic basal part; but it is really only in southern waters that strong colonies of this species are found with polysiphonic stems, at any rate a couple of feet high. This feature, then, is of little or no interest from the point of view of generic distinction; on

the other hand, it is perfectly correct to take the furnishment of the corbula blades with hydrothecæ as of primary importance, which Billard (1913 p. 85) also points out. The breadth of the single corbula blade however, is of minor significance in this respect, and cannot be taken as proof that the corbula here is more primitive than in *Aglaophenia*, where narrow-bladed corbulæ have also been found.

Thecocarpus myriophyllum (Linné) Nutting.

1758 *Sertularia myriophyllum*, Linné, Systema naturæ, ed. 10, p. 810.
1900 *Thecocarpus myriophyllum*, Nutting, Plumularidæ, p. 107, pl. 24, figs. 12—13.

The colonies have an unbranched or branched, polysiphonic or monosiphonic main stem. The primary tube of the stem is divided into shorter or longer internodia, each bearing about the middle a short apophyse, directed obliquely forward and sideways; at the base of this at its upper side there is a pair of sarcothecæ, and on the basal part of the internodium an unpaired median sarcotheca. The short internodia of the hydrocladium have each a large hydrotheca, slightly compressed laterally, and three sarcothecæ, a supra-calycine pair at the hydrotheca opening and a short proximal unpaired sarcotheca, the opening margin of which does not reach up to the middle of the hydrotheca; all sarcothecæ are adcaulinally split. The hydrotheca margin is furnished with a strong, sharply cut median abcauline tooth; between this and the hydrocladium the margin is slightly dentate or curved, more faintly near the hydrocladium than farther from it. The opening margin stands almost perpendicular to the hydrocladium.

The gonothecæ proceed from a hydrocladium which is transformed into a narrow-bladed corbula having its blades (ribs) furnished with a basal hydrotheca, and in addition, on the outer side, numerous sarcothecæ. Between the corbula and the stem the hydrocladium has a varying number of hydrothecæ. The gonotheca is pear-shaped.

Material:

"Ingolf" St. 15 66°18′ N., 25°59′ W., depth 330 fathoms ÷ 0,75°
— - 35 65°16′ N., 55°05′ W., — 362 — 3,6°
— - 81 61°44′ N., 27°00′ W., — 485 — 6,1°
"Thor" 63°18′ N., 21°30′ W., depth 178 metres
— 61°15′ N., 9°35′ W., — 872 —
Iceland: 3 miles E. of Bjarnaröi, — 70 fathoms.

Thecocarpus myriophyllum is undoubtedly the most frequently occurring *Aglaopheniid* in the eastern part of the North Atlantic (fig. L). It is therefore highly peculiar that it should now have been met with for the first time by the "Ingolf" in Davis Strait, where no specimen had previously been found. In Iceland waters also, reliable data have hitherto been extremely rare, though Sæmundsson (1911 p. 105) records the species from the south-west point of Iceland, albeit under the name of *Thecocarpus radicellatus*. We can now add the further finds in these waters from Danmark Strait and east coast of Iceland. *Thecocarpus myriophyllum* is a species belonging to the lower littoral

region of the warmer seas and the upper abyssal region; quite exceptionally it may penetrate deeper down, as seen from the above. In the boreal regions it is not altogether rare, and has even in a single instance been met with in the cold area.

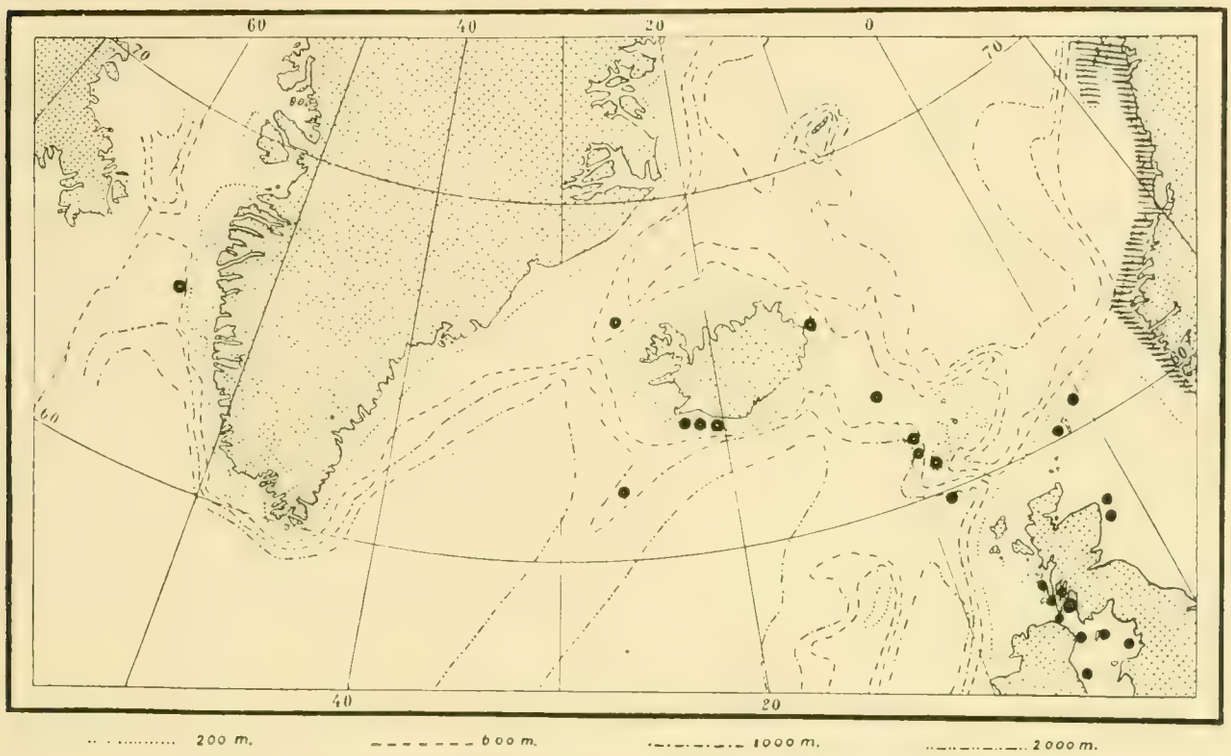

Fig. L. The distribution of *Thecocarpus myriophyllum* in the northern Atlantic.
In the hatched regions the literature notes a common, although scattered occurrence.

Gen. Aglaophenia Lamouroux.

Upright pinnate colonies with branched or unbranched main stem, the apophyses bearing unbranched hydrocladia with several hydrothecæ. All sarcothecæ immobile. Gonothecæ in a corbula formed by a metamorphosed hydrocladium; the corbula blades (ribs) are furnished with sarcothecæ, but lack hydrothecæ.

Aglaophenia tubulifera Hincks.

1861 *Plumularia tubulifera*, Hincks, A catalogue of the Zoophytes of South Devon, p. 256, pl. 7, figs. 1—2.

1868 *Aglaophenia tubulifera*, Hincks, A history of the British Hydroid Zoophytes, p. 288, pl. 63, fig. 2.

The colonies are pinnate with unbranched or branched monosiphonic main stem divided into short internodia. The internodium has close below the middle an apophyse directed obliquely forward and sideways, and three tubulose sarcothecæ, a pair at the upper side of the apophyse and an unpaired

one in the median line near the base. The internodia of the hydrocladia have each a hydrotheca and three sarcothecæ, a supracalycine pair near the hydrotheca aperture and a median proximal of greatly varying length. The proximal sarcotheca is tubulose, and has an open connection with the lumen of the hydrotheca; in the outer parts of the hydrocladium, it forms a more acute angle with the branch axis than nearer the stem; its free parts are in forma *typica* up to $^2/_3$ the length of the hydrotheca, in forma *Billardi* however, as a rule longer than the hydrotheca. The hydrotheca margin has an abcauline tooth, and on either side, between this and the hydrocladium, three, or more rarely four teeth. One or two internodial ribs are seen at the wall of the hydrotheca; at times an intrathecal rib may be indicated.

The gonothecæ are situate on a hydrocladium which has broad lateral blades converging to a corbula; the basal pair of blades is as a rule free, and hangs out and downwards; there is a hydrotheca between the corbula and the stem. The gonothecæ are pear-shaped.

Material:

"Thor", 35°57′ N., 5°35′ W., depth 740 metres.

The synonymy of the species has been dealt with in detail on a previous occasion (Broch 1912 p. 8) and notice has also been taken of the variations. Geographically, *Aglaophenia tubulifera* is a southern species, only quite exceptionally passing beyond the limit of the boreal waters round the British Isles; it belongs more especially to the middle and lower parts of the littoral region.

Family series **Sertulariina** nov.

Family **Sertulariidæ.**

The hydrothecæ are bilateral in structure and furnished with closing apparatus formed of from one to four plates. The colonies form sympodia or monopodia with terminal growth point. The polyps have a more or less pronounced abcauline and basal blind sack with a low, non-digestive endodermal epithelium; they are therefore bilaterally symmetrical.

Few families have been the subject of so much dispute as the *Sertulariidæ*, both as regards limitation and also in respect of division into genera. The best foundation is that given by Levinsen in his latest work (1913) where he comes to the same result as Stechow (1913). The latter writer here separates off the *Syntheciidæ* as a distinct family comprising those forms which lack the lid; but while Levinsen also discards this group and refers it to the family *Lafoëidæ*, Stechow considers the *Syntheciidæ* as an independent family, most nearly related to the *Sertulariidæ* sens. strict — a view in which we may fully concur, owing to the homogeneous organisation of the polyps. This principle for division is not very fully dealt with by Levinsen, and in particular the special organisation of the abcauline blind sack and its endodermal peculiarities seem altogether to have escaped his attention. This is suggested, as already mentioned, by his reference to a blind sack in *Lictorella pinnata* (G. O. Sars) which from a purely anatomical point of view is hardly tenable. Com-

mon to *Syntheciidæ* and *Sertulariidæ* is also the exterior ectoderm lamella, which forms an inner wall covering to the hydrothecæ; a parallel formation is, it would seem, found only in *Aglaopheniidæ*, where it is less pronounced. From the anatomical agreement of the polyps in the two families, and the fundamental differences in the structure of the polyps as compared with the remaining thecaphores, I have found it most correct to take the two families together in a distinct family series *Sertulariina*.

With regard to division into genera, however, I can on the whole agree with Levinsen, as will be seen from the following. Nevertheless it should be noted that the generic subdivision is still far from satisfactory. A considerable amount of anatomical investigation will be required before we can obtain a thoroughly adequate foundation here, and the present material, unfortunately, is not suitable for such studies.

In face of the above diagnosis, it may be objected that a genus such as *Diphasia* lacks the blind sack, at any rate, appears to do so. This point is not without importance, and has its own particular interest in consideration of the genus from a phylogenetic point of view. On closer examination of the group of species which Levinsen classes together in the genus *Sertularella*, we find that there are here, as a matter of fact, two distinct anatomical groups, which ought really to be separated as independent genera. The more restricted genus *Sertularella* will then comprise the species in which a closing apparatus consisting of 3 or 4 flaps is found together with polyps having fully developed abcauline blind sack; this class includes the great majority of species. On the other hand we have a group of species with the same sort of closing apparatus, but with polyps in which the blind sack is rudimentary or entirely lacking as far as can be seen from external observation. For this group, then, a special genus should be established. The group in question exhibits a close affinity to *Thyroscyphus*, which again forms a link with *Campanulinidæ*, and from this genus we must presume that the entire family has its origin. A species such as *Sertularella tamarisca* (Linné) belongs to this group of the *Sertularella*, and represents the transition stage to genera with rudimentary blind sack, *Diphasia* and *Dynamena*. From the second group, again, are derived the remaining genera with their marked lines of development in the closing apparatus. Taking into consideration both the organisation of the hydranth, and the structure and development of the closing apparatus, we come to fixed lines of development within the family, which are best illustrated by the following scheme:

Odontotheca Hydrallmania Thujaria

Sertularia

Diphasia *Dynamena* *Abietinaria*

a. Polyps with rudimentary blind sack. — *Sertularella* — *b.* Polyps with blind sack.

Thyroscyphus

Gen. Sertularella Gray.

Upright colonies with sympodial growth. The opening of the hydrotheca is furnished with three or four marginal teeth, between which are attached as many triangular opercular plates closing in a pyramid over the aperture.

The definition here agrees with that given by Levinsen (1913 p. 30). The genus seems, however, to form a somewhat heterogeneous collection of species which should, probably, from the structure of the polyp, be divided into two groups or genera. Of these groups, *Sertularella* sens str. will then comprise species with abcauline blind sack, while in the other group, we have species where this is rudimentary or indiscernible on external observation. The latter group leads, as above mentioned, to *Diphasia* and *Dynamena*, while the former gives the point of origin for the remaining genera of *Sertulariidæ*. The most primitive group is that of the species without visible blind sack.

Sertularella tamarisca (Linné) Levinsen.

1758 *Sertularia tamarisca*, Linnè, Systema naturæ, ed. 10, p. 808.

1893 *Sertularella tamarisca*, Levinsen, Meduser, Ctenophorer og Hydroider, p. 58.

Upright, somewhat irregularly branched, as a rule pinnate colonies, without distinct main stem. The hydrothecæ, which have a tripartite lid and tridentate opening margin, are set in two rows along the branches, a pair of hydrothecæ oppositely placed on each internodium. The hydrothecæ are very large, almost cylindrical, with the distal half free and highly diverging from the branch.

The male gonothecæ are reversed conical, compressed distally with a small tooth on either side and a short cylindrical neck centrally placed. The females are of the same shape, but have three distal broad blades, each furnished with a longitudinal indented median ridge; the three blades close in to a pyramid and form a large external marsupium, in which the larvæ are developed.

Material:

"Ingolf" St.	11,	64°34′ N.,	31°12′ W.,	depth	1300	fathoms,	1,6°
— -	87,	65°02,3′ N.,	23°56,2′ W.,	—	110	—	
— -	95,	65°14′ N.,	30°39′ W.,	—	752	—	2,1°
— -	98,	65°38′ N.,	26°27′ W.,	—	138	—	5,9°
— -	144,	62°49′ N.,	7°12′ W.,	—	276	—	1,6°
"Thor"		63°30′ N.,	20°14′ W.,	—	80	metres	

Iceland: 6 miles W. of Isafjord, depth 55 fathoms

5 — E. of Seydisfjord, — 135 —

63°21′ N., 17°15′ W., — 58 —

The Faroe Islands: 16 miles S. by E. of south point of Nolsö, depth 80 fathoms.

Sertularella tamarisca presents, as a matter of fact, a somewhat alien impression among the remaining *Sertularella* species, and has led an unsettled existence, now in this genus, now in *Diphasia* or *Dynamena*. The paired arrangement of the hydrothecæ and the remarkable female gonothecæ of

the species, with the marsupial chamber resembling that of *Diphasia fallax* (Johnston) and *Diphasia rosacea* (Linnè) have led to its being frequently referred to this genus. The state of the material did not permit of a quite certain investigation of the polyps, but as far as it was possible to judge it has a quite rudimentary blind sack, which brings the species nearer to *Diphasia*. On the other hand, the closing apparatus is altogether of the same type as *Sertularella*, thus removing the species again from *Diphasia*. The most natural thing would doubtless be to consider *Sertularella tamarisca* as the type of a distinct genus, which in a certain degree forms a link between the true *Sertularia* species and *Diphasia*. This would demand, however, in the first place a closer study of the structural

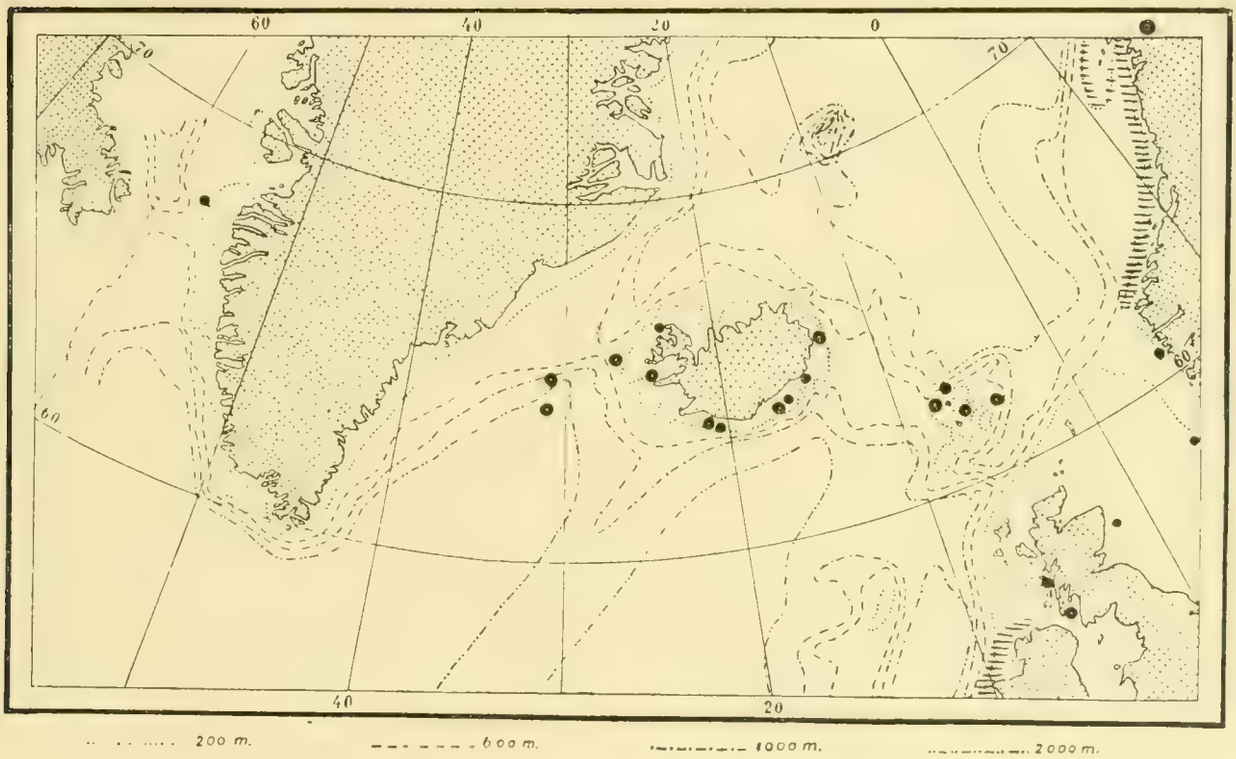

Fig. LI. The distribution of *Sertularella tamarisca* in the Northern Atlantic.
In the hatched regions the literature notes a scattered occurrence without giving particular data.

conditions of the species, and as my material is not suited to the purposes of such investigation, I have for the present refrained from establishing the new genus here.

It is not altogether easy to determine with certainty the biogeographical character of the species. *Sertularella tamarisca* is not a form of frequent occurrence, and is never met with in large numbers at a time; on the contrary, it is as a rule taken in single specimens, so that the species appears to be somewhat of a rarity. Further study seems to show that it is a boreal species capable of penetrating slightly into the arctic area and even more into warmer waters. Towards the north, it comes up into the White Sea, and towards the south, as we know, it penetrates into the Mediterranean. In the waters investigated (fig. LI) the species has not infrequently been found in the eastern part of the boreal region, while it has only once been met with in Davis Strait; it never penetrates into the cold area, despite the fact that its wide bathymetrical range would seem to suggest a con-

siderable elasticity in respect of physical conditions. The chief occurrence of the species falls in the lower part of the littoral region and the upper part of the abyssal.

Sertularella tricuspidata (Alder) Hincks.

1856 *Sertularia tricuspidata*, Alder, A notice of some new genera and species, p. 356, pl. 13, figs. 1—2.
1868 *Sertularella tricuspidata*, Hincks, A History of the British Hydroid Zoophytes, p. 239, pl. 47, fig. 1.

Upright colonies with pinnate or quite irregularly bushy ramification; in the pinnate colonies, the branches are alternating or subalternating, not infrequently they may themselves be dichotomically or pinnately branched; the branches are often bent or twisted. The monosiphonic stem and branches are segmented; each internodium has a hydrotheca. The hydrothecæ are situate on the distal part of the internodium, and are cylindrical or slightly barrel-shaped, with their narrowest part immediately below the aperture; they have three teeth of equal size on the aperture margin, the one median adcauline; in the sinuses between the teeth, the three triangular plates of the closing apparatus are attached. The adcauline wall of the hydrotheca has a free distal part between half and two-thirds the length of the hydrotheca. The polyp has a well-developed abcauline blind sack.

The gonothecæ are attached under the base of the hydrothecæ. They are oval to pear-shaped, with a short and narrow, reversedly conical, distally central neck, and with deep transverse furrows.

Material:

"Ingolf", beach of Jan Mayen.

—	St. 3	63°35′ N.,	10°24′ W.,	depth	272	fathoms	0,5°
—	- 34	65°17′ N.,	54°17′ W.,	—	55	—	—
—	- 54	63°08′ N.,	15°40′ W.,	—	691	—	3,9°
—	- 87	65°02,3′ N.,	23°56,2 W.,	—	110	—	—
—	- 95	65°14′ N.,	30°39′ W.,	—	752	—	2,1°
"Thor"		65°52′ N.,	23°58′ W.,	—	62	metres	
—		65°29,5′ N.,	24°63′ W.,	—	40	—	
—		64°02′ N.,	22°33′ W.,	—	34	—	
—		63°30′ N.,	20°14′ W.,	—	80	—	

Greenland: mouth of Nerak (depth not stated)
Hunde-Eiland (— - —)
Egedesminde, depth 30—40 fathoms
Store Hellefiskebanke, — 24 —
Sukkertoppen, on *Boltenia* (without further details)
Frederikshaab (— — —)

Iceland: Bakkefjord, depth 25—32 fathoms
Lonafjord, — 40 —
Malarif (depth not stated)
Reydarfjord, — 60—80 — [labelled *Sertularella polyzonias*]
63°21′ N., 17°15′ W. — 58 —

Iceland: Vestmanö, depth 25 fathoms
10 miles W. of Akranes (depth not stated) [labelled *Sertularella polyzonias*]
Bredebugt, depth 7—12 fathoms
65°00′ N., 24°38′ W., — 22 —
Önundarfjord — 10 —
Adalvik (depth not stated).

The Faroe Islands: 7 miles N. by E. of Myggenæs point, depth 57 fathoms
6 — N. by W. of Store Kalsö, — 60 —
Deep hole at north point of Nolsö, — 100 —
5 miles S.S.E. of Bispen, — 50 —

Sertularella tricuspidata is a circumpolar arctic species which is extremely numerous in arctic waters. From there is penetrates far down into the boreal area (fig. LII) where it is one of the most common species, especially round the Faroe Islands, Iceland, and off West Greenland. Along the east coast of Greenland, however, it is distinctly rare. Its infrequent occurrence off the north coast of Iceland on the other hand, should probably rather be apparent, as the result of insufficient investigations. Along the west coast of Norway, *Sertularella tricuspidata* goes southward as far as Bergen; according to the literature, it is also met with near the British Isles, but we have no certain data from here, so it would seem that this must be about the limit of its distribution. Bathymetrically, it belongs to the littoral region, exceptionally, however, it may, as shown by the find at the "Ingolf" St. 95, penetrate quite far down into the abyssal.

Fig. LII. The distribution of *Sertularella tricuspidata* in the Northern Atlantic.
In the hatched regions the literature notes a scattered occurrence.

Sertularella amphorifera Allman.

1877 *Sertularella amphorifera*, Allman, Hydroida..... of the Gulf Stream, p. 22, pl. 15, figs. 8—10.
1912 *Sertularella amphorina*, Bedot, Matériaux pour servir à l'histoire des Hydroides, 4me période, p. 352.

Upright slender colonies with monosiphonic hydrocaulus. Stem and main branches slightly prominent. The basal part of the stem is straight, irregularly segmented, without hydrothecæ and branches; higher up, it becomes regularly segmented, like the branches, with a hydrotheca on the distal part of each internodium. The branches arise in irregular alternation, and may themselves again ramify; like the hydrotheca-bearing part of the main stem, they are bent zigzag fashion. The hydrothecæ are large, cylindrical, slightly curved, with three equal sized, markedly prominent teeth, and in the sinuses between them three large triangular lid plates. The hydrotheca is attached to the branch by a narrow base. The polyp has a distinctly prominent abcauline blind sack.

The gonothecæ proceed from below the base of the hydrothecæ. They are a slender oval to pear-shaped, with a distally central narrow neck, and distinct transverse furrows; the neck passes evenly over into the gonotheca.

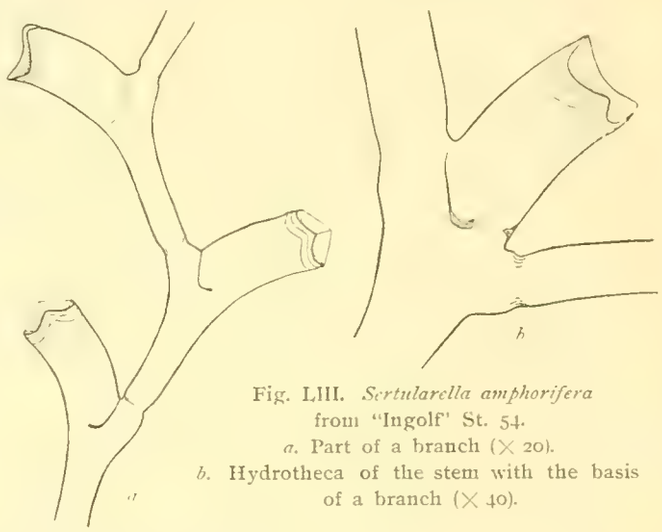

Fig. LIII. *Sertularella amphorifera* from "Ingolf" St. 54.
a. Part of a branch (× 20).
b. Hydrotheca of the stem with the basis of a branch (× 40).

Material:

"Ingolf" St. 7, 63°13′ N., 15°41′ W.; depth 600 fathoms, 4,5°
— - 54, 63°08′ N., 15°40′ W.; — 691 — 3,9°

Nutting (1904 p. 88) who had only some fragments of Allman's type specimen to work on, states that *Sertularella amphorifera* has possibly four hydrothecal teeth, and he gives some drawings where four such teeth are markedly in evidence, as if his specimen had been intact, and not, as he himself expressly notes in the text, defective. Billard (1906 p. 183) on the other hand, reports the species as distinctly tridentate, and this is also plainly to be seen from my specimens (fig. LIII). Between two branches on the stem, the number of hydrothecæ varies from two to five.

Sertularella amphorifera is evidently very closely related to *Sertularella tricuspidata*, extreme variants of which may present a strong resemblance to the former. On the whole however, *Sertularella amphorifera* seems to be of considerably more open growth, while its finer structure and long, slender internodia, together with the strongly projecting hydrothecæ, give it a typically different appearance from *Sertularella tricuspidata*, as is apparent at the first glance.

The finding of *Sertularella amphorifera* so far to the north is highly interesting. It was previously known only from the sea off Florida at Double Headed Shot Key, 471 fathoms, and from the west coast of Africa, where it was taken at 882 metres' depth. The species thus belongs to the warmer parts of the Atlantic abyssal region, and moves up, in the warm, deep water layers, to the deep off the south-east coast of Iceland.

Sertularella polyzonias (Linné) Gray.

1758 *Sertularia polyzonias*, Linné, Systema naturæ, ed. 10, p. 813.

1848 *Sertularella polyzonias* var. *a*, Gray, List of the specimens of british animals, p. 68.

Upright colonies with irregularly branched monosiphonic hydrocaulus, no distinct main stem. The branches are divided by oblique nodes into internodia, each bearing a hydrotheca, turning alternately to either side. The hydrothecæ are smooth or slightly wrinkled transversely, barrel-shaped, with a somewhat expanded opening part; the opening margin has four low and broad teeth, between which are attached the four triangular lid plates. The adcauline wall has a longer or shorter free part, according as the hydrotheca diverges more or less sharply from the branch. The polyp has a well-developed abcauline blind sack.

The gonothecæ proceed from close under the base of the hydrothecæ. They are egg-shaped, deeply furrowed transversely throughout their entire length, and have four markedly prominent strong teeth about the distally central opening.

Forma *typica*: fine and low colonies.

Forma *gigantea* (Mereschkowsky): large robust colonies.

Material:

Forma *typica*:

Iceland: Bredebugt, depth 35 fathoms (transitional to forma *gigantea*).
63°20′ N., 20°14′ W., depth 80 metres.

The Faroe Islands: 6 miles N. by W. of Store Kalsö, depth 60 fathoms.

Forma *gigantea*:

"Ingolf" St. 127 66°33′ N., 20°05′ W., depth 44 fathoms

Greenland: Akudlek — 30—60 — [labelled *Sertularella polyzonias*]
Jakobshavn (depth not stated) [— — —]
Egedesminde — - —
Store Hellefiskebanke (without further details)
— — depth 32 fathoms
Godthaab (without further details) [labelled *Sertularella polyzonias*]
Davis Strait, 67°34′ N., 55°29′ W. [— — —]
Sukkertoppen on *Boltenia* (depth not stated)

Kara Sea, "Dijmphna" [labelled *Sertularella polyzonias*].

Sertularella polyzonias is divided by many writers into two species, the gigantic arctic form being regarded as a distinct species, *Sertularella gigantea* Mereschkowsky. Kirchenpauer (1884 p. 34) has already drawn attention to the existence of intermediate forms between the two, which cannot show a single qualitative difference, the latter for instance, being distinguished merely by the fact that all dimensions are harmoniously increased. The very fact that this form belongs to the arctic and antarctic water layers, while the other is quite cosmopolitan, warns us to be careful about regarding them as distinct species. Geographical studies on the variations of hydroids have shown (cf. Broch 1909,

1913, 1914) that the dimensions may here quite commonly become coarser within the same species as the temperature decreases. In *Sertularella polyzonias* forma *gigantea*, this common law has been followed to an extreme, while the transition forms are comparatively few. That they exist, however, is plainly evident from the present material, where in particular certain colonies from Jakobshavn, Greenland, and all those from Bredebugt take up a doubtful intermediate position.

Forma *gigantea* (fig. LIV) is a typical arctic (and antarctic) character form, only exceptionally capable of penetrating into the boreal region. It is extremely common in West Greenland waters, and is also known from East Greenland; occasionally also from the north coast of Iceland. Forma *typica*, on the other

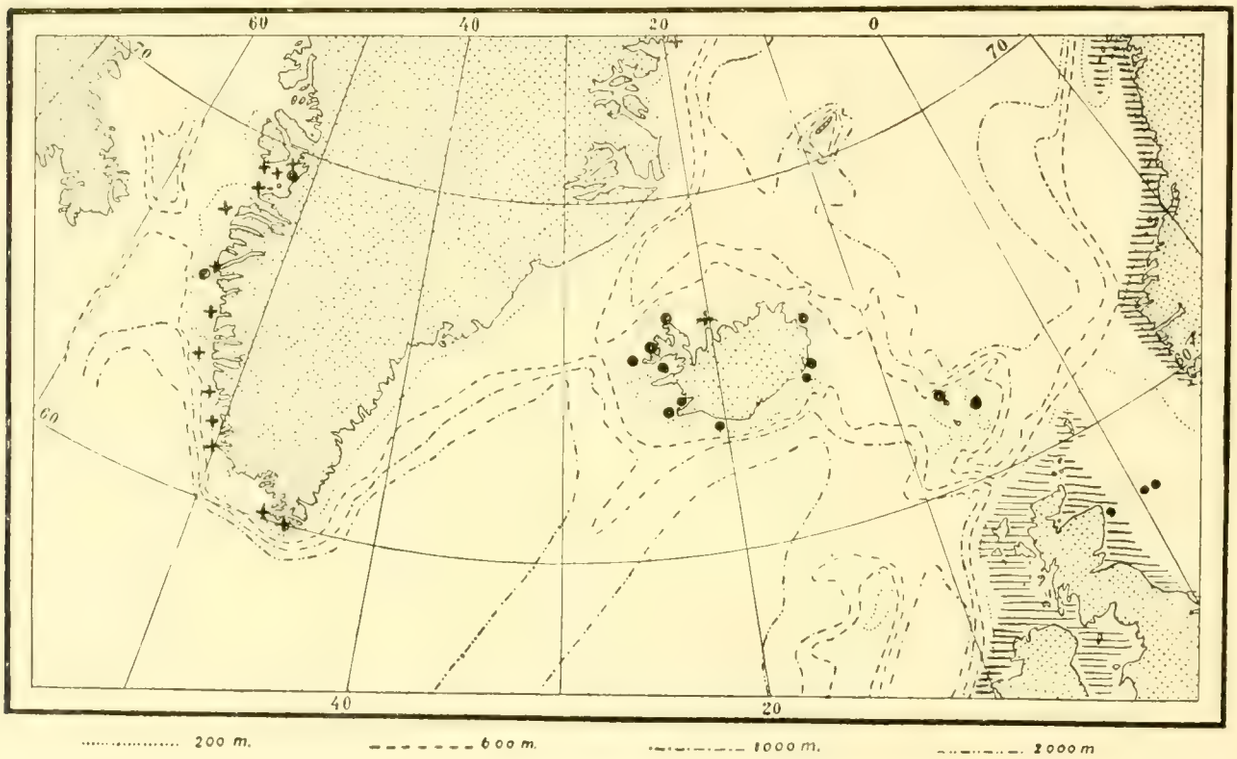

Fig. LIV. Finds of *Sertularella polyzonias* forma *typica* ● and forma *gigantea* + in the Northern Atlantic. In the hatched regions the literature notes a common occurrence of the forma *typica*.

hand, is cosmopolitan, and occurs also, albeit less frequently, in arctic waters. In the boreal area, it is particularly numerous in the eastern parts. Both forms belong to the middle parts of the littoral region, and rarely move down into the deep sea region.

Sertularella Gayi (Lamouroux) Hincks.

1821 *Sertularia Gayi*, Lamouroux, Exposition méthodique des genre . , . p. 12, pl. 66, figs. 8—9.
1868 *Sertularella Gayi*, Hincks, A History of the British Hydroid Zoophytes, p. 237, pl. 46, fig. 2.

Upright, irregular doubly pinnate colonies with distinctly prominent polysiphonic main stem and main branches. The outer branches are almost regularly pinnately branched often with their minor branches secondarily ramified. The outer branches are divided by indistinct oblique joints into short internodia, having on their distal half a large hydrotheca; the hydrothecæ are directed alternately to

either side in the broad plane of the colony. The hydrotheca has a free adcauline distal wall part, half as long as the hydrotheca or somewhat less, about $1^1/_2$ times the opening diameter. The hydrotheca has its greatest breadth at the middle, and narrows down both towards the base and towards the opening, which is set perpendicular to the axis of the hydrotheca. The free portion of the adcauline wall is as a rule furnished with somewhat faintly marked transverse furrows. The opening margin has four low teeth and four triangular lid plates in the sinuses between them.

The gonothecæ proceed from the branches close under the base of the hydrothecæ. They are oval, more or less furrowed transversely in the distal half, and have distally a narrow central opening with two diametrically opposite short broad teeth.

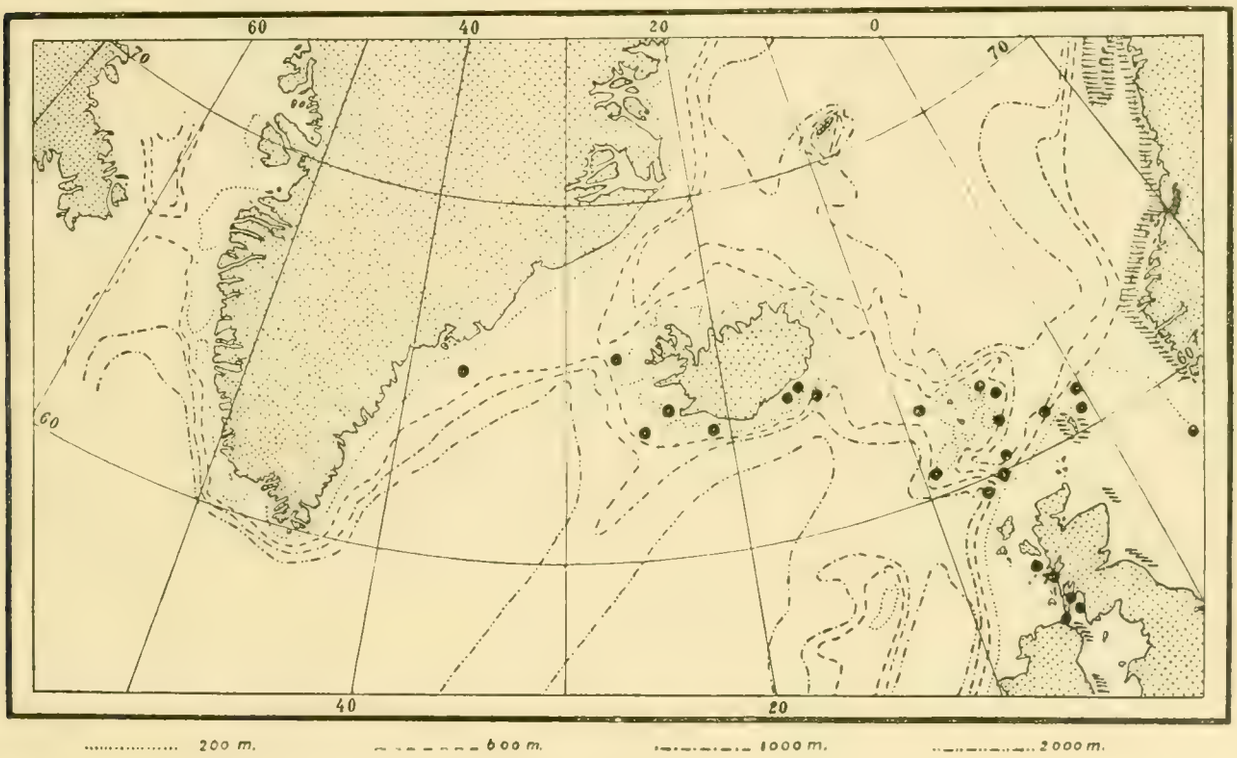

Fig. LV. The distribution of *Sertularella Gayi* in the Northern Atlantic.
In the hatched regions a common although scattered occurrence is stated in the literature without precise data.

Material:

"Ingolf" St. 1 62°30′ N., 8°21′ W., depth 132 fathoms 7,2
— - 55 63°33′ N., 15°02′ W., — 316 — 5,9
— - 85 63°21′ N., 25°21′ W., — 170 —
— - 94 64°56′ N., 36°19′ W., — 204 — 4,1°
— - 98 65°38′ N., 26°27′ W., — 138 — 5,9°
"Thor" 64°06′ N., 23°14′ W., — 98 metres [labelled *Sertularella polyzonias*]
Iceland: Ingolfshöfdi $9^1/_2$ miles in N. by E.$^1/_2$E., depth 53 fathoms.
The Faroe Islands: 60°23′ N., 8°55′ W., — 225

Sertularella Gayi is an atlantic warm-water species, which in the northern waters (fig. LV) exhibits an easterly distribution. It belongs to the deeper littoral and upper abyssal regions, where it is particularly frequent. In the south-eastern part of the boreal area it is quite common, and moves hence down into the cold area in the Faroe Channel; it is not altogether rare off the south coast of Iceland, where it seems now and again to have been confused with *Sertularella polyzonias*. The "Ingolf" has a single specimen from St. 94, so that the species can also occur in deep water off the south-east coast of Greenland, outside the mouth of Danmark Strait, where the deeper parts are still covered with warmer atlantic water layers.

Sertularella tenella (Alder) Hincks.

1856 *Sertularia tenella*, Alder, A notice of some new genera and species, p. 357, pl. 13, figs. 3—6.
1868 *Sertularella tenella*, Hincks, A History of the British Hydroid Zoophytes, p. 242, pl. 47, fig. 3.

Upright, unbranched or slightly branched openly constructed colonies with monosiphonic hydrocaulus. Stem and branches are divided by joints into not very long internodia, each having on its distal part a very slightly imbedded hydrotheca; proximally, the internodium is furnished with a pair of rings. The stem and branches are bent to an angle at the nodes, which gives them a markedly zigzag course. The hydrothecæ are large, about as long as the internodia, elongated oval, with somewhat more cylindrical opening part; they are distinctly furrowed transversely between the base and the cylindrical opening part. The aperture is set perpendicular to the longitudinal axis of the hydrotheca. The opening margin has four low teeth, and in the sinuses between them four triangular lid plates. The polyp has a well-developed abcauline blind sack.

The gonothecæ proceed from stem and branches close under the base of the hydrothecæ. They are oval to more pear-shaped, transversely furrowed throughout their entire length, and furnished with a distal central short, almost cylindrical neck.

Material:

"Ingolf" St. 94	64°56′ N.,	36°19′ W.,	depth 204	fathoms	4,1°
— - 95	65°14′ N.,	30°39′ W.,	— 752	—	2,1°

As a synonym to this species I have previously (1909 p. 126) noted *Sertularella pellucida*. Jäderholm has, however, (1909 p. 99, Taf. XI, figs. 8—11) given a closer study of this species, from which it appears that it does not belong here, its entire structure being different, and the colonies more resembling those of *Sertularella fusiformis*.

Kramp (1914 p. 1037) characterises *Sertularella tenella* as a cosmopolitan species. This must, however, as will be seen from the chart (fig. LVI) be taken with some little reserve. The species is altogether more sporadic in its occurrence within the northern waters, save probably for the tracts immediately round the British Isles, where it appears to be more common. Otherwise, it follows in the northern areas the same laws as do the warmer atlantic species, and is somewhat rare in the strictly boreal water layers. v. Lorenz, (1886) mentions the species from Jan Mayen, but this determination would seem, from the remaining data, to be somewhat uncertain.

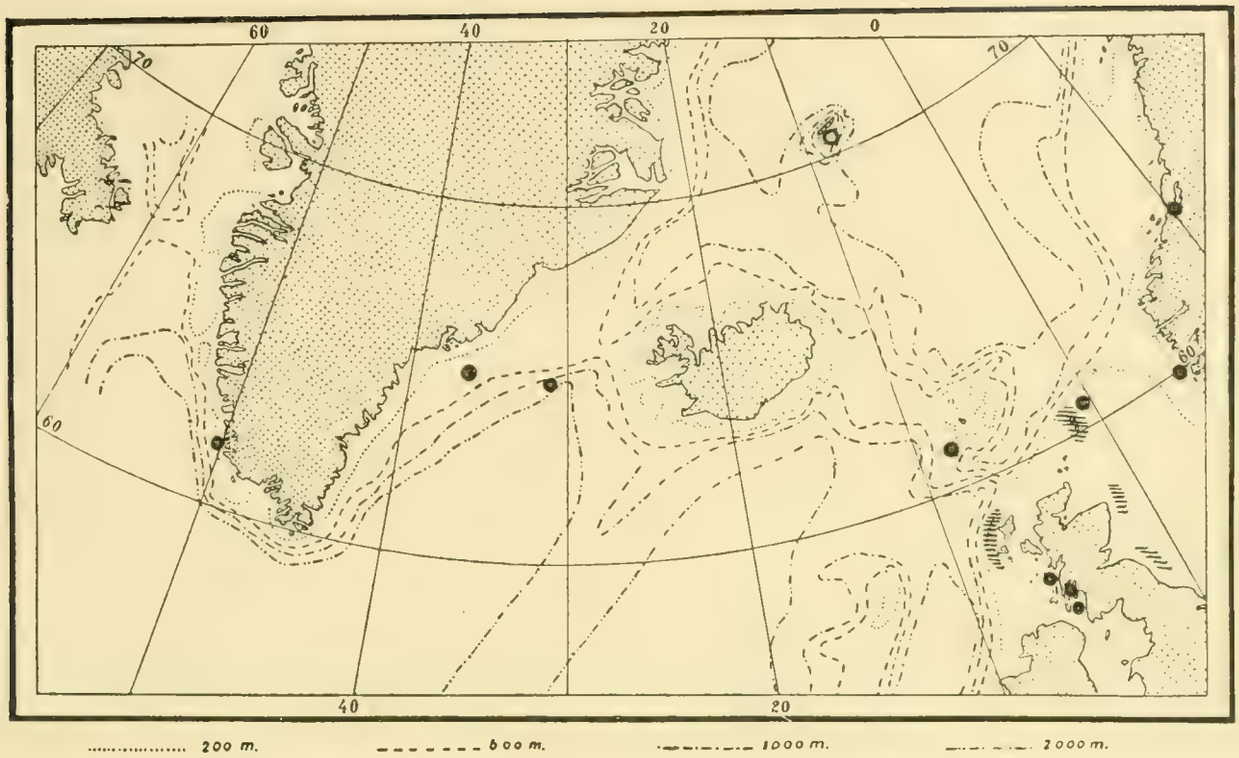

Fig. LVI. Finds of *Sertularella tenella* in the Northern Atlantic;
In the hatched regions the data are not altogether precise. (o doubtful locality).

Sertularella fusiformis Hincks.

1861 *Sertularia fusiformis*, Hincks, A Catalogue of the Zoophytes of South Devon, p. 253, pl. 6, figs. 7—8.
1868 *Sertularella fusiformis*, Hincks, A History of the British Hydroid Zoophytes, p. 243, pl. 47, fig. 4.
1907 *Sertularella pellucida*, Jäderholm, Über einige nordische Hydroiden.
1909 *Sertularella pellucida*, Jäderholm, Northern and Arctic Invertebrates, p. 99, Taf. 11, figs. 8—11.

Open and finely built, zigzag and slightly branched upright colonies with monosiphonic stem. The stem and branches are divided into short internodia which form an angle one with another, and are more or less distinctly ringed, more rarely quite smooth. From the same internodium may often proceed two or three branches, or simple internodia. The large, somewhat spindle-shaped hydrothecæ are situate on the outer half of the internodium, and are very slightly embedded; the opening part is again as a rule somewhat expanded; the aperture is set perpendicularly to the axis, and has four not very prominent teeth, between which are attached four triangular lid plates.

The gonothecæ are attached to the branches or stolons. They are elongated oval to egg-shaped, in the latter case with the broader part somewhat below the middle. The gonotheca has a distal central aperture with four strong teeth.

Material:

"Ingolf" St. 3 63°35′ N., 10°24′ W., depth 272 fathoms, 0,5°.

Sertularella fusiformis assumes a highly characteristic appearance from the peculiarity that it has often on stem or branches two or three short branchlets proceeding simultaneously from the same point, these short branchlets consisting of a single internodium, or more rarely a couple, with large hydrothecæ almost terminally placed. An excellent picture of this is given by Jäderholm (1909 Taf. 11, fig. 9). His specimens undoubtedly belong to *Sertularella fusiformis*, and are only remarkable in having the internodia entirely smooth; here, however, all transition stages occur, so that we are not warranted in setting aside the specimens on such ground as types of a distinct species.

Sertularella fusiformis is probably a warm atlantic species, but its occurrence is little known. In the waters investigated, it is previously known from the Hebrides, and from the Clyde Sea area; to these, Jäderholm adds a single find from Spitzbergen, and the species has now also been taken by the "Ingolf" about midway between the Faroe Islands and Iceland.

Sertularella rugosa (Linné) Hincks.

1758 *Sertularia rugosa,* Linné, Systema naturæ, Ed. 10, p. 809.

1868 *Sertularella rugosa,* Hincks, A History of the British Hydroid Zoophytes, p. 241, pl. 47, fig. 2.

Upright, irregularly branched small colonies without pronounced main stem; the latter is monosiphonic. The colony is divided by oblique nodes into short internodia, each bearing a hydrotheca directed alternately to either side, and situate on the upper half of the internodium. The hydrothecæ are broad oval or barrel-shaped, with deep transverse furrows, which are particularly marked on the abcauline side, where a very deep furrow is always found immediately beneath the aperture. The opening forms an angle with the hydrotheca axis, and is turned away from the branch; it is furnished with four low, often somewhat indistinct teeth, between which four triangular lid plates are attached. The polyp has a large abcauline blind sack.

Fig. LVII. Hydrothecæ of *Sertularella rugosa* from Herlö near Bergen (× 40).

The gonothecæ proceed from the internodia close under the hydrothecæ. They are egg-shaped or more oval, with deep transverse furrows, and have distally a central broad opening, surrounded by four short strong teeth.

Material:

Jan Mayen, depth 15 fathoms (East Greenland expedition).
Iceland: Grindavik (depth not stated).
10 miles W. of Akranes, on algæ
Stykkisholm, depth 30 fathoms
Bredebugt (without further details)
The Faroe Islands: Solmunde, on algæ
Thorshavn, on algæ, depth 3—4 fathoms.
Vestmanhavn, — 3,5—4 —

The available illustrations of *Sertularella rugosa* are very little characteristic, and this applies especially to Nutting's (1904 pl. 17, figs. 1—5) which present an entirely misleading impression, inasmuch as they suggest that the hydrothecæ are distinctly ringed. A new drawing is therefore given here (fig. LVII) showing the deep transverse furrows; particularly characteristic is the deep abcauline furrow beneath the aperture.

Sertularella rugosa must be characterised as a boreal species, having its bathymetrical distribution in the upper half of the littoral region, though it does not often penetrate up into the tidal zone. Kirchenpauer (1884) records it as found at Greenland, but there are no subsequent finds recorded from there. In the areas investigated (fig. LVIII) it has, it will be seen, an easterly distribution from Iceland to up in the Barents Sea, but its occurrence in the purely arctic area is quite sporadic, while on the west coast of Norway, for instance, it is a characteristic species in the laminaria zone. New finds are those from the Faroe Islands, where the species might be expected to be found from its occurrence off the coasts of Iceland, the British Isles, and Norway.

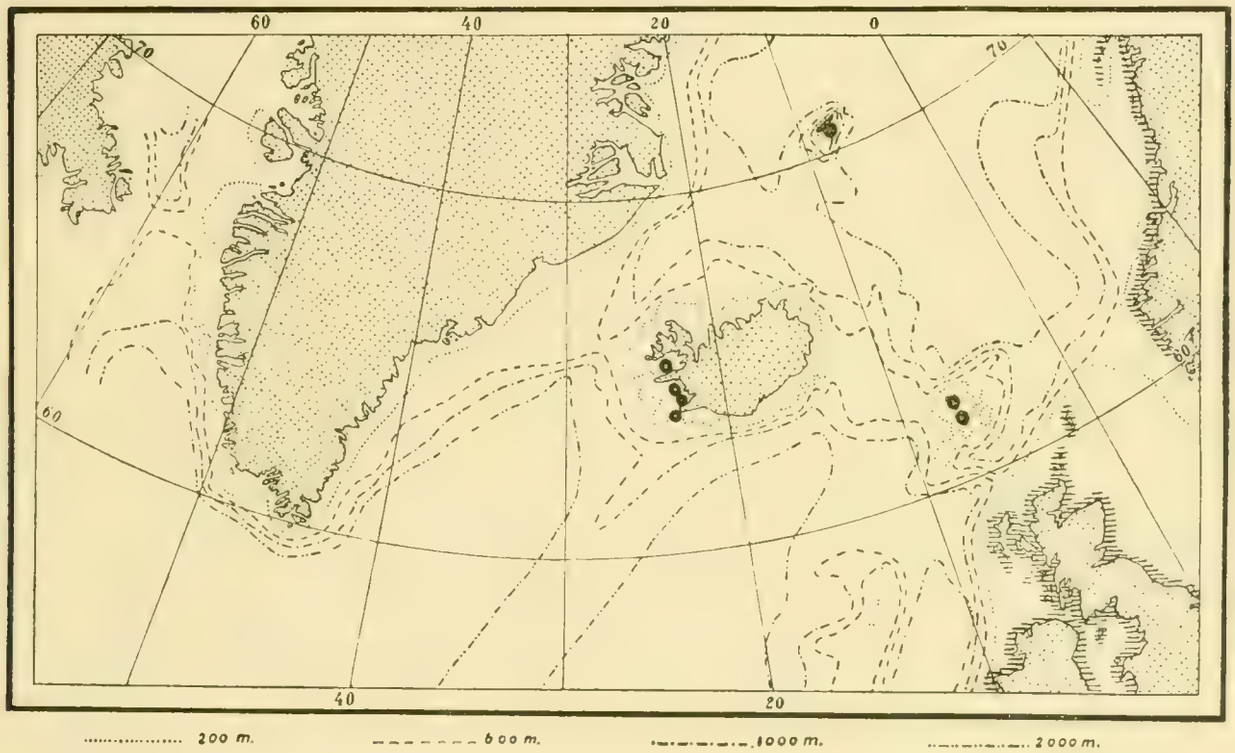

Fig. LVIII. Distribution of *Sertularella rugosa* in the Northern Atlantic.
In the hatched regions a common occurrence is noted.

Diphasia Agassiz.

Upright colonies, the hydrothecæ having a horizontal or slightly obliquely situated aperture without distinct teeth, but as a rule with an adcauline sinus, in which the large single opercular plate is attached. The polyps have, as far as can be seen from external observation, no abcauline blind sack.

This definition differs in one important feature from that given by Levinsen (1913 p. 309), the organisation of the polyps being taken into consideration. We thus obtain a stronger and more natural limitation, and the genus then practically coincides with the group *Eudiphasia* Broch. It has long been a doubtful question whether the two groups *Eudiphasia* and *Abietinaria* should be assigned generic rank or not, attention having previously been paid only to the form of the hydrotheca as the decisive point, and distinction thus made between species having more cylindrical hydrothecæ or hy-

drothecæ expanding distally (*Eudiphasia*) from those in which the hydrothecæ are bottle-shaped (*Abietinaria*). There are, however, transition forms, and the great variation in the hydrothecæ in most species renders a limit such as that so drawn extremely vague.

We now find, however, that the structure of the polyp is different in the two groups, the blind sack being only in the latter found in full development. This is an organisational feature of so considerable importance as not only to warrant, but even to demand, a generic distinction between the two groups, which also on the whole present interesting points of difference in the gonangia. In *Diphasia*, we find that the female gonothecæ are as a rule furnished with spinous or leaf-shaped outgrowths, which very often fold in together, forming a distal chamber for the brood, a marsupium. This is a biological phenomenon, and from a phylogenetic point of view of less importance; on the other hand, it is interesting to note that it here appears to occur as a constant characteristic in a whole series of related species. It is also worth noting that this feature is likewise found in *Sertularella tamarisca* (Linné) a species which appears to form a link between *Sertularella* and *Diphasia*.

Diphasia fallax (Johnston) Al. Agassiz.

1847 *Sertularia fallax*, Johnston, A History of the British Zoophytes, p. 73, pl. 11, figs. 2, 5, 6.
1865 *Diphasia fallax*, Al. Agassiz, Illustrated Catalogue, p. 142.

Upright pinnate colonies with more or less pronounced monosiphonic main stem, and as a rule with convex foreside. Stem and branches are divided into internodia, each bearing a pair of oppositely placed hydrothecæ. The branches proceed alternately from the stem, and are themselves often sparsely branched, frequently with tendril-like terminal parts. Between two successive branches on the same side of the stem there are two to four hydrothecæ, the one of them being at the corner of the branch. The hydrothecæ are deeply embedded, with a free distal part of the adcauline wall, in length equal to the opening diameter, or slightly less. The aperture is round, the margin with adcauline sinus, in which the large opercular plate is attached. The greatest diameter of the hydrotheca is at the opening.

The gonothecæ are situate on the upper side of the branch or on the fore side of the colony. The males are pear-shaped, with four distal short broad spines, and a short conical to cylindrical central neck. In the females, the four spines have developed into four broad triangular blades, which close in together over a distal brood-chamber in which the larval development takes place.

Material:

"Ingolf"	St.	3,	63°35′	N.,	10°24′	W.,	depth	272	fathoms	0,5°.	Variety.
—	-	51,	64°14′	N.,	14°22′	W.,	—	68	—	7,32°	—
—	-	87,	65°02,3′	N.,	23°56,2′	W.,	—	110	—	—	
	-	93,	64°24′	N.,	35°14′	W.,	—	767	—	1,46°	—
—	-	94,	64°56′	N.,	36°19′	W.,	—	204	—	4,1°	
—	-	95,	65°14′	N.,	30°39′	W.,	—	752	—	2,1°	
—	-	96,	65°24′	N.,	29°00′	W.,	—	735	—	1,2°	—
—	-	98,	65°38′	N.,	26°27′	W.,	—	138	—	5,9°	
—	-	115,	70 50′	N.,	8 29′	W.,	—	86	—	0,1°	

"Thor" 66°19′ N., 23°27′ W., depth 115—120 metres. Variety.
— 65°52′ N., 23°58′ W., — 62 —
— 63°30′ N., 20°14′ W., — 80 —
Greenland: Davis Strait, — 100 fathoms (without further details)
Iceland: 5 miles E. of Seydisfjord, — 185 —
Ingolfshöfdi 9½ miles in N. by E.½E. (depth not stated)
Vestmanö, depth 50 fathoms
Skagi, — 40 metres
6 miles W. of Iceland (without further details) [labelled *Diphasia rosacea*]
Ønundarfjord, depth 10 fathoms [— — —]
65°39′ N., 28°25′ W., depth 553 fathoms.
Between Iceland and The Faroe Islands: depth 270 fathoms (without further details).
The Faroe Islands: 8—10 miles N. of The Faroe Islands (— — —)
7 miles N. by E. of Myggenæs point, depth 57 fathoms
6 — N. by W. of Store Kalsö, — 60 —
Deep hole at north point of Nolsö, — 100 —
Borönæs 13 miles in N. 75° W. — 30 —
16 miles E. by S. of south point of Nolsö — 80 —

It may be a question whether *Diphasia fallax* cannot exceptionally be confused with *Diphasia Wandeli* Levinsen, if the latter species, as Sæmundsson opines, can occur with only two rows of hydrothecæ on the branches. There are also in the present material colonies of *Diphasia fallax* differing in appearance, so that there is some ground for further considering the point.

Sæmundsson (1911 p. 97) mentions having found colonies of *Diphasia Wandeli* with only two rows of hydrothecæ on the branches, and with female gonothecæ, which, however, from his drawings, agree entirely with *Diphasia fallax*. According to a footnote in Sæmundsson's work (1911 p. 98) Levinsen should, after seeing the colonies, have expressed as his opinion that they must rather be regarded as aberrant colonies of *Diphasia fallax* than as representatives of *Diphasia Wandeli*. Now Sæmundsson points out, in the same place, that a colony of *Diphasia Wandeli* from the Norwegian Sea, which he has had occasion to study, had on the basal parts of eight of its branches only two rows of hydrothecæ, while the outer parts of these branches, and all the remaining ones throughout their length, had three rows of hydrothecæ. This reminds one not a little of the aberrant *Thujaria*, which is further described in "Fauna artica" (Broch 1909 p. 177). As the colony described by Sæmundsson is sterile, it cannot be determined with certainty. It is probably a *Diphasia Wandeli*, but it might also be imagined that it could be a mutant of *Diphasia fallax*, though this is less likely to be the case. Typical female colonies of *Diphasia Wandeli* with gonothecæ have not yet been found; as to the males, we know that they differ from *Diphasia fallax* in having eight instead of four distal spines on the gonothecæ, these eight spines being arranged in pairs. It is therefore impossible to say with certainty which species Sæmundsson had before him, as long as typical and fertile female colonies of *Diphasia Wandeli* have not yet been found. Sæmundsson's colonies form, moreover, only the extreme link in a continuous variation series, of which the central one is *Diphasia fallax*.

The "Ingolf" brought back from several of its stations colonies of the same type described by Sæmundsson as *Diphasia Wandeli*. They are stiffly built, with a distinctly marked, often somewhat darker and plainly segmented main stem. Each internodium has a pair of hydrothecæ and a branch, directed alternately to either side, so that in these colonies, we have constantly two hydrothecæ between two successive branches on the same side of the stem; of these two hydrothecæ, the one (the lower) is situate in the corner by the branch. In the most extreme specimens of this variant group, we find single undivided branches. This variety is represented by a particularly pure type in specimens from the "Ingolf" St. 3 and St. 93. In these colonies, there is no pronounced fore or rear side as generally seen in *Diphasia fallax*. This must doubtless be taken in connection with the fact that the

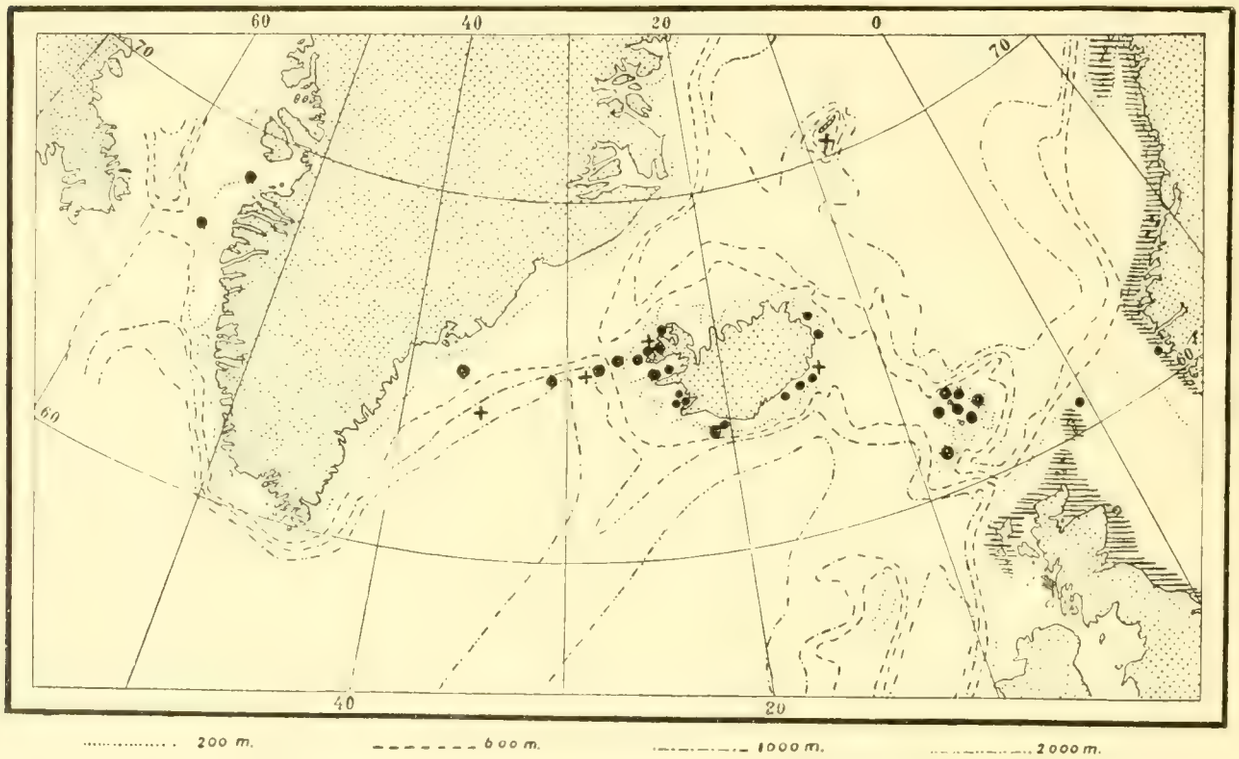

Fig. LIX. The distribution of *Diphasia fallax* in the Northern Atlantic.
In the hatched regions a common occurrence in reported (+ the variety spoken of in the text).

most marked representatives of the variety are attached to a firm underlayer, stones or mollusc shells, and not, as is mostly the case with this species, to stems of other hydroids; they thus stand more perpendicularly, and consequently develope more symmetrically, whereas the ordinary colonies, being fixed in a more horizontal position, find it better to develope more onesidedly, with an upturned "front".

Among the numerous transition forms, it will here suffice to mention some specimens from "Thor" (65°52′ N., 23°58′ W.). They are very closely allied to the group of variants described as a distinct variety, but exhibit at the same time several of the characteristic features of the main species. The stem is not quite so marked as compared with the branches, albeit its darker brown colour helps to bring it out; its segmentation is less prominent, and the branches proceed more openly and somewhat irregularly, with three, or more often four hydrothecæ between two branches on the same side

of the stem, the one hydrotheca in the branch corner. Finally, the branches and the colonies are curved, so as to present a distinctly convex foreside; the branches themselves also, are not infrequently again ramified. The colonies are thus typical transition forms, and as such occur in all shades of difference between the typical main form and the extreme, regularly pinnate variants, we cannot separate the latter as a distinct species.

Kramp (1914 p. 1053) has very appropriately characterised *Diphasia fallax* as "an atlantic boreal species only sporadically found in arctic regions". Its occurrence in the north Atlantic (fig. LIX) shows, however, that it is still not quite universal in the boreal waters; it appears, strangely enough, to be very rare off the west coast of Greenland, where we should otherwise have expected to find it of common occurrence in the mixed company of southern and northern forms found in Davis Strait. Bathymetrically, its chief occurrence falls in the middle and lower part of the littoral region, and the upper part of the abyssal; at times it may penetrate far down into the latter, as is shown by the list of finds from the "Ingolf". It is consequently the more remarkable that *Diphasia fallax* should seem to disappear at a somewhat greater distance from the coasts. A glance at the chart shows that the species has very rarely indeed been taken far from islands or continent, and this cannot be accidental, since the investigations both of the "Ingolf" and later expeditions have been carried out to a very great extent in the open sea within the areas in question. The explanation of this must be left to future studies.

Diphasia Wandeli Levinsen.

1893 *Diphasia Wandeli*, Levinsen, Meduser, Ctenophorer og Hydroider, p. 55, pl. 8, figs. 1—5.

Upright pinnate colonies with pronounced dark monosiphonic main stem. The stem is divided by transverse nodes into short internodia, each bearing a pair of hydrothecæ placed oppositely, and a branch under the base of the one, turning alternately to either side of the stem. The branches are likewise divided up into short internodia, each having three hydrothecæ in a wreath; there are thus three rows of hydrothecæ on each branch. The hydrothecæ are deeply embedded; the adcauline wall has a free distal part about one-fifth to one-fourth the length of the hydrotheca, between half and once the opening diameter. The opening is set almost perpendicular to the branch axis; the margin has a slight adcauline sinus, in which the large opercular plate is attached.

The gonothecæ arise on the branches close under the base of the hydrothecæ. The males are reversely conical, with eight short paired spines on the distal part; the narrow distally central aperture has a rudimentary neck, or none at all.

Material:

Greenland: Davis Strait 65°22′ N., 54°02′ W., depth 66 fathoms [Levinsen's type specimen].

Diphasia Wandeli appears to be a very rare species; typical three-rowed colonies have, besides the spot mentioned, only been found once, near Papey, East Iceland. All the other specimens recorded by Sæmundsson (1902 p. 67 and 1911 p. 97) belong properly to the above described variety of *Diphasia fallax*. The two finds belong to the middle part of the littoral region.

Diphasia rosacea (Linné) L. Agassiz.

1758 *Sertularia rosacea*, Linné, Systema naturæ, Ed. 10, p. 807.

1862 *Diphasia rosacea*, L. Agassiz, Contributions to the natural history of the United States, vol. 4, p. 355.

Upright colonies without distinct main stem. The colonies are irregularly pinnate or bushily branched, segmented, and with a pair of oppositely placed hydrothecæ on each internodium. The hydrothecæ are slender, almost evenly tubular, with slightly divergent distal part. The free distal portion of the adcauline wall is about half the length of the hydrotheca, between $1^1/_2$ times and twice the opening diameter, rarely somewhat shorter, down to about the same length as the opening dia-

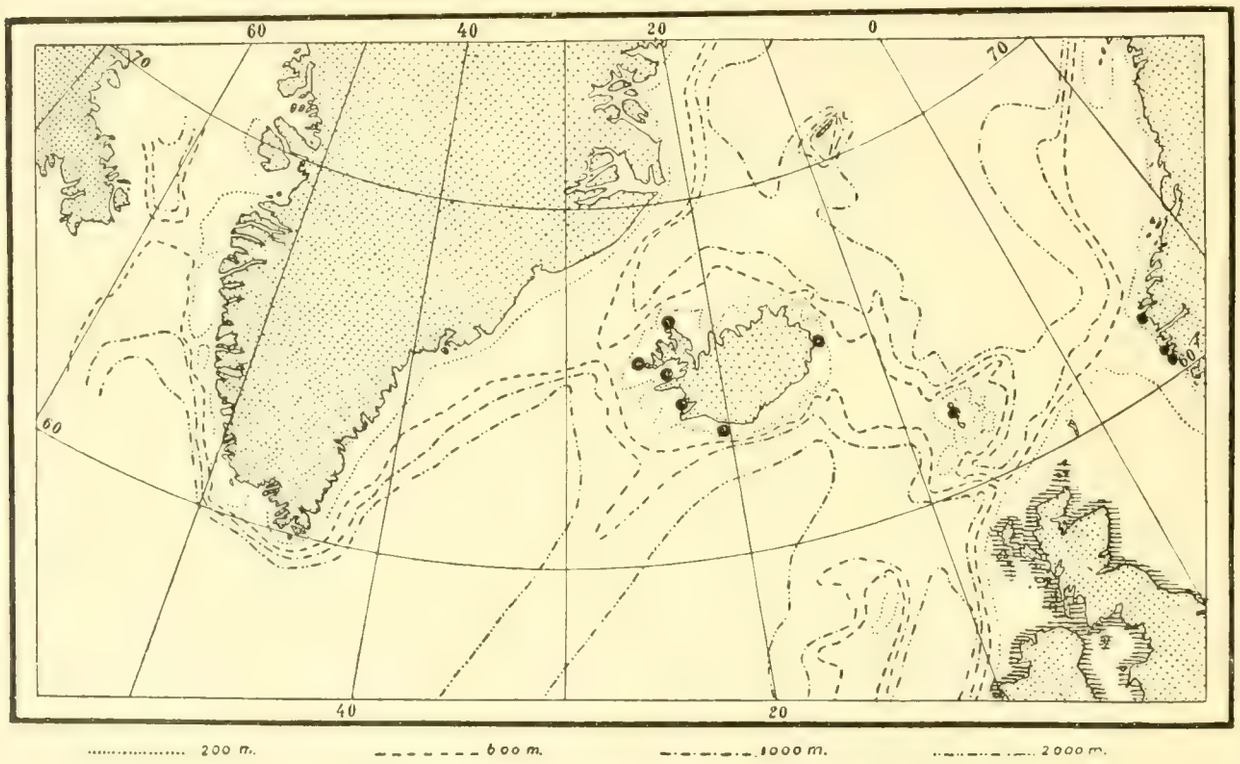

Fig. LX. The occurrence of *Diphasia rosacea* in the Northern Atlantic.
In the hatched region a common occurrence is recorded.

meter. The opening margin has a slight adcauline sinus, in which the large opercular plate is attached.

The gonothecæ arise close under the base of the hydrothecæ. The males are pear-shaped, with normally eight longitudinal ribs, each terminating in a distal short blunt point; the gonotheca has a central short cylindrical neck. The females are also pear-shaped, with eight long ribs, of which six terminate in as many broad blades closing together over a distal brood-chamber; the two last, diametrically opposite ribs end in forward pointing horn-like outgrowths of varying length.

Material:

"Thor" 63°30′ N., 20°14′ W., depth 80 metres.

Iceland: Stykkisholm, — 30 fathoms.

Sæmundsson (1902 p. 66) also mentions specimens of this species from Önundarfjord, Iceland, but a reinvestigation of his specimens shows that they must be referred to *Diphasia fallax*.

Diphasia rosacea should doubtless be regarded as a southern species having a very wide distribution in the southern part of the boreal area (fig. LX). It has been found at several places near Iceland, and is also recorded from the Faroe Islands. Round the British Isles and in the North Sea it is very common, and very frequent between Bergen and Stat on the west coast of Norway. Having also been found in north Norway (Tananger), it will probably likewise prove to be fairly common along the Norwegian coast in the deeper part of the laminaria belt, which is its true home.

Diphasia attenuata Hincks.

1866 *Sertularia attenuata*, Hincks, On new British Hydroida, p. 298.

1868 *Diphasia attenuata*, Hincks, A History of the British Hydroid Zoophytes, p. 247, pl. 49, fig. 1.

Upright, often brown-coloured, pinnate colonies with slightly pronounced monosiphonic stem, the lower part often without hydrothecæ or branches, and divided into internodia of irregular length; the upper part of the stem has alternating branches, which are in rare cases themselves secondarily branched to a slight degree, and may now and again terminate in tendril-like outgrowths. The branches and the upper part of the stem are indistinctly segmented; each internodium bears a pair of oppositely placed or slightly subalternating hydrothecæ. Between two successive branches on the same side of the stem, there are as a rule three, more rarely four hydrothecæ, the lowest in the branch corner. The hydrothecæ are large, tubular, the free distal part of the adcauline wall amounts to about half the length of the hydrotheca, and is somewhat more than the diameter of the opening. The hydrotheca is bent to an angle, so that its free part forms an angle of about 60° with the branch axis. The hydrotheca opening is nearly perpendicular to the branch axis; its margin has an adcauline sinus, in which the large opercular plate is fastened.

The gonothecæ are situate on the upper side of the branches, and proceed from close under the base of the hydrothecæ. The male gonothecæ are oval to pear-shaped, with six faint longitudinal ribs terminating distally in as many blunt points; the aperture is centrally placed on a broad distal cone. The female gonothecæ are oblong pear-shaped, and have likewise six faint longitudinal ribs, each with one or two markedly prominent spines on the distal part; the gonothecæ lack distal brood-chamber.

Material:

"Ingolf" St.	96,	65°24′ N.,	29°00′ W.,	depth	735	fathoms,	1,2°
—	- 98,	65°38′ N.,	26°27′ W.,	—	138	—	5,9°
—	- 115,	70°50′ N.,	8°29′ W.,	—	86	—	0,1°
—	- 127,	66°33′ N.,	20°05′ W.,	—	44	—	5,6°

Diphasia attenuata belongs to the littoral region of the warm Atlantic, and penetrates at times even far down into the abyssal region; the species has previously been quite frequently observed in British waters. The finds at the threshold of Danmark Strait are therefore not surprising, but that from Jan Mayen is remarkable, and must doubtless be accounted for as due to larval transportation, possibly from the waters about Danmark Strait in the same way as the occurrence at the "Ingolf" St. 127 at the north side of Iceland.

Diphasia alata Hincks.

1855 *Sertularia alata*, Hincks, Notes on British Zoophytes, p. 127, pl. 2.

1868 *Diphasia alata*, Hincks, A History of the British Hydroid Zoophytes, p. 258, pl. 48, fig. 2.

Upright pinnate colonies with a not very marked, brown, monosiphonic stem, exceptionally polysiphonic in its basal part; the stem and branches are indistinctly segmented. The hydrothecæ are arranged in opposite or subalternate pairs; they may also, in exceptional cases, be alternately set. On the branches, the hydrothecæ exhibit a tendency towards unilateral arrangement on the front of the colony. The branches arise alternately from the stem; between two successive branches on the same side of the stem there are three hydrothecæ, the lowest at the branch corner. The hydrothecæ are large, bent to an angle, with a free distal portion of the adcauline wall between one-third and one-half the length of the hydrotheca, about equal to the opening diameter. The abcauline wall has at the middle, near the bend, a prominent transverse inner rib; the angle between the branch axis and that of the distal part of the hydrotheca is greater than 60°. The plane of the hydrotheca aperture is almost perpendicular to the branch axis; the margin has a deep adcauline sinus, in which the large opercular plate is attached.

The gonothecæ are small, almost pear-shaped, distally quadrilateral in section, with a short and blunt distal point in each corner, and a small round distally central opening, but no neck. The female gonothecæ develop no brood-chamber; they are as a rule slightly asymmetrical, whereas the males are symmetrical in structure.

Material:

"Thor" 35°57′ N., 5°35′ W., depth 740 metres.

Diphasia alata belongs to the warmer tracts of the eastern part of the Atlantic, and seems there to be mainly restricted to the lower part of the littoral region and the upper portion of the abyssal. It is a rare visitor in the northern waters, where it has been observed off the west coast of Scotland, at the Hebrides, Shetland, and the west coast of Norway from Jæren to a little north of Bergen. It has not, however, been recorded from the Faroe Islands, Iceland or Greenland.

Gen. Dynamena (Lamouroux).

Upright colonies with imbedded, bilaterally built hydrothecæ. The hydrotheca aperture has two large lateral teeth, between which there is a large abcauline sinus and a smaller adcauline one; the latter is often divided into two by a slightly prominent median tooth. In each main sinus a membrane is fixed, so that the closing apparatus consists of two membranes, the abcauline with a free distal part. The polyp has no pronounced blind sack.

This definition of the genus *Dynamena* we also find indicated by Kühn (1913 p. 252). Levinsen is not disposed to consider the development of a pronounced blind sack as of any systematic importance (1913 p. 286), which view must doubtless be accounted for by his having apparently confused this feature in the organisation with casual S-shaped hydranth contractions. Kühn regards the

disappearance of the blind sack as a secondary phenomenon, and keeps mainly to the character of the gonangia. In this, however, it is impossible to concur, as these organisational features are entirely independent one of another, and the lines of development in gonangia and polyps can clearly not be taken as of equal significance. There is, as I have often here pointed out, no reason to reduce the importance of polyp development in systematics; phylogenetically, it is the most valuable clue. And in this case, it suggests that lid formation may partly indicate converging lines, as will be seen from the diagram given under the heading of *Sertulariidæ*. It is therefore likewise impossible to follow Levinsen in grouping *Dynamena* and *Sertularia* together in one genus exclusively from the uniformity of their closing apparatus.

Dynamena pumila (Linné) Lamouroux.

1758 *Sertularia pumila*, Linné, Systema naturæ, Ed. 10. p. 807.

1812 *Dynamena pumila*, Lamouroux, Extrait d'une mémoire sur la classification des Polypes, p. 184.

Upright colonies with irregular, as a rule pinnate ramification, exceptionally with an indication of monosiphonic main stem. The branches are secondarily ramified in irregular pinnate formation. The colony is divided into short internodia, each bearing a pair of hydrothecæ oppositely placed. The hydrotheca is deeply embedded; its adcauline wall has a free distal portion about the same length as the opening diameter, between one-fourth and one-third the length of the hydrotheca. The opening margin has two prominent lateral teeth, and in the middle of the adcauline lesser sinus is a slightly developed broad median tooth. The adcauline closing membrane has no free part; the abcauline is large, with a free distal part. The diaphragm almost radially symmetrical.

The gonothecæ proceed from below the base of the hydrothecæ on the one side of the branches. They are pear-shaped, with a very short neck, and a round, symmetrically situate distal opening with operculum. Material:

Greenland: Egedesminde
Sukkertoppen
Julianehaab, on *Fucus*.
Kangerdluarsuanguak.
Iceland: Reykjavik, on *Ascophyllum*, and *Fucus*, and down to 4 fathoms depth.
Grindavik, Bredebugt
Grafarvogr
Isafjord.
The Faroe Islands: Strömö.
Thorshavn.

I have in a former work (Broch 1910 p. 29) pointed out that Nutting's drawing of the gonotheca (1904 p. 27, fig. 80) is altogether misleading, presenting the impression that the acrocyst, as it projects from the gonotheca, must perforate the operculum. This is, however, not the case; the operculum opens at one side, and the acrocyst is then thrust through the opening thus made.

Dynamena pumila belongs to the tidal zone, and is most frequently found on fucoids and the shallower living *Laminaria*; the species evinces a high degree of elasticity with regard to salinity,

and thus belongs to the hydroids found farthest up in the fjords, where the salinity is greatly reduced by the inflow of river water. The species has also a wide southerly distribution, and is very common even in the Mediterranean. It is a character form in the boreal areas (fig. LXI) where it occurs in quantities along the coasts. On the other hand, its occurrence in strictly arctic waters is very rare and sporadic. From Greenland it has been recorded at several places along the west coast, and will probably prove more frequent here than the data at present to hand would seem to show.

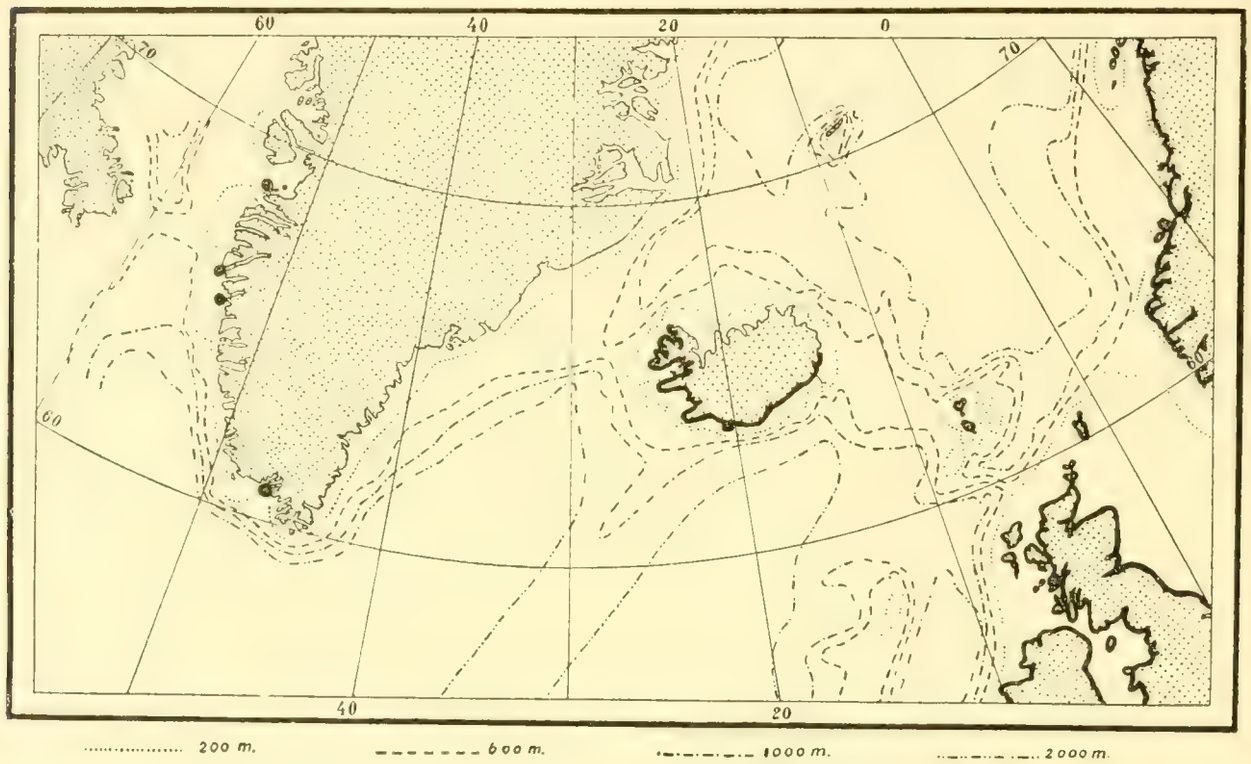

Fig. LXI. The distribution of *Dynamena pumila* in the Northern Atlantic.

Gen. Abietinaria (Kirchenpauer).

Upright colonies with hydrothecæ having their opening horizontally or slightly obliquely set; the opening margin lacks distinct teeth, but has often an adcauline sinus in which the large single opercular plate is fixed. The polyp has a well developed abcauline blind sack.

On comparing this definition with that given by Levinsen for the sub-genus *Abietinaria* (1913 p. 310) we at once find that there is a fundamental difference, the diagnosis here given being based chiefly on the organisation of the polyp. This gives us a clear mark of distinction as against *Diphasia*, and necessitates the separation of the groups as two different genera. There can be no doubt that *Diphasia*, as defined by Levinsen, formed a diphyletic group, and that two separate lines of development lead from the *Sertularella* to the two groups. The relation in point of opercular formation must here doubtless be taken as a secondary phenomenon of convergence, in comparison with the organisation of the polyp.

Abietinaria abietina (Linné) Kirchenpauer.

1758 *Sertularia abietina*, Linné, Systema naturæ, Ed. 10, p. 808.

1884 *Abietinaria abietina*, Kirchenpauer, Nordische Gattungen und Arten von Sertulariden, p. 29, 35.

Coarsely built, pinnate colonies, the branches often secondarily branched pinnately in the same plane. The stem is zigzag, with paired subalternating hydrothecæ in two rows, there are as a rule three, more rarely four hydrothecæ on the stem between two successive branches on the same side, the lowest in the branch angle. The hydrothecæ of the branches are set subalternately in pairs, and in two opposite rows. The hydrothecæ are large, swollen at the lower end, narrowing upwards and terminating in a short slightly outward curving neck; the aperture lies obliquely or more rarely perpendicular to the branch axis; the margin has no adcauline sinus; the opercular plate is attached adcaulinally. The free distal part of the adcauline wall is more than half the length of the hydrotheca, and about twice that of the opening diameter. The interval between two successive hydrothecæ on the same side is from half to once the length of the hydrotheca, rarely a little less. The diaphragm is of distinctly bilateral structure, with a narrow egg-shaped cleft, the longitudinal axis of which lies in the broad plane of the branch.

The gonothecæ proceed from close under the basis of the hydrothecæ, and are as a rule set on the upper side of the branch. They are oval, with a short, almost rudimentary stalk, and have a short, broad cylindrical neck.

Material:

"Thor" 65°52′ N., 23°58′ W., depth 62 metres
— 62°29,5′ N., 24°56′ W., — 40 —
— 64°16′ N., 22°17′ W., — 50 —
— 64°02′ N., 22°33′ W., — 34 —
— 63°30′ N., 20°14′ W., — 80 —
— 61°07′ N., 9°30′ W., — 835 —

Greenland: Store Hellefiskebanke, off Holstensborg, depth 18—20 fathoms.

Iceland: Bakkefjord (depth not stated)
Seydisfjord, depth 6 fathoms
Off Seydisfjord (depth not stated)
Reydarfjord, depth 50 fathoms
Ingolfshöfdi 9½ miles in N. by E.½ E. (depth not stated)
Vestmanö, depth 25 fathoms
Reykjavik (depth not stated)
Hvalfjord, depth 24 fathoms
Bredebugt, 64°45,8′ N., 23°55,2′ W., depth 30 fathoms
6 miles W. of Iceland, 65°00′ N., 24°38′ W., depth 22 fathoms
Patreksfjord, depth 7—25 fathoms
Axarfjord, — 18 — —

The Faroe Islands: 8—10 miles N. of the Faroe Islands (without further details)
6 miles N. by W. of Store Kalsö, depth 60 fathoms
7 — N. by E. of Myggenæs point — 57 —
Borönæs 1 3/4 miles in N. 75° W. — 30 —
Deep hole at north point of Nolsö — 100 —
13 miles W. by S. of Munken — 150 —

I have in earlier works (1908, 1909) united this species with the next, the more finely built form *Abietinaria filicula* (Ellis et Solander), having overlooked the specific character which lies in the

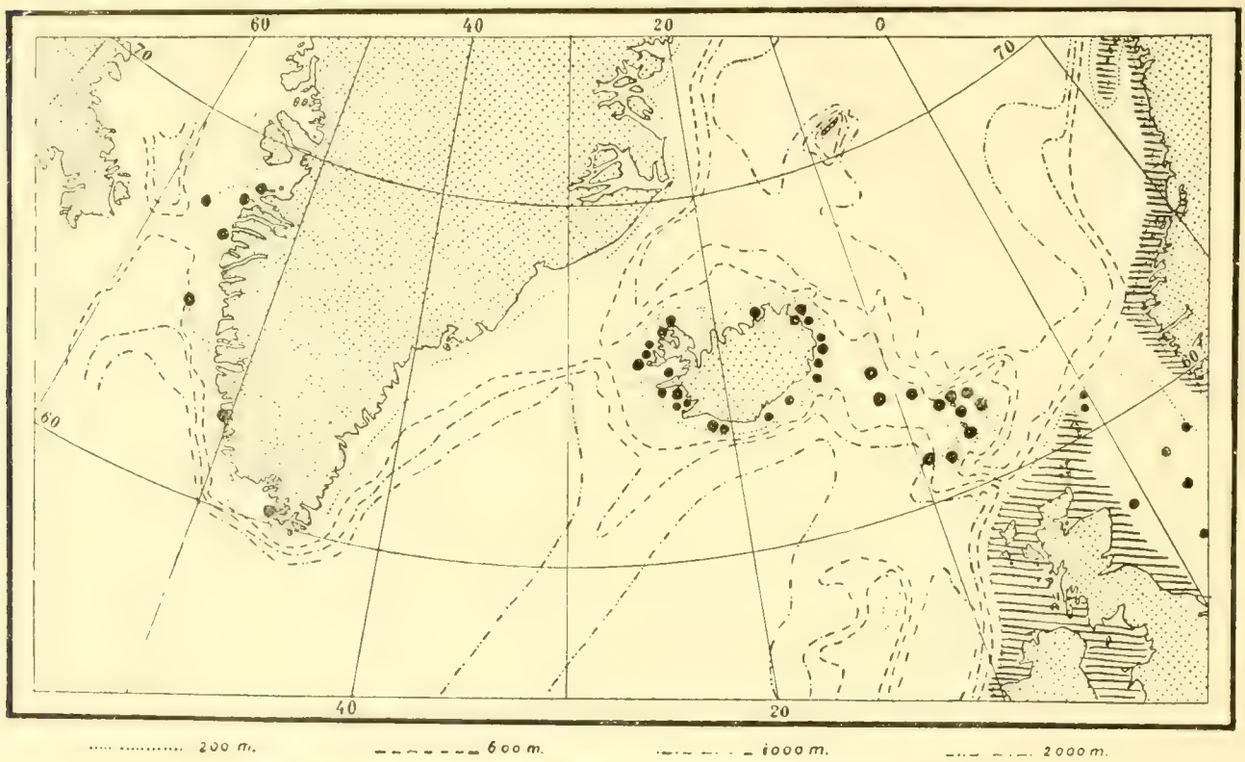

Fig. LXII. The distribution of *Abietinaria abietina* in the Northern Atlantic.
In the hatched regions a common occurrence is reported.

peculiar diaphragm of *Abietinaria abietina*, as pointed out by Levinsen (1893 p. 56). Generally speaking, the robuster stucture of the colonies will obviate any doubt when dealing with the last-named species, but this is not always the case. Occasionally, *Abietinaria abietina* may assume a finer structure (cf. Broch 1908) and it was from observation of such doubtful colonies that I was led to combine the two species under a common name. In such dwarf colonies, however, identity may easily be determined by examination of the diaphragm, which in *Abietinaria abietina* is typically bilateral, whereas in *Abietinaria filicula* the development is almost entirely radially symmetrical.

Abietinaria abietina is a circumpolar boreal species, capable of penetrating far into the arctic area, albeit its occurrence there is more sporadic. It can also move far to the south, and is found in the Mediterranean and at Madeira. It belongs really to the littoral region, but may exceptionally

penetrate down into the abyssal. In northern waters (fig. LXII) it is extremely frequent along the coast of Norway, round the British Isles, at the Faroe Islands and along the east, south and west coasts of Iceland but very rare on the north coast of the same. Along the east coast of Greenland it does not appear to have been found, but it is met with again from several parts of West Greenland. It is remarkable that it should not be represented in the large amount of material collected by the "Ingolf" expedition, but the explanation must presumably be that the species does not often live far from the coasts.

Abietinaria filicula (Ellis et Solander) Kirchenpauer.

1786 *Sertularia filicula*, Ellis and Solander, The natural history of many curious and uncommon Zoophytes, p. 57, pl. 6, figs. *c*, *C*.

1884 *Abietinaria filicula*, Kirchenpauer, Nordische Gattungen und Arten von Sertulariden, p. 29.

Finely built pinnate colonies, the branches often secondarily ramified pinnately in the same plane as the main colony. Stem zigzag, with paired subalternating hydrothecæ in two opposite rows. There are as a rule three, more rarely four hydrothecæ between two successive branches on the same side of the stem, the lowest in the branch angle. The hydrothecæ of the branches also are arranged subalternately in two rows. The hydrothecæ have a swollen basal part, narrowing upwards, and with a slightly expanded opening margin; the opening plane is almost perpendicular to the branch axis. The opening margin lacks adcauline sinus, and has a large adcaulinally fastened opercular plate. The free distal part of the adcauline wall about half as long as the hydrotheca, and twice the opening diameter. The distance between two successive hydrothecæ on the same side is about equal to the length of the hydrotheca. The diaphragm is almost radially symmetrical, with circular aperture.

The gonothecæ arise close under the base of the hydrothecæ, and are as a rule set on the upper side of the branches. They are oval, with rudimentary stalk, and have a broad, short cylindrical neck.

Material:

"Thor" 65°52′ N., 23°58′ W., depth 62 metres
— 64°02′ N., 22°33′ W., — 34 —
Greenland, on ascidiæ (without further details).
Iceland: Bakkefjord, depth 25—32 fathoms
Seydisfjord, — 6—38 —
Reydarfjord, — 50 —
Faskrudsfjord, — 20—50 —
Breidalsvik, — 14 —
Djupivogr, — 8 —
Vestmanö, — 10—15 —
Faxebugt, — 25 —
Stykkisholm — 30 —
Skálanes, — 7—8 —

Iceland: 6 miles W. of Iceland, 65°32′ N., 24°38′ W., depth 25 fathoms
Patreksfjord, depth 15—50 metres
Dyrafjord, (depth not stated)
Adalvik, (— - —)
The Faroe Islands: 61°07′ N., 9°30′ W., depth 410 fathoms
6 miles N. by W. of Store Kalsö, depth 60 fathoms.

Abietinaria filicula is a boreal species, rarely penetrating into arctic waters, nor does it enter the warmer seas; its distribution is circumpolar. Within the area investigated (fig. LXIII) it is frequent

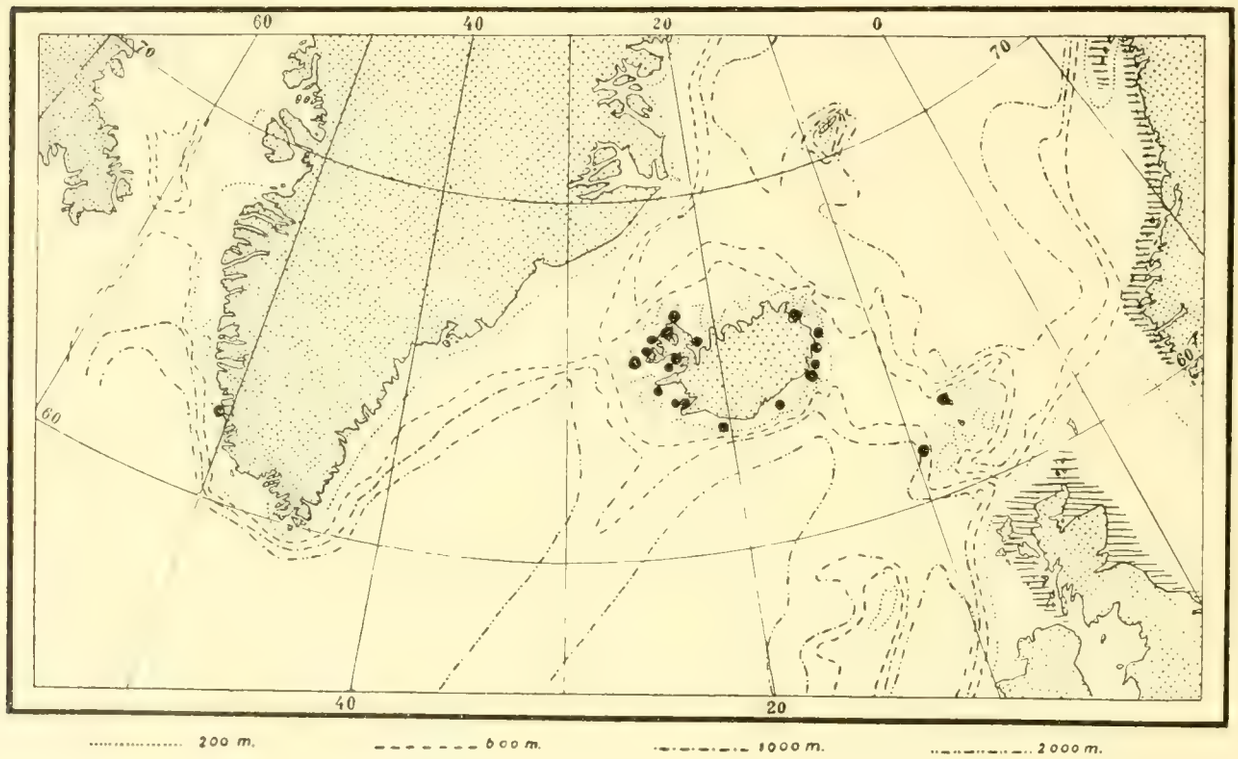

Fig. LXIII. The distribution of *Abietinaria filicula* in the Northern Atlantic.
In the hatched regions the literature notes a common occurrence.

off the west coast of Norway, and in the northern British waters; at the Faroe Islands it seems to be rare, while on the other hand it is one of the commonest species in Iceland waters, albeit lacking here along the north coast. About Greenland, *Abietinaria filicula* is very rare, and has only been recorded with certainty once from the west coast, near Godthaab. It belongs to the littoral region, but can quite exceptionally also move down into the abyssal, as for instance west of the Faroe Islands.

Abietinaria (?) fusca (Johnston) Levinsen.

1847 *Sertularia fusca*, Johnston, A history of the British Zoophytes, p. 70, fig. 11.
1874 *Thujaria salicornia*, Allmann, Report on the Hydroida . . . . . Porcupine, p. 473, pl. 65, fig. 3.
1878 *Sclaginopsis fusca*, Mereschkowsky, New Hydroida from Ochotsk, Kamtschatka . . . . . p. 436.
1913 *Abietinaria fusca*, Levinsen, Systematic Studies on the Sertulariidæ, p. 310.

Stiffly built, pinnate, dark-brown colonies with undivided branches. The stem, which is monosiphonic, is divided up into irregular internodia, and has two single longitudinal rows of hydrothecæ and two rows of alternating branches; there are three hydrothecæ between two successive branches on same side of the stem, the lowest in the branch corner. The branches have two rows of very closely packed hydrothecæ, the hydrothecæ in the single longitudinal rows have their oral parts alternately turned to either side, making a distinct approach to quadriserial arrangement, and the branches thus become almost quadrilateral in section. The hydrothecæ are small, entirely embedded, without any free distal part of the adcauline wall; the opening margin forms an adcauline sinus, in which the large opercular plate is attached. The hydrotheca opening is comparatively very large.

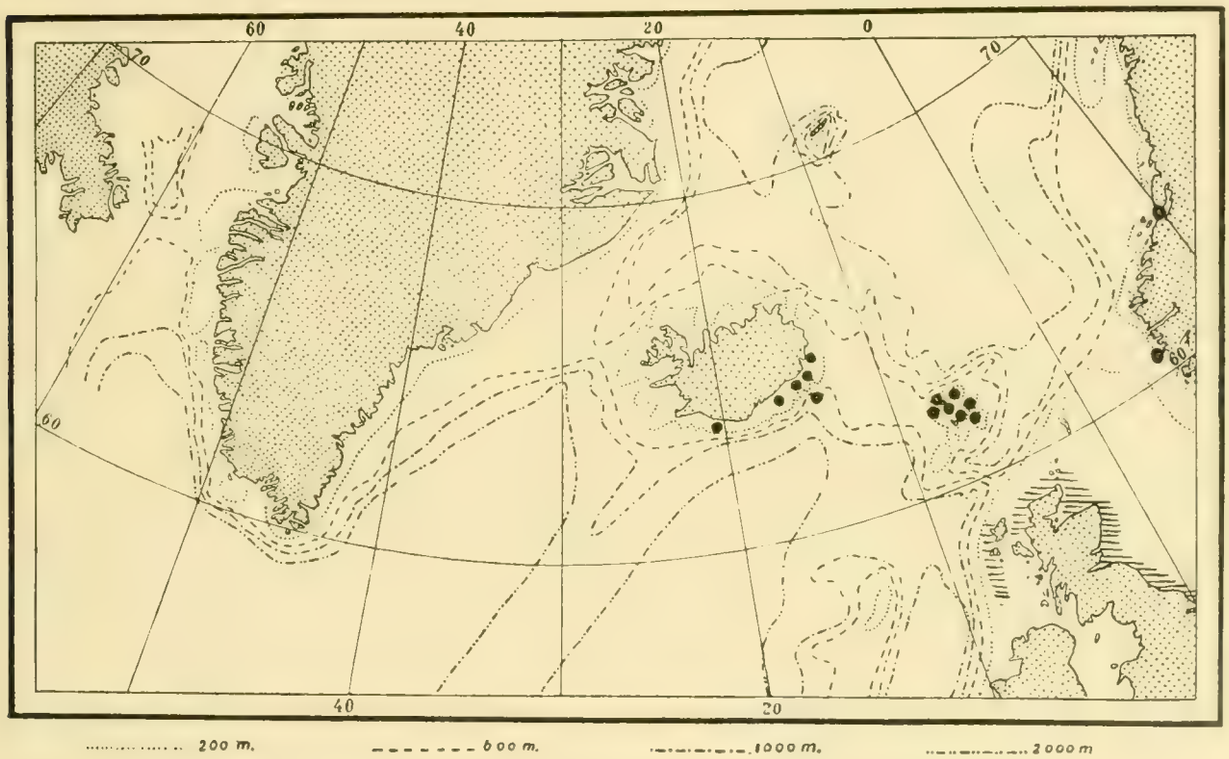

Fig. LXIV. The occurrence of *Abietinaria (?) fusca* in the Northern Atlantic.
(In British waters the data are somewhat vague, but note a rather common occurrence).

The gonothecæ are set on the upper side of the branches. They are pear-shaped, with short stalks.

Material:

"Ingolf" St. 55 63°33′ N., 15°02′ W.; depth 316 fathoms, 5,9°
The Faroe Islands: 7 miles N. by E. of Myggenæs point, depth 57 fathoms
6 — N. by W. of Store Kalsö, — 60 —
Deep hole at north point of Nolsö, — 100 —
16 miles E. by S. of south point of Nolsö, — 80 —

It is uncertain whether this species can be allowed to retain its place in the genus *Abietinaria*.

Unfortunately, the state of the material did not permit investigation of the structure of the polyp, as to whether a blind sack has been developed or not; a query is therefore here appended to the generic name.

The geographical data for *Abietinaria (?) fusca* (fig. LXIV) present a somewhat scattered impression of an atlantic species not penetrating far into the boreal waters. On the other hand, its marked local restriction is highly surprising; the entire area of distribution of the species, or very nearly so, is shown in the chart. Outside the areas marked, *Abietinaria (?) fusca* has hitherto been recorded from the east coast of England and from Bohuslän (Sweden), as also, strangely enough, in a single instance from the Kola Peninsula (Jäderholm 1909 p. 95). Once also — "Ingolf" St. 55 — the species has been met with in the upper part of the abyssal region; otherwise, it has only been taken in the lower part of the littoral.

Gen. Sertularia (Linné).

Upright colonies with embedded, bilateral hydrothecæ, the opening with two large lateral teeth, between which is a large abcauline and a smaller adcauline sinus; the latter may be divided into two by a slightly prominent low median tooth. In each of the two main sinuses there is fastened a closing membrane, so that the closing apparatus consists of a smaller adcauline membrane without free part, and a larger abcauline membrane with free distal part. The polyp has a well developed abcauline blind sack.

The organisation of the polyp warrants the distinction here made between *Sertularia* and *Dynamena*. The genus *Sertularia*, as here laid down, forms a well-defined whole; the separation of the different *Sertularia* species, however, is an extremely difficult matter, and it is important first of all to take a survey of the various characters and their significance, in order to form an opinion as to the value of the species described from northern waters. In Jäderholm's arrangement (1909 p. 25) we find under *Thujaria* the following *Sertularia* species: *Sertularia Fabricii* Levinsen, *Sertularia robusta* Clark, *Sertularia plumosa* Clark, *Sertularia vegae* Thompson, *Sertularia argentea* Linné, *Sertularia cupressina* Linné, *Sertularia inflata* Schydlowsky, *Sertularia Tolli* (Jäderholm), *Sertularia Thompsoni* Schydlowsky, *Sertularia tenera* G. O. Sars, *Sertularia arctica* Allman, and *Sertularia Birulæ* Schydlowsky; to this must be added the polyserial *Sertularia mirabilis* Verrill. There is no doubt that the number of species must, on further investigation, be very considerably reduced. An examination of the variations which may occur within a single large colony will suffice to convince an unbiassed investigator that quite a number of the specific characters employed must be ranked among the more or less accidental variations, while other characters again properly belong to the category of developmental stages. It has not proved possible to procure indubitable specimens of all the 13 species mentioned, but I am inclined to ascribe this in part to their lack of solidity.

I have already in a previous work (1909 p. 171) pointed out that of the above-named species, *Sertularia arctica* and *Sertularia Thompsoni* are undoubtedly synonymous with *Sertularia tenera*. Jäderholm's drawings (1909 pl. 9, figs. 7—9) clearly show that *Sertularia vegæ* is synonymous with *Sertularia robusta*, to which species *Sertularia plumosa* should also probably be referred. We have

thus brought down the number of species to 8 or 9, which figure, as will be seen from the following, must be yet further reduced. Before passing on to special treatment of the different species, however, certain remarks as to the nature of the variations will not be out of place.

The form of the colony in all young *Sertularia* specimens is pinnate, and with the exception of a very few species such as for instance *Sertularia mirabilis*, it appears to be a general rule that the stem sooner or later assumes a spiral coil, while at the same time the broad plane of the branches changes from the perpendicular to the horizontal, perpendicular to the axis of the stem. The cause of this spiral coiling it is difficult to determine, but the feature itself cannot be accepted as a good specific character (cf. Broch 1912 p. 13). More importance should be attached to the winding of the coil, whether right or left; the only northern species which is dextrorse is the *Sertularia Fabricii*.

A peculiarity in all spirally coiled species is the fact that their branches are more or less markedly dichotomically ramified; as long as the colony still preserves its pinnate shape, this secondary ramification is less pronounced, but in spirally coiled forms it is more so.

The stem may be more or less prominent in one and the same species, now darker, now lighter in hue, as a rule slightly zigzag, more rarely quite straight, though this cannot be taken as a specific character. The distance between the branches proceeding from the stem likewise varies within one and the same species, and this feature has considerable influence on the habitus of the colony generally. The stem is in all species segmented; in those investigated, the internodia had as a rule one, more rarely two, and in quite exceptional cases three branches; where only one branch is present, it proceeds from the basal part of the internodium. It is not altogether impossible that the frequency of branches from the internodia may prove of some value as a specific character.

The hydrothecæ are subject to considerable variation within one and the same species. The divergent free distal part may diverge more or less from the branch, and it is somewhat different in the pinnate and spiral parts of the colony. In the pinnate portions, the symmetrical plane of the hydrotheca always coincides with the broad plane of the branch; in the spirally coiled part, on the other hand, we find that the hydrothecæ in most of the species tend more or less towards unilateral arrangement on the upward side of the branch. The aperture, however, varies very little indeed, and Nutting's statement (1904 p. 70) as to great variation in the character of the aperture in *Sertularia tenera* can only be ascribed to insufficient care in the investigation. Owing to this tendency to unilateral arrangement, we normally find that the hydrothecæ on these branches are seen in oblique projection. This has led numerous investigators to regard certain species, such as in particular *Sertularia argentea*, as furnished with asymmetrically developed lateral teeth, whereas careful investigation shows that this is not the case. — The proportion between length of the hydrotheca and the free projecting part seems to furnish a useful specific character.

The gonothecæ are, as already pointed out (1909 p. 172) extremely variable in *Sertularia* species, and their developmental stages have more than once been used as specific characters. It is simply astonishing to see how far from critical the investigations have often been with regard to this. The grown gonothecæ vary greatly in one and the same species. In species where they have no spines, they may be round in section, or angular, with a varying number of angles; this is also noted by Jäderholm (1909 p. 94) but he has not noticed that one colony may have both round and angular

gonothecæ at the same time. This character should therefore be used with caution. In species where the gonothecæ are furnished with spines, the development of the spines themselves often varies greatly in gonothecæ which are fully developed and bear acrocysts; their number also is subject to accidental variation in a striking degree. All this calls for discretion in using the gonothecæ as specific characters.

The variational phenomena here mentioned show, that careful and critical judgement is necessary in defining *Sertularia* species, at the same time indicating that many of the species already established have little justification for their position as such. The present material does not include all northern species, and cannot serve as a basis for thorough revision; it will nevertheless contribute to the elucidation of certain synonyms.

Sertularia cupressina Linné.

1758 *Sertularia cupressina*, Linné, Systema naturæ, Ed. 10, p. 808.
1758 *Sertularia argentea*, Linné, Systema naturæ, Ed. 10, p. 809.

Upright colonies, the young ones, and the basal parts of the larger ones, to a greater or lesser extent pinnate, with alternating or partly opposite branches. The older colonies have, for a shorter or greater distal part, sinistrorse spirally coiled stem, so that the branches stand in a spiral. The stem is as a rule distinctly prominent, monosiphonic, with a branch arising basally from the internodium; more rarely, the latter may have two, or quite exceptionally three branches. The branches themselves are secondarily more or less ramified dichotomically, their broad plane is in the pinnate parts perpendicular, in the spiral horizontal. Between two successive branches on the same side of the stem or in the same spiral there are two to four, as a rule three hydrothecæ, the lowest at the branch angle. The branches are divided up into irregular internodia with a varying number of hydrothecæ on each; the hydrothecæ are on the lower branches oposite, or subalternately placed, and have a common plane of symmetry with the branch; on the upper branches they are more or less turned upward towards the upper side of the branch; i. e. with a tendency to unilateral arrangement. The depth to which they are embedded in the branch varies somewhat; the basal have a smaller, the distal a larger free distal part. The adcauline wall has a free part from one-fourth to one-half the length of the hydrotheca; from one-third to a little more than the diameter of the aperture. The hydrotheca has its greatest breadth nearly at the middle, and narrows sharply towards the aperture, less markedly towards the base. The opening has two strong lateral teeth of equal size. The abcauline opercular plate has a large free distal part.

The gonothecæ proceed from the branches close under the base of the hydrothecæ, and on the upper branches they are always on the upper side. They are pear-shaped to slender oval, and oval in transverse section, distally provided with one or two lateral teeth in a highly variable stage of development; the teeth may also be entirely lacking. Distally, they narrow evenly down to a short, broad opening often surrounded by a short cylindrical neck.

Material:

"Thor" 65°52′ N., 23°58′ W., depth 62 metres
— 65°02′ N., 13°56,5′W., — 140 —

"Thor" 64°02′ N., 22°33′ W., depth 34 metres [labelled *Sertularia tenera*]
— 63°30′ N., 20°14′ W., — 80 —
Iceland: Bakkefjord, — 25—32 fathoms [labelled *Sertularia tenera*]
Faskrudsfjord, — 20—50 —
Vestmanö — 25 —
Hvalfjord, — 22 — [some of the specimens labelled *Sertularia tenera*]
The Faroe Islands: 6 miles N. by W. of Store Kalsö, depth 60 fathoms
7 — N. by E. of Myggenæs point, — 54 —
Vestmanhavn (depth not stated)
Glyversnæs near Thorshavn (— - —)
Deep hole at north point of Nolsö, depth 100 fathoms
5 miles S.S.E. of Bispen, — 50 —
North Sea: 3½ miles W. ¼ S. of Kærgaarde beacon, — 15 metres
2 — N. by W. of Vedersö beacon, — 18—20 —
East coast of Southern Jutland (without further details).

The study of the present extensive material of *Sertularia cupressina* has shown that variations have played a predominant part in the separation of *Sertularia* species. Hincks, in his classic work on the British Hydroids (1868 p. 271) draws distinction between *Sertularia argentea* and *Sertularia cupressina* on the lines that the former has a more bushy appearance, the latter a more "spire-like apex", while at the same time the dark stem of the latter species contrasts strongly against the lighter branches. In a large material, however, both these characters are seen to be subject to great variation, and in both respects the two species pass gradually over one into the other. The other distinctive feature is the hydrothecæ, which are thus described: "The hydrothecæ of the *cupressina* are appressed, tubular, not much narrowed or divergent above, with a bilabiate mouth, while those of *argentea* are shorter, swollen below, tapering upwards, with the aperture bent, sharply pointed at one side, and oblique". We need not here dwell on the general form; this is, as will be seen from the figures here given (fig. LXV) highly variable in one and the same branch. More weight should be attached to the fact that the opening in *Sertularia argentea* is oblique, i. e. furnished with one more and one less prominent tooth. Bonnevie (1899 p. 83) also, in her determinative key, attaches principal importance to this feature, whereas Nutting (1904 p. 62) less happily lays stress upon the remaining features in the hydrotheca. Further investigation, however, soon leads to the conviction that the character is based upon insufficiently careful study. Owing to the strong tendency of the species towards unilateral hydrotheca arrangement on the upper branches, the hydrothecæ will here be viewed in oblique projection (cf. fig. LXV). Consequently, the outer tooth is seen in its full length, the inner foreshortened in perspective. This is the cause of the oft-mentioned "asymmetry", which must consequently be abandoned as a purely fictitious character.

Both the mentioned species are noted in the literature as having the gonothecæ furnished distally with two lateral points, proceeding as outgrowths from the narrow margins of the gonotheca,

which is ellipsoidal in section. Even though this form may predominate in many colonies, it is nevertheless far from constant; a very high degree of variation may normally be observed even within a single colony (fig. LXV *e*—*k*). We often find, on one and the same branch, gonothecæ with two points, others with but one, and some with none at all. (This applies, of course, only to acrocyst-bearing, i. e. fully developed, gonothecæ; those shown were all provided with acrocysts.) Now while in some colonies the two-pointed gonothecæ are numerically predominant, though it is extremely seldom that they are practically supreme, this "normal" form of gonotheca is in the minority in other colonies, where on the contrary the great majority are of the one-pointed type; the entirely spineless

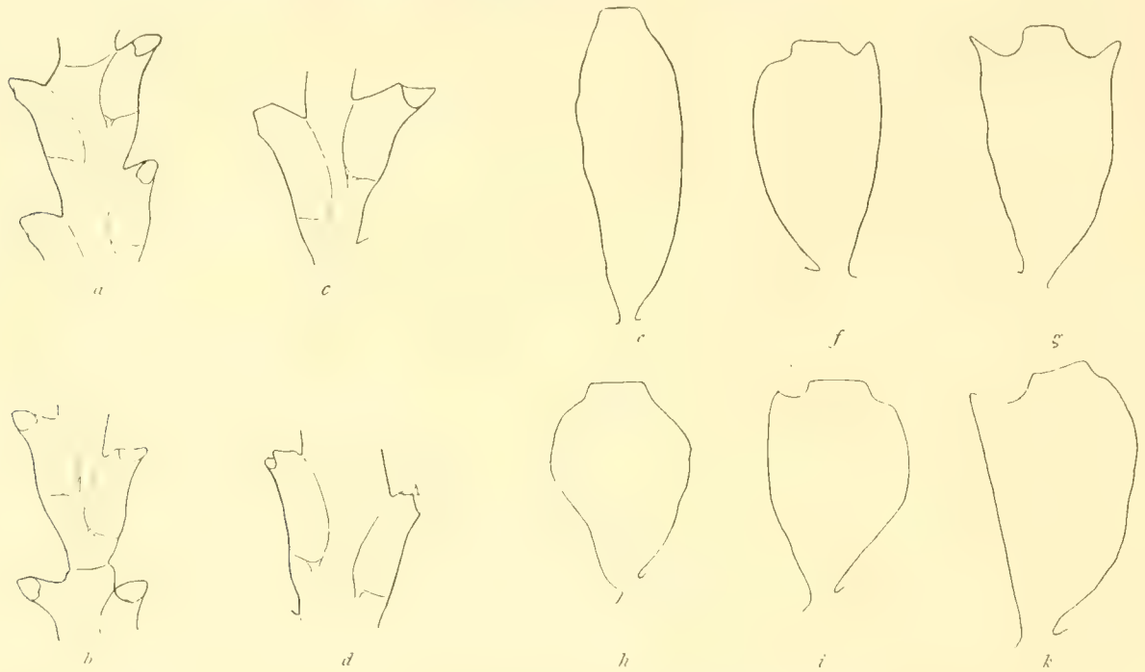

Fig. LXV. *Sertularia cupressina.*
a Distal hydrothecæ of a branch of a colony from the western coast of South Jutland. — *b* Proximal hydrothecæ from the same branch. — *c* Distal hydrothecæ of a branch of a colony from 6 miles N. by W. of Store Kalsö. — *d* Proximal hydrothecæ of the same branch. — *e*—*g* Gonothecæ from the same colony as *a* and *b*. — *h*—*k* Gonothecæ from the same colony as *c* and *d*. (× 40).

gonotheca again is not represented to any considerable number in any colony in the material, and must be reckoned as an exception of more or less frequent occurrence. — The mentioned variations in the gonangia throw a doubtful light upon unicarinate forms such as *Sertularia Birulæ* Schydlowsky, where the trophosome, according to the descriptions given, does not differ from that of *Sertularia cupressina*; the species should doubtless be withdrawn, but as it is not represented in the material, further investigation should be made before the point is decided.

After the investigations described, it is impossible to maintain the distinction between *Sertularia cupressina* and *Sertularia argentea*. The distinction in question, which was originally made from a very restricted material, has since only been retained on the strength of superficial studies, as is shown by the case of the asymmetrically developed teeth above mentioned. And it is just such superficial investigations which have led to this superfluity of species into which the genus is still divided.

Sertularia cupressina should best be characterised as a boreal species capable of penetrating

considerably into the arctic areas, and also southward into warmer seas; it is mentioned from the Mediterranean to Nova Zembla, but the most numerous finds have been made in the boreal region. The species is known from both sides of the Atlantic, and also from the Pacific, which renders its occurrence within the area investigated the more remarkable (fig. LXVI). It is very common in the British waters, and along the west coast of Norway, and is now found to be common also at the Faroe Islands and on the east, south and west coasts of Iceland. It has not however, yet been recorded from Greenland, where there would seem every reason to expect it, since it is known from the arctic waters off the east coast of America. The reason of this peculiarity must for the present be left an open question. *Sertularia cupressina* has its chief occurrence in the upper half of the littoral region, and is only extremely rarely met with in the abyssal.

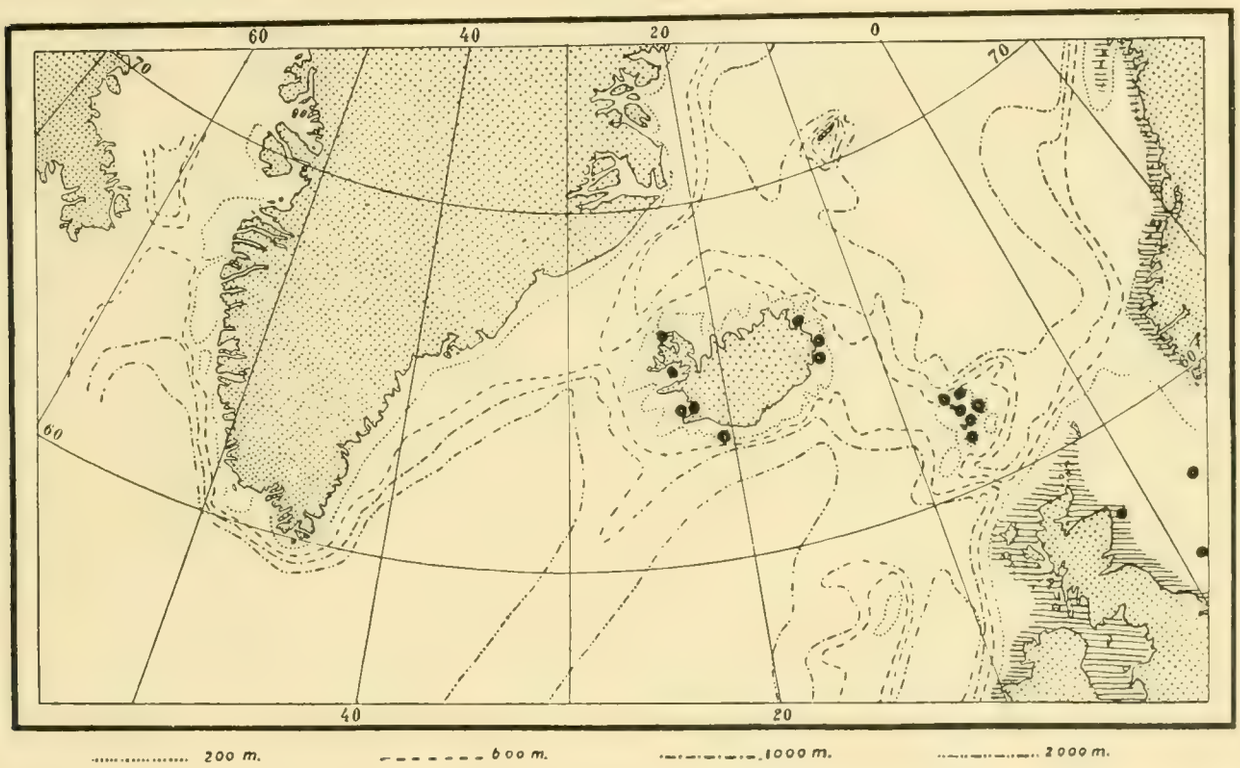

Fig. LXVI. The distribution of *Sertularia cupressina* in the Northern Atlantic.
In the hatched regions a common occurrence is stated.

Sertularia tenera G. O. Sars.

1874 *Sertularia tenera*, G. O. Sars, Bidrag til Kundskaben om Norges Hydroider, p. 108, pl. 4, figs. 1—4.

1874 *Sertularia arctica*, Allman, On the diagnosis of new genera and species of Hydroids, p. 179.

1884 *Sertularia albimaris*, Thompson, The Hydroid Zoophytes of the "Willem Barents", p. 3, pl. 1, figs. 1—3.

nec 1877 *Sertularia albimaris*, Mereschkowsky, On a new genus of Hydroids ..... p. 228.

1887 *Sertularia argentea* + *S. Dijmphnæ*, Bergh, Goplepolyper (Hydroider) fra Kara-Havet, p. 335, pl. 28, fig. 3.

1899 *Dynamena unilateralis*, Bonnevie, Den norske Nordhavs-Expedition, p. 78, pl. 7, fig. 5.

1901 *Sertularia Thompsoni*, Schydlowsky, Les Hydraires de la Mer Blanche.

The young colonies are always pinnate, the larger ones now pinnate, now with distally sinistrorse stem. The stem itself is but slightly pronounced, if at all; it is monosiphonic and indistinctly segmented, with almost regularly alternating branches. The branches again produce irregular, not infrequently alternating branchlets, which may further be tertially ramified. The pinnate portions of the colonies have the broad plane of the branches perpendicularly set; in the spirally coiled ones, on the other hand, it is horizontal. On the same side of the stem, or in the same spiral, there are three very rarely two or four hydrothecæ between two successive branches, the lowest in the branch corner. The branches are divided into irregular internodia with a varying number of hydrothecæ. The hydrothecæ are subalternately to alternately placed; their plane of symmetry coincides, in the pinnate portions, with the broad plane of the branches, but is often much displaced in the spiral parts, so that the hydrothecæ here often come very near to unilateral arrangement on the upper side of the branches. The hydrothecæ are not very deeply imbedded, and have a highly diverging distal part; the free distal part of the adcauline wall is almost invariably more than half the length of the hydrotheca, and twice to three times the opening diameter. The maximal breadth is near the middle decreasing thence equally to either end. The aperture margin has two distinct somewhat rounded lateral teeth of equal size; the abcauline large lid plate has a large free distal part.

Fig. LXVII. *Sertularia tenera.* Part of a branch with a polygonal gonotheca, from the Kara Sea, "Dijmphna". (× 40).

The gonothecæ are attached to the branches close under the base of the hydrothecæ; in the spiral part always on the upper side of the branch. The gonothecæ are oval, and round or polygonal in section, in the latter case with four to six, most frequently five sides; they have distally a broad round opening and an often almost imperceptible tubulous neck.

Forma *spitzbergensis*: large, spiral and bushy colonies with approach to unilateral arrangement of the hydrothecæ.

Forma *sibirica*: large, pinnate, slender colonies with no indication of unilateral arrangement in the hydrothecæ.

Material:

"Ingolf" St. 69 62°40′ N., 22°17′ W., depth 589 fathoms 3,9°
"Thor" 64°16′ N., 22°17′ W., — 50 metres
Greenland: Egedesminde, on *Boltenia*, — 30—50 fathoms
Iceland: Hvalfjord, — 22 —
The Faroe Islands: 2 miles N.W. of Agraleide, depth 150 fathoms
Kara-Sea: "Dijmphna" [labelled *Sertularia argentea* and *Sertularia Dijmphnæ*].

Sertularia tenera stands clearly apart from the foregoing species, and appears to vary somewhat less in the shape of the hydrothecæ. The two geographical varieties are peculiar; the only real distinction lies in the habitus of the colony, and it is not altogether rare to find transition forms, especially in the Murman Sea. We are still, however, unaware as to what factors exert the determinative influence upon the shape of the colonies.

The principal difference, as compared with *Sertularia cupressina*, is apparent, even in quite young colonies, from the shape of the hydrothecæ. *Sertularia tenera* (fig. LXVII) has larger hydrothecæ than the mentioned species, and the highly divergent, quite large distal free part gives the colonies a peculiar appearance, very suggestive of *Abietinaria filicula* (Ellis et Solander) with which also its dimensions very nearly agree. A character applicable to the larger colonies on the whole is the fact that the main stem in *Sertularia tenera* does not exhibit any superiority in point of thickness over the branches, whereas in *Sertularia cupressina* it stands out in virtue of its greater dimensions; this feature, however, is not always absolutely reliable. — Despite their great variability, the gonothecæ also present certain differences as between the two species. The gonothecæ in *Sertularia*

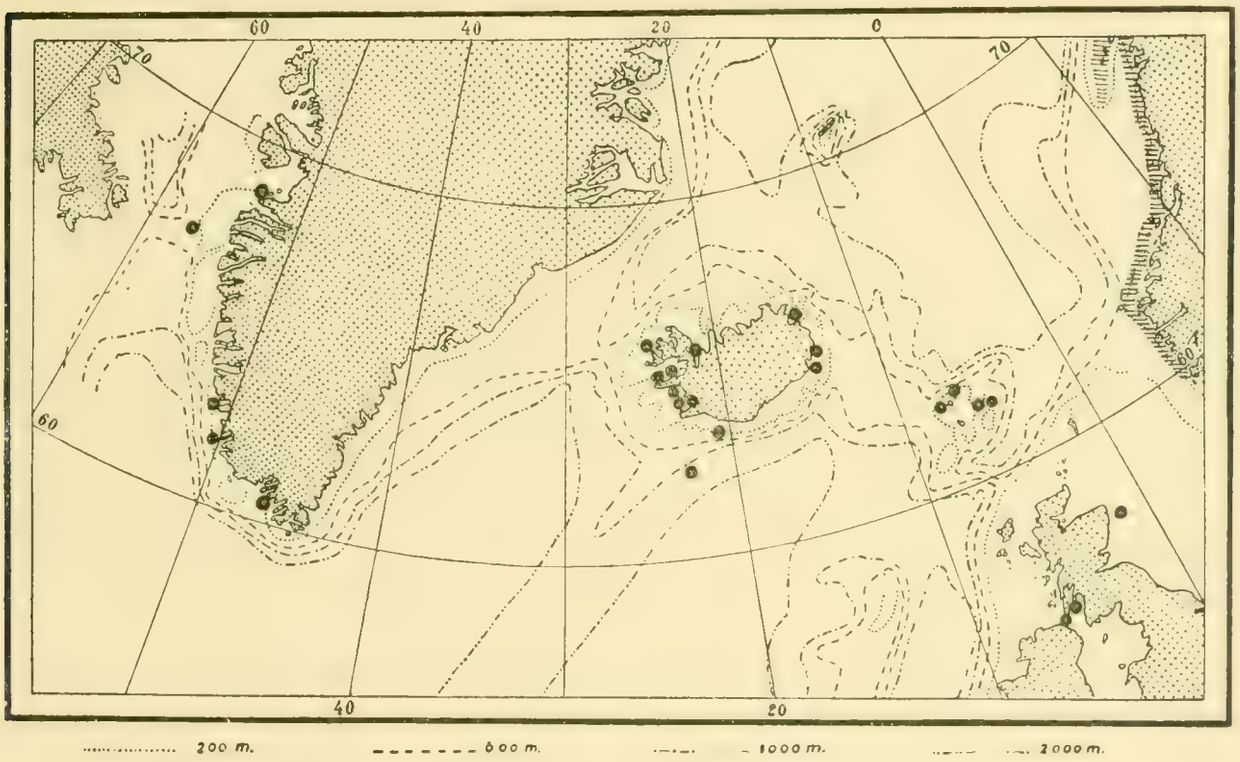

Fig. LXVIII. The distribution of *Sertularia tenera* in the Northern Atlantic.
In the hatched region a common occurrence is recorded.

tenera are, even where the polygonal form is markedly prominent, never furnished with spines, as is normally the case with *Sertularia cupressina*.

Jäderholm (1909 p. 94) suggests the possibility that *Dynamena unilateralis* Bonnevie (1899 p. 78) might be synonymous with *Thujaria arctica* (Allman). An investigation of the original specimens fully bears out the correctness of this supposition; the specimens are well developed and entirely typical colonies of *Sertularia tenera* forma *spitzbergensis*.

Sertularia tenera is an arctic-boreal species having its most frequent occurrence at the limit between the two areas; it belongs to the littoral region, and only exceptionally does it move down into the abyssal. The species has never before been met with at such a depth as at the "Ingolf" St. 69, and this find must be regarded as a mere accident. Ritchie (1911 p. 218) believes the species to

be more common in the Scottish waters than is generally supposed from the data obtained; he considers it likely that it may have been confused with young colonies of *Sertularia argentea*. This supposition will probably prove correct, as the species is fairly common along the west coast of Norway, and penetrates right down to Bohuslän. It is also not uncommon at the Faroe Islands and Iceland; with regard to the latter locality, it is scarce on the south coast, and apparently not very frequent on the north. From East Greenland, it is known only by a single find far to the north, whereas it has been met with several times in West Greenland waters. (Fig. LXVIII).

Sertularia Fabricii Levinsen.

1893 *Sertularia Fabricii*, Levinsen, Meduser, Ctenophorer og Hydroider, p. 48, pl. 6, figs. 14—17.

Upright colonies with not very pronounced, monosiphonic stem, the hydrothecæ and branches forming dextrorse spirals. Of the basal branches, only the basal internodium is retained, the remainder falling away. The stem is divided into internodia, each bearing a basal branch, alternating in each of the two hydrotheca series; between two successive branches in the same hydrotheca series the stem has normally three hydrothecæ the lowest in the branch corner. The broad plane of the branches is horizontally set. The branches are secondarily ramified dichotomically, and divided into internodia of varying length. The hydrothecæ are set in two rows, subalternately or alternately placed; they are deeply imbedded the free part of the adcauline wall is between one-third and one-sixth the length of the hydrotheca, or between one-half and one whole opening diameter. The distal part of the hydrotheca diverges only slightly from the axis of the branch On the spiral branches, the hydrothecæ tend more or less towards unilateral arrangement on the upper side of the branch. The hydrothecæ are of equal breadth in their imbedded part, and narrowing slightly in the free portion towards the opening; the margin of the latter has two short and broad lateral teeth; the abcauline opercular plate has a large free distal part.

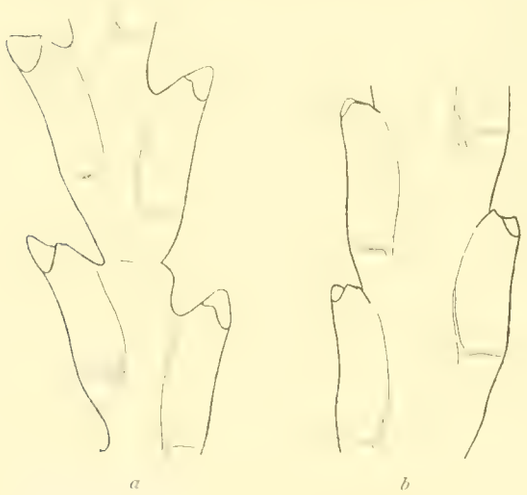

Fig. LXIX. *Sertularia Fabricii* from Godthaab. *a* Hydrothecæ from the distal part of a branch. *b* Hydrothecæ from the proximal internodium of the same. (× 40).

The gonothecæ proceed from below the base of the hydrothecæ on the upper side of the branch. They are slender, reversely conical, somewhat flattened in transverse section, the narrow sides as a rule running out each into one short, strong tooth; more rarely, one tooth — or both — may be lacking. The gonotheca has a broad distal aperture, furnished with a short, often rudimentary cylindrical neck.

"Ingolf" St. 2, 63°04′ N., 9°22′ W., depth 262 fathoms 5,3°
— - 3, 63°35′ N., 10°24′ W., — 272 — 0,5°
— - 4, 64°07′ N., 11°12′ W., — 237 — 2,5°

Greenland: Store Hellefiskebanke, depth not stated
Godthaab, depth 30—40 fathoms
Julianehaab, depth not stated
} Levinsen's type specimens.

Jan Mayen, depth 50—60 fathoms (East-Greenland Expedition).
Iceland: Mouth of Berufjord, depth 41—54 fathoms.
Kara Sea, "Dijmphna".

Sertularia Fabricii is very closely related to *Sertularia cupressina*, but differs primarily in its dextrorse stem. Moreover, its hydrothecæ are as a rule more deeply imbedded than in the latter species (fig. LXIX). Levinsen (1893 p. 48) calls attention to a peculiarity in the species, to wit, that the basal branches throw off their extreme parts, leaving only the proximal internodium; this appears to be a characteristic feature in the species, the explanation of which cannot be arrived at from our present knowledge of its biology; it gives the species a highly remarkable appearance. Another char-

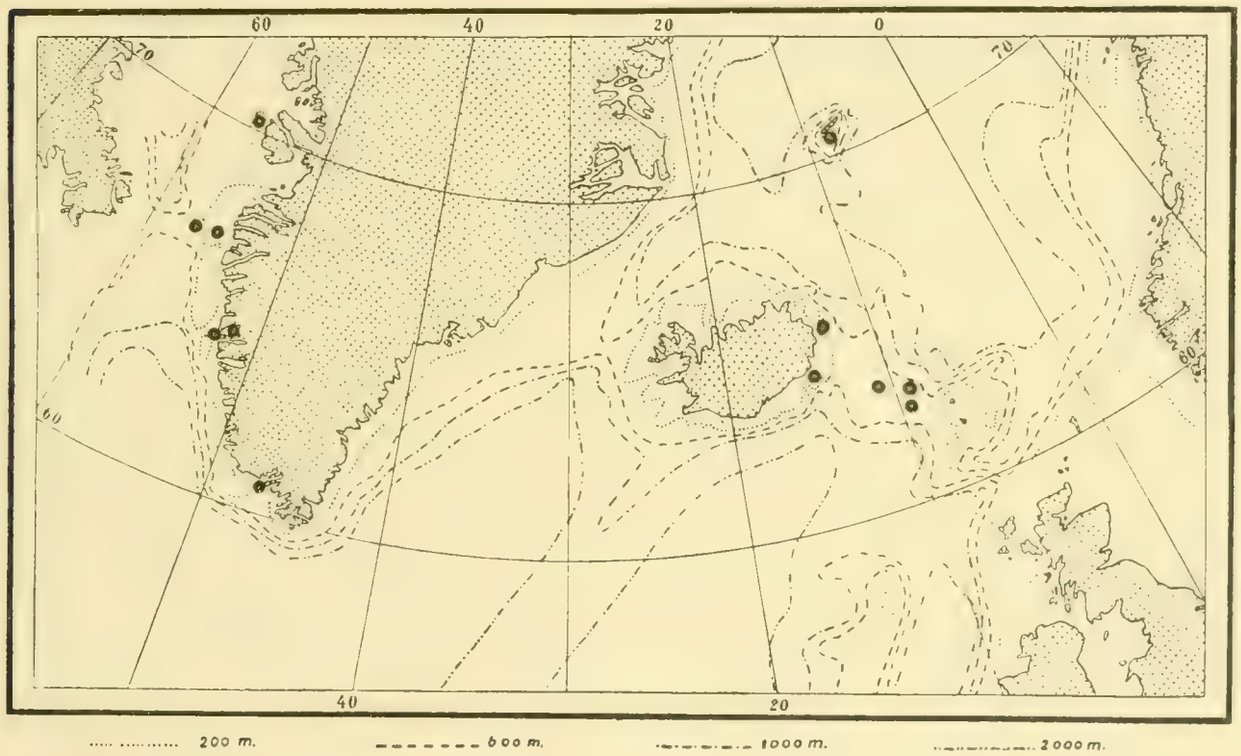

Fig. LXX. Finds of *Sertularia Fabricii* in the Northern Atlantic.

acter which has been emphasised is less reliable; according to Levinsen, the upright direction of the branches is 45° with the longitudinal axis of the stem; but the colonies from Jan Mayen and from the "Ingolf" St. 2 had branches standing out almost perpendicularly from the stem, and farther out even turning downwards; in these colonies also, the tendency to unilateral arrangement of the hydrothecæ is remarkably slight; despite this, and despite the fact that they are of finer build than those from Greenland, they cannot be regarded as types of a distinct species.

It is interesting to note how exactly the hydrothecæ in *Sertularia Fabricii* follow the same rules in their variation as in *Sertularia cupressina*. On the proximal part of the branches, the hydrothecæ are far more deeply imbedded than at the extremities (fig. LXIX). The gonothecæ, on the other hand, evince a much slighter variational tendency in the present specimens, which rather give

one the impression that only the extreme — and thus latest developed — gonothecæ on the branches can lack one or the other of the distal spines. This is different from what we find in *Sertularia cupressina*, where the variants are distributed throughout the whole of the branch, without any distinctly demonstrable regularity. Nutting (1904 p. 71) who mentions the fact that the gonothecæ in *Sertularia Fabricii* do vary, has not gone into the question of detail.

The recent assignment of a previously undetermined specimen from the Kara Sea to *Sertularia Fabricii* suggests that we have here a circumpolar species, capable of penetrating somewhat down into the boreal areas. Further investigations will probably show the species to be more common in arctic waters than would appear from the data on record. *Sertularia Fabricii* doubtless belongs, strictly speaking, to the littoral region, but can, as shown by the finds at "Ingolf" St. 2, 3, and 4, also move some way down into the abyssal. The species has previously been recorded from Alaska and Puget Sound. Within the area investigated (fig. LXX) it is noted from West Greenland, Jan Mayen, and the submarine ridges between Iceland and the Faroe Islands, where the fauna is of a mixed character.

Sertularia (?) tubuliformis (Marktanner-Turneretscher) Levinsen.

1890 *Dynamena tubuliformis*, Marktanner-Turneretscher, Die Hydroiden des k. k. naturhistorischen Hofmuseums, p. 238.

1904 *Thujaria tubuliformis*, Nutting, Sertularidæ, p. 70, pl. 11, figs. 1—8.

1913 *Sertularia tubuliformis*, Levinsen, Systematic Studies on the Sertulariidae, p. 298.

Upright pinnate colonies with alternating branches. The main stem has, on each internodium, on one side a branch and two hydrothecæ, on the other a hydrotheca. The branch has in most cases minor branchlets oppositely placed, and is divided by distinct segmentation into internodia, bearing two to four, generally three pairs of hydrothecæ, of which the basal ones are the largest, the distal being the smallest. The internodium as a whole tapers distally. The hydrothecæ are set in more or less markedly subalternating, often almost opposite pairs, and are deeply imbedded. The free part of the adcauline wall is between one-third and one-fourth the length of the hydrotheca, from half to once the opening diameter. The hydrothecæ are of almost equal breadth throughout their length. The opening margin has two large lateral teeth, and a more or less strongly developed median tooth in the adcauline sinus. The closing apparatus consists of two membranes, of which the abcauline has a free distal part.

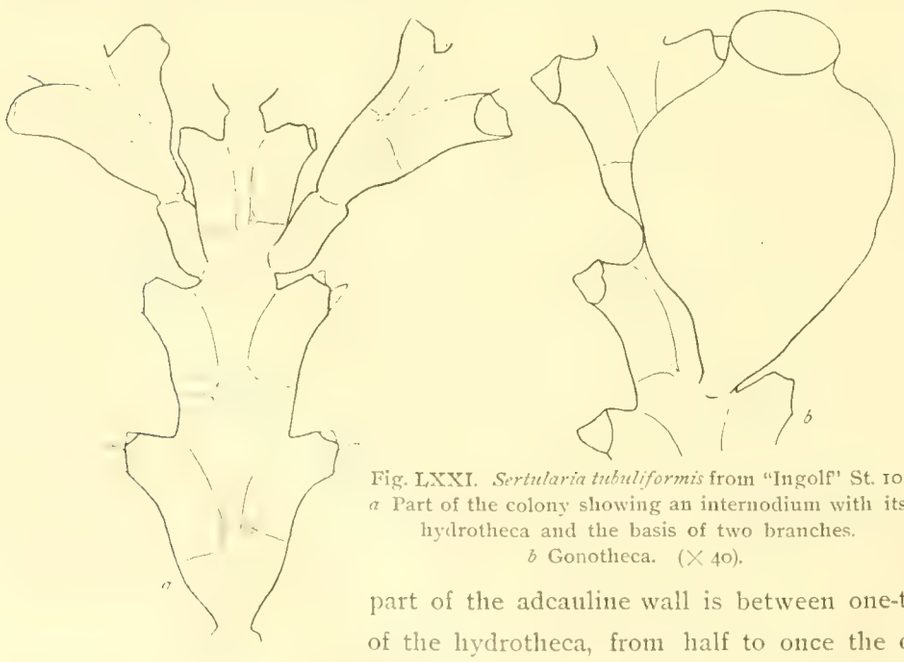

Fig. LXXI. *Sertularia tubuliformis* from "Ingolf" St. 10. *a* Part of the colony showing an internodium with its hydrotheca and the basis of two branches. *b* Gonotheca. (× 40).

The gonothecæ proceed from close beneath the base of the hydrothecæ. They are flattened pear-shaped, with a broad opening on a distally central, trumpet-shaped neck.

Material:

"Ingolf" St. 10 64°24′ N., 28°50′ W., depth 788 fathoms, 3,5°.

In point of habitus, this little colony much resembles *Dynamena pumila*. Unfortunately, the state of preservation did not permit any further study of the polyps, and it is not impossible that the species may be found to lack the blind sack, in which case, of course, it must be referred to the genus *Dynamena*. There is no pronounced main stem, and the colony itself rather presents the impression of being only a branch. In all other features however (fig. LXXI) it entirely agrees with earlier descriptions, as also with colonies from West Africa, so that its specific identity is beyond doubt.

Levinsen (1913 p. 298) notes that the median tooth in this species is of the same length as the lateral ones; this I have not found to be the case in any of the specimens I have been able to examine. The median tooth varies somewhat, and Levinsen's statement seems to suggest that his material consisted of extreme variants.

The finding of this species in deep water so far to the north is highly interesting. In the Atlantic, it was formerly only known from West Africa, and from the tropic-subtropical littoral region of America to the region of Florida. It will probably also prove to inhabit other localities in the deep warm atlantic waters, when sufficient investigations have been made.

Sertularia mirabilis (Verrill) Levinsen.

1873 *Diphasia mirabilis*, Verrill, Brief contributions to Zoology, p. 9.
1893 *Sertularia mirabilis*, Levinsen, Meduser, Ctenophorer og Hydroider, p. 49.

Upright, robust, pinnate, colonies. The main stem slightly zigzag, monosiphonic, and with two single rows of alternately set hydrothecæ. Between two successive branches on the same side of the stem there are three hydrothecæ, the lowest in the angle of the branch. The branches have six, more rarely only four longitudinal rows of hydrothecæ, the arrangement being produced as follows: three (or two) hydrothecæ are set in a wreath at the same height, and the next circle has its hydrothecæ facing the intervals of the first. The hydrothecæ are fairly deeply imbedded in the stem and branches, with a free part of the adcauline wall only about half the length of the hydrotheca, or between two and three diameters of the opening. The opening margin has two lateral, strongly prominent teeth and an almost rudimentary median tooth in the adcauline sinus. The abcauline closing membrane has a free distal part.

The gonothecæ proceed from close under the base of the hydrothecæ on the one side of the branches. They are pear-shaped to oval, smooth, with a rudimentary neck and broad round aperture.

Material:

"Thor" 61°07′ N., 9°30′ W., depth 835 metres
Greenland: Kudlisat, Disco (depth not stated)
Store Hellefiskebanke, depth 24—32 fathoms.

Iceland: Adalvig (depth not stated).

Kara Sea: "Dijmphna".

Sertularia mirabilis is a circumpolar arctic species, belonging to the upper and middle parts of the littoral region. This being the case, it is remarkable to find it, west of the Faroe Islands, in the abyssal region, as taken by the "Thor" (fig. LXXII). Within the waters investigated, *Sertularia mirabilis* is a species of rare occurrence, otherwise found once at the north-west point of Iceland, and high up in Davis Strait off the west coast of Greenland.

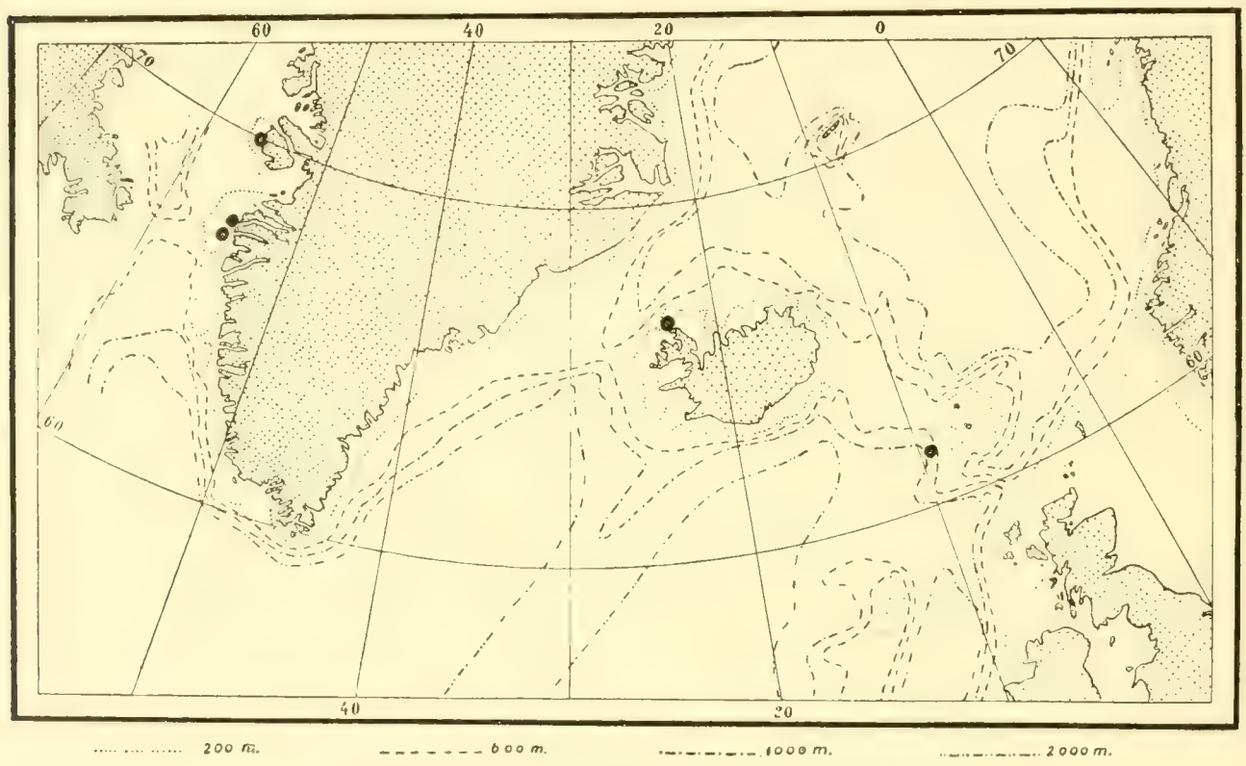

Fig. LXXII. Finds of *Sertularia mirabilis* in the Northern Atlantic.

Gen. Hydrallmania (Hincks).

Upright colonies with bilateral sessile to slightly imbedded hydrothecæ. The hydrotheca aperture is furnished with two lateral teeth, between which there is a smaller abcauline and a larger adcauline sinus; median teeth lacking. In each of the two sinuses there is fastened a membrane, so that the closing apparatus consists of two membranes, the adcauline with a free distal part. The polyp has a well developed abcauline blind sack.

The diagnosis as given coincides with Levinsen's definition (1913 p. 305); we have here merely added the structure of the polyp body. — Levinsen points out that it may be considered doubtful whether a separation between *Hydrallmania* and *Sertularia* really is altogether justified, and the observations noted in the following may to a certain degree serve to accentuate the dubiousness

of the point. In the northern *Sertularia* species, we find a general tendency towards spiral arrangement of the branches, together with an often very marked approach to unilateral arrangement of the hydrothecæ. The spirally placed branches are secondarily ramified, often dichotomically, but in *Sertularia tenera* irregularly pinnately. From this then, it is in reality but a short step to *Hydrallmania*. And finally, there is a certain amount of variation in the *Sertularia* species, with regard to proportion between the two sinuses, which in some species may be characterised as of equal size. We have thus, as the last and most essential distinctive feature, the fact that the adcauline closing membrane in *Hydrallmania* has a free distal part, whereas in *Sertularia*, this is reserved for the abcauline membrane. It may be doubtful whether these small differences should be regarded as of generic importance; for the present, however, I have found it most correct to follow Levinsen in distinguishing between the two genera.

Hydrallmania falcata (Linné) Hincks.

1758 *Sertularia falcata*, Linné, Systema naturæ, Ed. 10, p. 810.
1868 *Hydrallmania falcata*, Hincks, A History of the British Hydroid Zoophytes, p. 273, pl. 38.

Colonies with slender, spiral, monosiphonic and segmented main stem, where as a rule each internodium bears a branch. The branches form an open spiral about the stem, and are themselves regularly secondarily ramified pinnately; the main stem has a hydrotheca in the corner at the origin of the branch, or may in rare cases be altogether devoid of hydrothecæ. Branches and branchlets are segmented, the irregular internodia bear on the one side (the upper) a more or less close row of hydrothecæ, the opening part of which is turned out alternately to either side from the median plane of the branch. On young pinnate colonies the hydrothecæ are imbedded, and alternately placed in two opposite rows on the branches, the broad plane of which stands vertically. The hydrothecæ are bottle-shaped to tubular, distally often bent, in young colonies with biserial arrangement, somewhat imbedded, in older ones with unilateral arrangement and almost sessile. The opening margin is armed with two large lateral teeth, the largest sinus is adcauline, and has a closing membrane with free distal part.

Fig. LXXIII. *Hydrallmania falcata* from the Trondhjem fjord. Part of a branch of a young, pinnate colony of the *Sertularia*-type. (× 40).

The gonothecæ are oval, as a rule somewhat flattened, with a short tubulous neck; they are quite smooth or irregular and slightly furrowed transversely.

Material:

"Ingolf" St. 6	63°43′ N.,	14°34′ W.,	depth	90	fathoms	7,0°
— - 60	65°09′ N.,	12°27′ W.,	—	124	—	0,9°
— - 87	65°02,3′ N.,	23°56,2 W.,	—	110	—	—
— - 127	66°33′ N.,	20°05′ W.,	—	44	—	5,6°
"Thor"	66°19′ N.,	23°27′ W.,	—	115—120	metres	
—	65°52′ N.,	23°58′ W.,	—	62	—	
—	64°16′ N.,	22°17′ W.,	—	50	—	
—	64°06′ N.,	23°14′ W.,	—	98	—	

"Thor" 64°02′ N., 22°33′ W., depth 34 metres
— 63°30′ N., 20°14′ W., — 80 —
— 61°07′ N., 9°30′ W., — 835 —
Iceland: Reydarfjord, depth 45—80 fathoms
Mouth of Berufjord, — 41—54 —
Vestmanö, — 25—30 —
Hvalfjord, — 22 —
Bredebugt, 64°45,8′ N., 23°55,2′ W. depth 30 fathoms
Stykkisholm, — 30 —
6 miles W. of Iceland, 65°32′ N., 24°38′ W., depth 22 fathoms
Talknafjord, depth 22 fathoms
Dyrafjord, — 15 —
Önundarfjord — 10 —
Adalvik (depth not stated).
The Faroe Islands: 6 miles N. by W. of Store Kalsö, depth 60 fathoms
7 — N. by E. of Myggenæs point, — 57 —
12 — N.W. of Agraleide, — 150 —
Deep hole at north point of Nolsö, — 100 —

Sæmundsson (1911 p. 92) briefly mentions that the branches in young colonies of *Hydrallmania falcata* are at times short, unbranched, and biserial, and that the same is often the case with the basal branches in somewhat larger colonies. Levinsen also (1913 p. 308) mentions small pinnate colonies of 29 mm length from Hellebæk, Denmark, but without quoting further details as to the hydrothecæ. The frequent occurrence of the species in the Trondhjem Fjord has afforded an opportunity for closer study; the colonies are often very finely built.

Young colonies of *Hydrallmania falcata* may at times even at a length of 5 cm be singly pinnately branched, and it is then extremely difficult to distinguish them from *Sertularia*. The stem, which is here, of course, not yet spiral, has a hydrotheca at the base of each branch, a feature which is likewise common in larger colonies from the Trondhjem Fjord, and which I have found in most of the other colonies investigated from our seas. The hydrothecæ on the branches in young colonies, as also those on the branches in the pinnate basal parts of older ones, are arranged in two opposite rows (fig. LXXIII) in such a manner that the symmetrical plane of the hydrothecæ coincides with the vertically set broad plane of the branches; the hydrothecæ on these branches are alternately set, and with quite a considerable interval between. The distal half, or more, of the adcauline wall is free; the length of the free portion is from once to twice the diameter of the opening. Quite young colonies are thus extremely liable to be confused with small *Sertularia* colonies, unless the hydrothecæ are very carefully examined. The adcauline sinus in *Hydrallmania* is normally deeper than the abcauline; the difference is, however, at times very slight, and if the closing membranes have fallen away, it is very difficult to identify the colonies.

When the colonies are somewhat larger, the spiral coiling of the stem begins to make its

appearance at the top. And at the same time, a marked change takes place in the branches, which now turn 90° on their axis, so that their original broad plane becomes horizontal; further, a displacement of the hydrotheca towards the upper side of the branch also sets in, and the typical unilateral arrangement usual in the species now becomes apparent. Soon the bases of the hydrothecæ form a single row, and only the oral part is turned or bent out alternately to either side of the median plane, as a last trace of the biserial structure. Gradually also, secondary ramification takes place, the primary branches throwing out secondary branchlets, directed alternately to either side in the primary broad plane of the branch. In the more finely built colonies, the main branch has three, or more rarely four hydrothecæ between two branchlets; in colonies of coarser build, on the other hand, the number is only exceptionally as low as three, and as a rule we find four or more hydrothecæ between the origins of two secondary branches.

The features here mentioned are of importance in several respects. In the first place, they show that *Hydrallmania* colonies agree entirely in their mode of development with the remaining *Sertulariidæ* having spiral stem, as far as this has been studied and described; they prove also, that the *Hydrallmania* colony, which at the first glance appears so entirely distinct, can be easily traced back to the typical colony in *Sertularia tenera* or *Thujaria thuja*. In the second place, the features in question reveal a striking resemblance between finer colonies of *Hydrallmania falcata* and *Hydrallmania distans* Nutting from Puget Sound; the likeness is so great that we are tempted to note them down without further consideration as synonyms, or rather, to regard the specimens from Trondhjem Fjord as belonging to the latter species. It would, however, be highly remarkable that this Pacific species should occur here and not elsewhere in the Atlantic. And closer study now shows that the Trondhjem Fjord type is not isolated, but is related, through every possible transition type, to the close and robust form which is predominant in the open sea, and which has always been taken as the type for *Hydrallmania falcata*. It is interesting also to note that several colonies in the material, as for instance some from Berufjord, have in among the lower normal branches one or two others of the *Sertularia* type. Elsewhere in the material we also find small colonies from several places agreeing with the young form from the Trondhjem Fjord, only of coarser build.

Nutting (1904 p. 126) notes as a distinctive character between *Hydrallmania distans* and *Hydrallmania falcata* that the latter species lacks hydrotheca on the stem at the base of the branch. This is, however, exceptional. The hydrotheca on the stem at the base of the branch may at times, especially in older colonies, be lacking, but in most cases it is to be found, and is always present in the somewhat smaller colonies. Nor can the difference mentioned by Nutting as existent in the gonothecæ be accepted as a specific character; it lies well inside the limits of variation observed in a single fairly luxuriant colony of *Hydrallmania falcata*. That I nevertheless refrain from definitely withdrawing *Hydrallmania distans* is due to the fact that my collections include no material of the species in question, and I am thus unable to determine whether possibly some characters not mentioned in Nutting's diagnosis might be found, sufficient to warrant specific distinction. The other American Pacific species also, *Hydrallmania franciscana* (Trask), calls for thorough investigation, its raison d'être being likewise highly problematical. The available drawings and data for the two species are not enough to decide the question.

Hydrallmania falcata has its chief occurrence in the littoral region of the boreal seas, and may exceptionally penetrate deeper down into the abyssal, where it has, however, once or twice been observed at 2000 metres depth. The species can move right up into arctic waters, and has even been met with in the Kara Sea; otherwise, its occurrence coincides with the presence of warmer currents in the high arctic areas. It may also penetrate some distance to the southward, as is shown by its more sporadic occurrence in the Bay of Biscay. In the North Atlantic also, it has been found off the east coast of America. It is thus the more surprising that it should never have been recorded from Greenland (fig. LXXIV) as it is one of the most common of all species in Iceland waters; on the west and east coast especially, the finds were so numerous that it was impossible to note them all on the

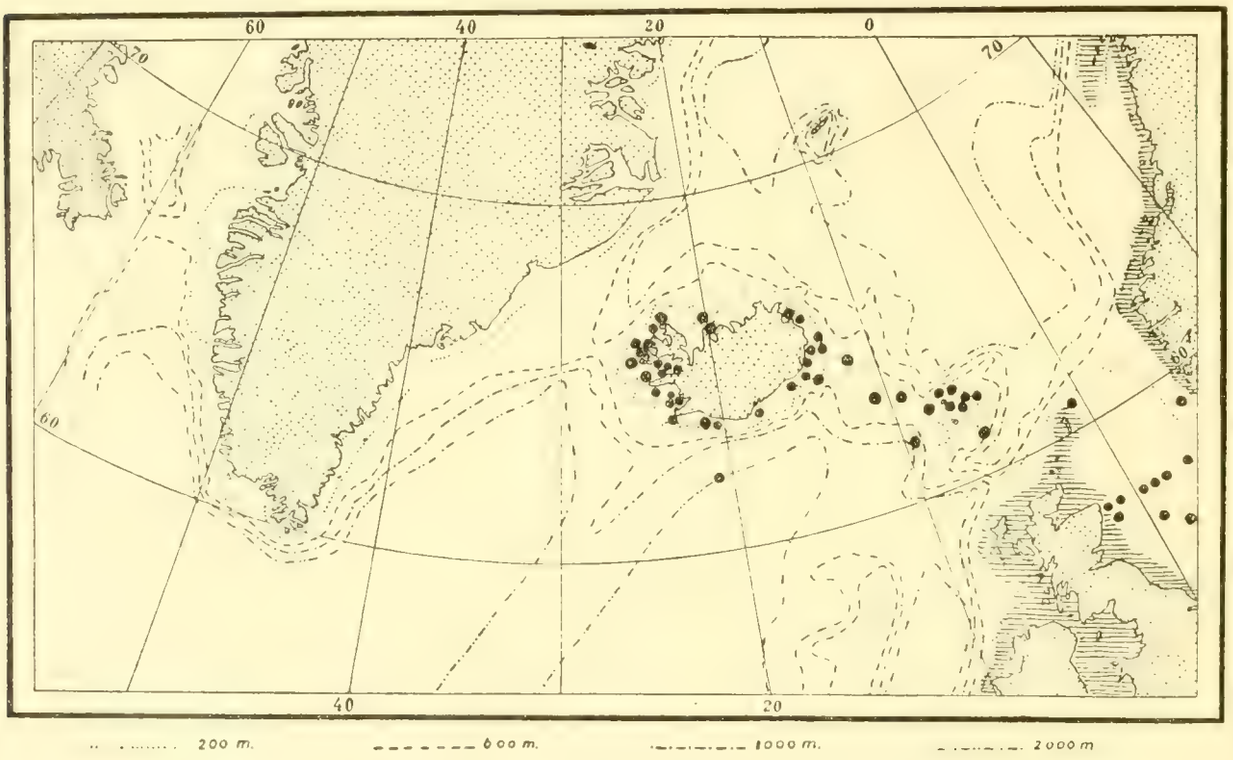

Fig. LXXIV. The distribution of *Hydrallmania falcata* in the Northern Atlantic.
In the hatched regions the literature notes a common occurrence.

chart. On the north coast of Iceland, *Hydrallmania falcata* is quite sporadic in its occurrence, and is not particularly numerous on the south coast. Between Iceland and the Faroe Islands, and on the northern side of the latter, it is again fairly numerous, while in the North Sea area and along the coast of Norway it appears as a character form.

Gen. Thujaria (Fleming).

Upright colonies with imbedded hydrothecæ. The hydrothecæ are of bilateral structure; the aperture is furnished with an abcaulinally fixed single opercular plate or membrane, attached to the margin of the hydrotheca, as a rule in a more or less pronounced sinus. The polyp has an abcauline strongly developed blind sack.

Thujaria thuja (Linné) Fleming.

1757 *Sertularia thuja*, Linné, Systema naturæ, Ed. 10, p. 809.

1828 *Thujaria thuja*, Fleming, A History of British Animals, p. 545.

Upright colonies, shaped like a bottle-brush, with dark-coloured, distinct monosiphonic hydrocaulus. The branches form an irregular, close double spiral round the indistinctly segmented stem, one branch to each joint. The stem has two rows of hydrothecæ; there are normally three hydrothecæ on the stem between two successive branches in the same row, the lowest in the branch corner. The branches form, at their point of origin, almost a right angle with the stem, and are repeatedly divided dichotomously, and curve slightly upward. They are segmented, with a large and varying number of hydrothecæ on each joint. The hydrothecæ form two opposite rows on the branches; their plane of symmetry coincides with the broad plane of the branch, which is horizontal. The hydrothecæ are entirely imbedded in the branches, with no free portion of the adcauline wall; they are subalternately arranged; at the top of the branch they have two lateral teeth, but in course of growth the adcauline sinus fills up, normally altogether. The interval between two successive hydrothecæ is about twice the opening diameter of the hydrotheca. The operculum is formed by a round plate abcaulinally attached.

The gonothecæ are situate on the upper side of the branch, and proceeding from close under the base of the hydrothecæ. They are oval, without ribs or wrinkles, with a short neck and broad round aperture.

Material:

"Ingolf" St.	2,	63°04′ N.,	9°22′ W.,	depth 262	fathoms,	5,3°
— -	3,	63°35′ N.,	10°24′ W.,	— 272	—	0,5°
— -	4	64°07′ N.,	11°12′ W.,	— 237	—	2,5°
— -	15,	66°18′ N.,	25°59′ W.,	— 330	—	÷0,75°
— -	34,	65°17′ N.,	54°17′ W.,	— 55	—	—
— -	51,	64°15′ N.,	14°22′ W.,	— 68	—	7,32°
— -	87,	65°02,3′ N.,	23°56,2′ W.,	— 110	—	—
— -	95,	65° 14′ N.,	30°39′ W.,	— 752	—	2,1
— -	96,	65°24′ N.,	29°00′ W.,	— 735	—	1,2°
— -	98,	65°38′ N.,	26°27′ W.,	— 138	—	5,9°
— -	127,	66°33′ N.,	20°05′ W.,	— 44	—	1,6°
"Thor"		66°19′ N.,	23°27′ W.,	— 115—120	metres	
—		63°46′ N.,	22°56′ W.,	— 150	—	

Greenland: Davis Strait, depth 66—67 fathoms (without further details)

Iceland: Seydisfjord, — 40 —

5 miles E. of Seydisfjord, depth 135 fathoms

Reykjavik (depth not stated)

6 miles W. of Iceland, 65°32′ N., 24°38′ W., depth 22 fathoms

Danmark Strait 65°39′ N., 28°25′ W., (depth not stated)

Iceland: Danmark Strait 66°20′ N., 25°12′ W., depth 96 fathoms
Adalvik, depth 5,5 fathoms (on roots of Laminaria).
The Faroe Islands: 6 miles N. by W. of Store Kalsö, depth 60 fathoms
Vestmanhavn (depth not stated)
Deep hole of north point of Nolsö, depth 100 fathoms
16 miles E. by S. of south point of Nolsö, depth 80 fathoms
Borönæs 13 miles N. 75 W., depth 30 fathoms.

Quite young colonies of *Thujaria thuja* are pinnate, and very difficult to distinguish from small colonies of *Thujaria laxa* Allman. The broad plane of the branches in such specimens, up to a couple

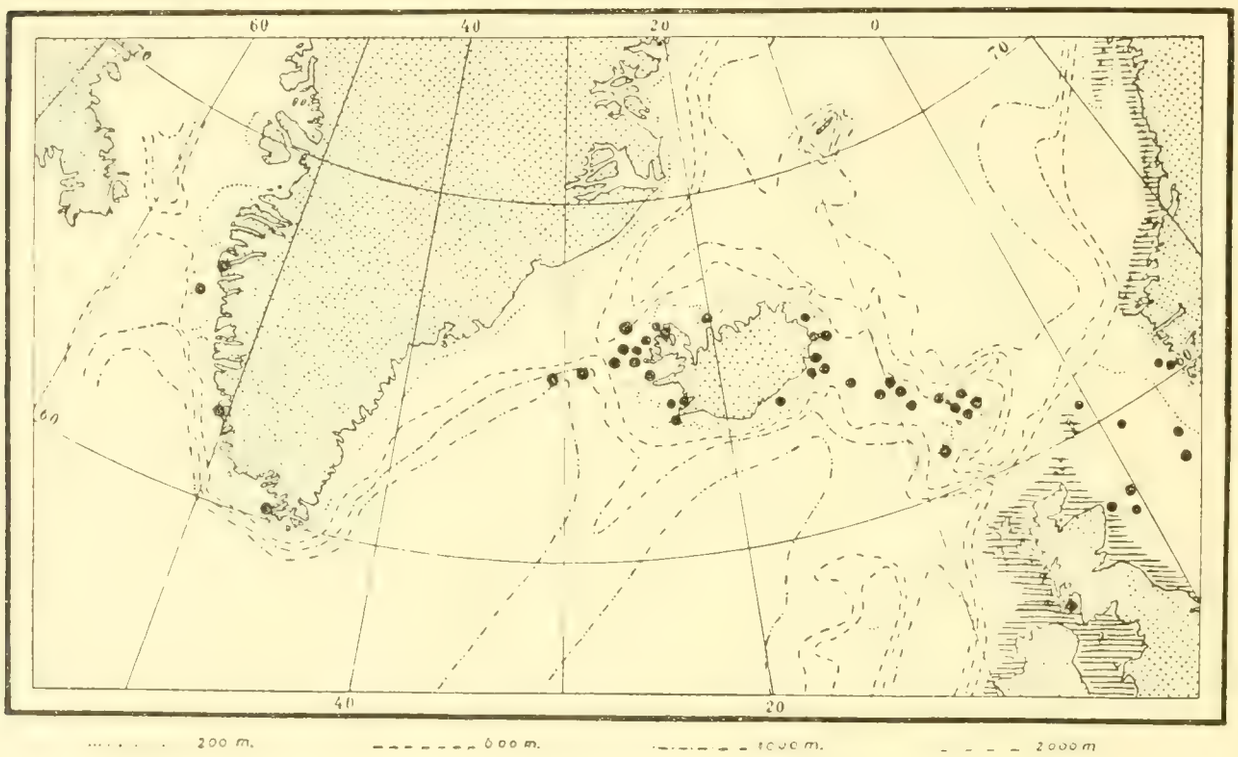

Fig. LXXV. The distribution of *Thujaria thuja* in the Northern Atlantic.
In the hatched regions a common occurrence is recorded.

of centimetres high, is vertical, and the branches are single. Here, however, the hydrotheca at the tip of the branch, which is of the *Sertularia* type, will as a rule reveal the identity of the species. The occurrence of this type of hydrotheca in *Thujaria thuja* is, as I have previously pointed out (1905) of considerable interest, as giving us a hint of the derivation of the *Thujaria* species from *Sertularia*.

Thujaria thuja is a boreal species, capable of moving far to the south; it is said to have been found both off the coast of Portugal and in the Mediterranean, but is not common south of Ireland. On the other hand, it does not enter the purely arctic waters; it has its chief distribution in the deep littoral region, but may occasionally be met with in the abyssal, and even deep down in the same, as is seen from the finds of the "Ingolf" at St. 95 and 96. In the North Atlantic (fig. LXXV) the

species is rare off the west coast of Greenland, and appears to be altogether lacking on the east coast. In Iceland waters, it is frequent on the west coast, and in Danmark Strait, and is also common on the east coast; common on the ridge between Iceland and the Faroe Islands, and around the latter Islands. In the North Sea, it is one of the most common species, and occurs also as a common form along the coast of Norway right up to the North Cape.

Thujaria sp. aff. hippuris Allman.

From the "Ingolf" St. 24 (63°06′ N., 56°00 W., depth 1199 fathoms, 2,4°) we have some colonies of a *Thujaria*, the identity of which cannot be determined with certainty. The colonies are slenderly pinnate, with branches openly set; the stem is very slightly pronounced, and in colonies 10 cm. high shows incipient spiral coiling at the top; the broad plane of the branches here assumes a horizontal position, while elsewhere it is always vertical. The branches form almost a right angle with the stem. The stem has two rows of hydrothecæ, and is divided into internodia bearing as a rule four branches, two to either side, alternately placed. There are three hydrothecæ between two successive branches on the same side of the stem, the lowest in the branch angle. The branches are irregularly segmented, with two to five, or rarely more, hydrothecæ on the internodium. The hydrothecæ are set in two rows on the branches; their plane of symmetry coincides with the broad plane of the branches; they are alternately placed on the slightly zigzag branches (and stems) and separated, in the same row, by intervals exceeding the length of the hydrotheca (fig. LXXVI). The hydrothecæ are deeply imbedded, and have a short free distal part of the adcauline wall; the length of this is at the outside half the opening diameter. The hydrotheca opening is round, with an even margin, and no indication of teeth or sinus; there is a large round opercular plate abcaulinally fixed. The colonies are unfortunately all sterile, with no indication of gonangia formation.

Fig. LXXVI. *Thujaria* sp. aff. *hippuris*. Part of a branch. (× 40).

The colonies described appear in their general features to present some considerable likeness to *Thujaria hippuris* Allman, but are even more slender and with more widely set hydrothecæ than noted for the species in question (cf. Allman 1874, p. 473, pl. 45 fig. 2, and Kramp 1913, p. 26). The shape of the colony in *Thujaria hippuris* is very nearly the same as in *Thujaria thuja*. The largest colonies in the material show that the present species would also probably be of the same form when fully grown; the pinnate arrangement of the colonies, and the lack of secondary ramification in the branches, can therefore only be regarded as juvenile characters. The slight specific differences otherwise existing in the genus *Thujaria* call, however, for caution. The hydrothecæ in the colonies here concerned are not entirely imbedded, as is otherwise stated to be the case with *Thujaria hippuris*, but have a very short free distal part on the adcauline side; there is also a wider interval between the hydrothecæ in the same row, and the branches are bent slightly zigzag fashion. These points render it somewhat doubtful whether the specimens in question really belong to *Thujaria hippuris*, and the identity cannot be determined with certainty until the variational conditions of the species in question have been further elucidated. The enormous depth at which the colonies occur is very interesting, and will possibly serve to explain its extremely slender form.

Thujaria laxa Allman.

1874 *Thujaria laxa,* Allman, Report on the Hydroida ..... "Porcupine", p. 472, pl. 45, fig. 1.

1895 *Thujaria lonchitis*, Marktanner-Turneretscher, Hydroiden von Ost Spitzbergen, p. 422.

1903 *Thujaria Hjorti,* Broch, Die von dem Norwegischen Fischereidampfer "Michael Sars" ..... gesammelten Hydroiden, p. 7, Taf. III, figs. 11—14.

1904 *Thujaria immersa*, Nutting, Sertularidae, p. 66, pl. 9, figs. 3—4.

The upright colonies are as a rule pinnate in their lower parts, spirally curved in the upper, and with slender, secondarily dichotomously ramified branches, forming an open double spiral around the distinct main stem, which is somewhat darker in colour. In the pinnate portion, the broad plane of the branches is vertical, in the spiral it is horizontal. The stem has two opposite rows of hydrothecæ; there are as a rule 4 or 5 hydrothecæ between two successive branches on the same side (or in the same spiral), the lowest at the corner of the branch. The branches form almost a right angle with the stem, and are very nearly straight; they are irregularly segmented with a large number of hydrothecæ on each internodium. The hydrothecæ are set subalternately in two rows on the branches; their symmetrical plane coincides with the broad plane of the branch. The hydrothecæ are entirely imbedded, or have a very small free distal part of the adcauline wall, never more than half the opening diameter. The interval between two successive hydrothecæ in the same row is as a rule about equal to or slightly more than the opening diameter. The hydrotheca opening is round, the margin without any indication of teeth or sinus, and has a round opercular plate abcaulinally attached.

The gonothecæ are situated on the upper side of the branches close under the basis of the hydrothecæ. They are oblong, narrow pear-shaped, the male distally cut off transversely, the female more rounded, without neck.

Material:

"Ingolf" St.	3	63°35′ N.,	10°24′ W.,	depth	272	fathoms	0,5°			
— -	15	66°18′ N.,	25°59′ W.,	—	330	—	÷ 0,75°			
— -	32	66°35′ N.,	56°38′ W.,	—	318	—	3,9°			
- -	34	65°17′ N.,	54 17′ W.,	—	55	—	—			
— -	44	61°42′ N.,	9°36′ W.,	—	545	—	4,8°			
— -	51	64°15′ N.,	14°22′ W.,	—	68	—	7,32°			
— -	87	65°02,3′ N.,	23°56,2′ W.,	—	110	—	—			
— -	94	64°56′ N.,	36°19′ W.,	—	204	—	4,1°			
— -	98	65°38′ N.,	26°27′ W.,	—	138	—	5,9°			
Greenland:	Turner Sound,			—	120	—				
	Cape Tobin,			—	57	—	(East Greenland Expedition)			
	Off Henry Land,			—	20	—	—	—	—	
	Off Henry Land,			—	160—200	—	—	—	—	

Between the Faroe and the Shetland Islands, depth 255 fathoms.

Kara Sea, "Dijmphna" [labelled *Thujaria lonchitis* and *Thujaria articulata*].

Thujaria laxa belongs to the lower parts of the littoral region, and the upper part of the abyssal. It is an arctic species, which has been found from Davis Strait to Tajmyr; it is also represented

in the material from the cruise of the "Dijmphna" in the Kara Sea, but has there erronously been referred either to *Thujaria lonchitis* or *Thujaria articulata*. From its arctic home, the species also spreads out into the boreal region (fig. LXXVII) where it has been recorded from the Faroe Islands and Iceland, and in Davis Strait. It will presumably also be found to occur off the coast of Norway, but in these waters, it has not hitherto been distinguished from *Thujaria lonchitis*, so that we have no reliable data up to the present.

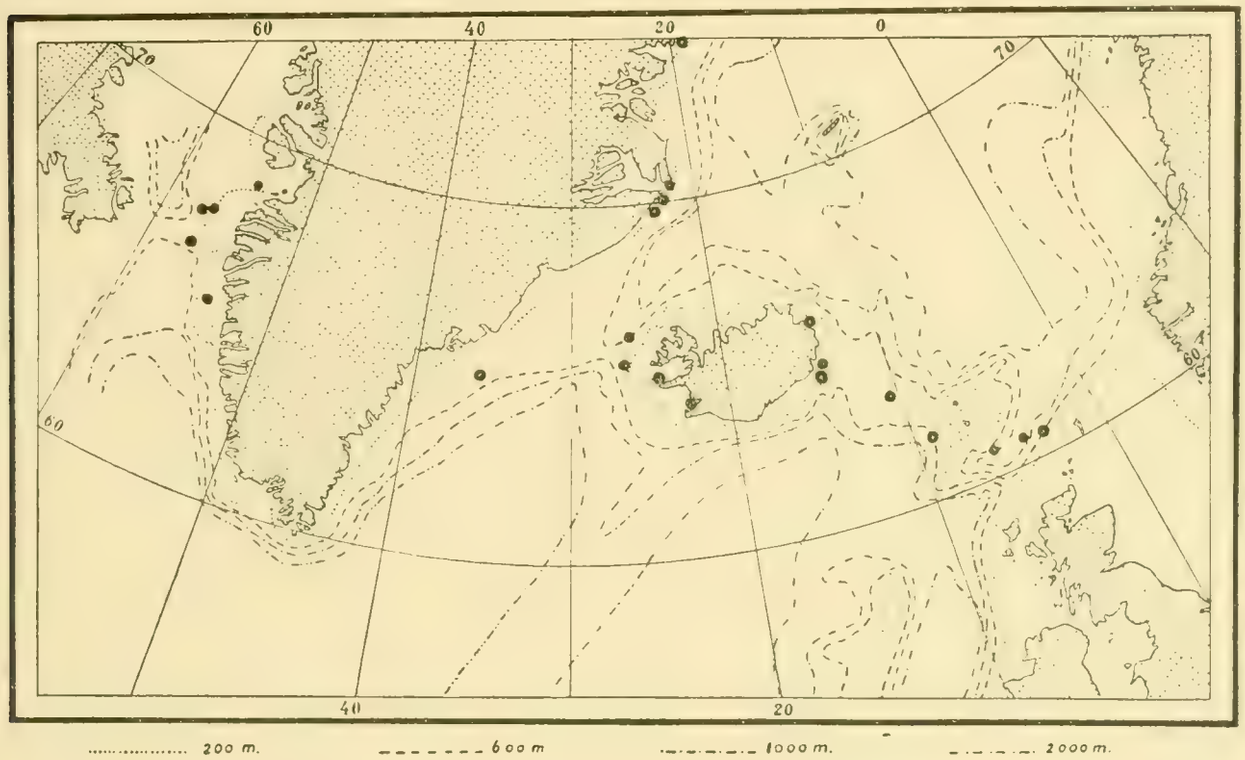

Fig. LXXVII. Finds of *Thujaria laxa* in the Northern Atlantic.

Thujaria alternitheca Levinsen.

1893 *Thujaria alternitheca*, Levinsen, Meduser, Ctenophorer og Hydroider, p. 52 pl. 7, figs. 15—20.

Robust, upright colonies with spiral, monosiphonic stem. The stem is divided by distinct segmentation into internodia of varying length, and has two single spiral tiers of hydrothecæ; there are from 3 to 6 hydrothecæ between two successive branches in the same spiral, the lowest in the branch corner. Normally, the sixth branch will be found straight above the first in the same tier. The broad plane of the branches is perpendicular to the axis of the stem (lies horizontally) and the branches form, at their point of origin, almost a right angle with the stem, afterwards curving somewhat downwards; they are secondarily branched dichotomously, and divided into internodia with five or more pairs of hydrothecæ. The hydrothecæ of the branches form two very close longitudinal rows; the hydrothecæ are closely set, each thrusting its opening part out upwards and sideways beyond the next, displaced alternately to either side of the median line through the base of the hydrothecæ, presenting a distinct approach to quadriserial arrangement. The hydrothecæ are entirely imbedded in the stem and branches, without any free distal part of the adcauline wall. The opening is circular, the margin without teeth or sinus, with a large round opercular plate abcaulinally attached.

The gonothecæ are set on the upper side of the branches. They are pear-shaped, with rudimentary neck and broad aperture.

Material:

"Ingolf" St. 31	66°35′ N.,	55°54′ W.,	depth	88 fathoms	1,6°
— - 34	65°17′ N.,	54°17′ W.,	—	55	— —
Greenland: Davis Strait,			—	100	— (without further details) [type specimen].
Iceland: Skagi,			—	20	— [labelled *Thujaria lonchitis*]
Dyrafjord,			—	15	—

In all probability, this species also will prove to have a pinnate development stage, like the other, spiral *Thujaria* species. In the arrangement of the hydrothecæ, *Thujaria alternitheca* forms a parallel to *Abietinaria* (?) *fusca* (Johnston), and it is interesting here to note how the hydrothecæ, owing to their extremely close accumulation, thrust their opening part to one side or the other from the base of the next following. An investigation of the tip of the branch shows that this is a secondary phenomenon. The hydrothecæ are to begin with symmetrically situate, with their symmetrical plane parallel to the branch axis; only on the formation of a new distal hydrotheca is the aperture of the one behind it thrust out to the side. We have here, then, a typical instance of convergency, as towards *Abietinaria* (?) *fusca*, which cannot be taken as evidence of closer relationship, and thus does not afford any justification for uniting the two species mentioned, and other multiserial forms in a special genus *Selaginopsis*; any such would also have to include species with and those without blind sack, which can hardly be considered permissible.

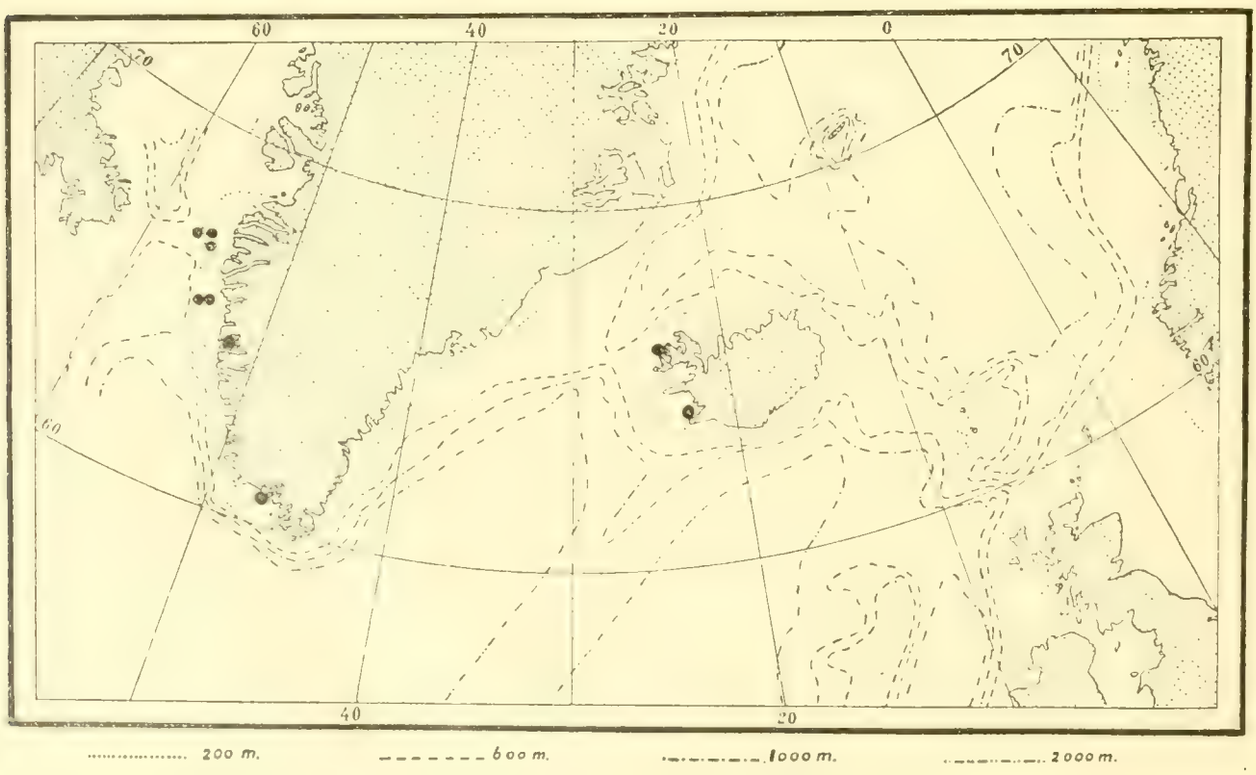

Fig. LXXVIII. Finds of *Thujaria alternitheca*.

Thujaria alternitheca is probably an arctic species of highly localised occurrence. It belongs to the deepest littoral waters. Previously, it was only known from Davis Strait, but is now found to occur also off the west coast of Iceland, where it has been confused with a form of much finer build, *Thujaria lonchitis*.

Thujaria variabilis nov. nom.

1899 *Selaginopsis arctica*, Bonnevie, Den Norske Nordhavs-Expedition, p. 87, pl. 6, fig. 4.

Coarse, upright pinnate colonies with undivided branches. The stem is slightly zigzag, divided into internodia of irregular length, with from two to twelve regularly alternating branches and two single rows of hydrothecæ; the stem is not spirally coiled. The stem has from two to four, normally three, hydrothecæ between two successive branches on the same side, the lowest in the branch angle. The branches have four, exceptionally two or three, rows of hydrothecæ; on the four-rowed branches, the hydrothecæ are set in opposite pairs, the symmetrical plane of the one pair being then perpendicular to that of the next; three-rowed branches are spirally coiled, two-rowed straight, with the symmetrical plane of the hydrothecæ vertical. The hydrothecæ are broad and deeply imbedded, with a short, often quite insignificant free distal part of the adcauline wall, never more than a third of the opening diameter, or one-tenth to one-twelfth the length of the hydrotheca. The opening is round, with smooth margin, without teeth or sinus, and has a large opercular plate abcaulinally fixed.

The gonothecæ are set on the upper side of the branches, and proceed from close below the base of the hydrothecæ. The gonothecæ are inversely conical, distally cut off transversely, without neck.

Material:

Iceland, Reydarfjord, depth 80 fathoms (some of them labelled *Thujaria lonchitis*).

A number of very fine colonies belonging to this species have been incorrectly determined by Sæmundsson as *Thujaria lonchitis*, from which *Thujaria variabilis* is immediately distinguishable by its extremely robust appearance and thick branches. The colonies are interesting in several respects. They show, in the first place, that aberrant branches with fewer than four hydrothecæ rows are by no means rare, and in the second, that the number of hydrothecæ rows on a branch may vary from one internodium to another. There are thus some branches which are basally quadriserial, distally bi- or triserial; others again are biserial, triserial or quadriserial throughout their entire length, or only quadriserial at the extremities. This feature, then, is subject to great variation. It is also remarkable that biserial branches are straight, whereas the triserial, and exceptionally also the quadriserial, are twisted, so that the hydrothecæ here lie in very steeply ascendant spiral tiers about the branches. The normal quadriserial branch on the other hand, presents a compressed *Staurotheca* type, where the single hydrotheca pair is revolved as against the preceding pair, and has its plane of symmetry perpendicular to that of the latter; this also gives very close spiral lines in the arrangement of the hydrothecæ, as pointed out by previous investigators. The species, with its variations, gives a drastic exposure of the value attaching to the distinctive characters for the genera *Staurotheca* and *Selaginopsis*.

It is evident from the foregoing that *Selaginopsis artica* Bonnevie must be classed under the

genus *Thujaria*, as I have already (1909 p. 222) placed it. The same genus, however, has formerly been made to include *Sertularia arctica* Allman and *Sertularia arctica* Thompson, which is incorrect. The proper method of proceeding here will be to alter the name of the present species, as being of later date, and this I have accordingly done, naming it, from the variable character of the branches, *Thujaria variabilis*.

Thujaria variabilis has only occasionally been found in arctic waters near Beeren Island, at Spitzbergen and off the Murman Coast at 38 to 86 metres' depth. Reydarfjord thus represents the most southerly find, and is also, with its 80 fathoms, the deepest.

Thujaria lonchitis (Ellis and Solander) Fleming.

1786 *Sertularia lonchitis,* Ellis and Solander, The natural history of many curious and uncommon Zoophytes, p. 42.
1828 *Thujaria articulata*, Fleming, A History of british animals, p. 545.
nec 1766 *Sertularia articulata,* Pallas, Elenchus Zoophytorum, p. 137.
1847 *Thujaria articulata,* Johnston, A History of the British Zoophytes, p. 84, pl. 18, figs. 3—4.
nec 1851 — — Busk, A list of Sertularian Zoophytes and Polyzoa from Port Natal, Algoa Bay . . . ., p. 119.
1868 — — pars, Hincks, A History of the British Hydroid Zoophytes, p. 277, pl. 60.
1874 — — G. O. Sars, Bidrag til Kundskaben om Norges Hydroider, p. 106.
1884 — *lonchitis,* Kirchenpauer, Nordische Gattungen und Arten von Sertulariden, p. 24, pl. 14, fig. 7.
(nec 1884 — *articulata,* Kirchenpauer, l. c. p. 26, pl. 14, fig. 8.)
nec 1888 — *pectinata,* Allman, "Challenger" vol. 23, p. 69, pl. 33, fig. 1.
1890 — *lonchitis,* Marktanner-Turneretscher, Die Hydroiden des k. k. naturhistorischen Hofmuseums, p. 236.
1893 — — Levinsen, Meduser, Ctenophorer og Hydroider, p. 53.
1899 — *articulata* pars, Bonnevie, Den norske Nordhavs-Expedition, p. 84.
1904 — *lonchitis*, Nutting, Sertularidae, p. 66, pl. 9, figs. 5—8.
1909 — *kolaënsis*, Jäderholm, Northern and Arctic Invertebrates, p. 88, pl. 8, figs. 17—18.
?1909 — *lonchitis*, Jäderholm, l. c. p. 89, pl. 9, fig. 3.
1909 — — Broch, Die Hydroiden der arktischen Meere, p. 174.

The upright colonies are as a rule pinnate throughout their entire length, more rarely with a spirally coiled distal part of the monosiphonic stem. In the pinnate portion of the colonies, the broad plane of the branches is vertical, in the spiral horizontal; the branches form almost a right angle with the stem, which is dark in colour. The stem is segmented in its lower part, but in the upper, the segmentation becomes almost entirely effaced; the branches are subalternately to alternately set. The stem has two rows of hydrothecæ; between two successive branches on the same side of the stem there will be two to three, rarely more (up to five) hydrothecæ, the lowest in the angle of the branch. The branches are not generally ramified, but may more rarely exhibit secondary dichotomous ramifi-

cation; they are divided into irregular internodia with a large and varying number of hydrothecæ on each. The hydrothecæ are alternately or subalternately set in two opposite rows on the branches; their symmetrical plane coincides with the broad plane of the branch. The hydrothecæ are deeply imbedded; the adcauline wall has a free distal part between half and once the opening diameter or between one-eighth and one-fourth the length of the hydrotheca itself. The hydrotheca opening is round, the margin as a rule having a more or less distinct abcauline sinus, so that the hydrotheca aperture often appears furnished with two sligtly prominent teeth. The distance between two hydrothecæ in the same row is very slight, less than half the opening diameter. The operculum is formed by a large opercular plate abcaulinally attached.

The gonothecæ are set on the upper side of the branches, and proceed from close under the base of the hydrothecæ. They are narrowly pear-shaped, with a short, often almost rudimentary cylindrical neck, and broad aperture.

Material:

"Ingolf" St. 44 61°42′ N., 9°36′ W., depth 545 fathoms, 4,8°
— - 144 62°49′ N., 7°12′ W., — 276 — 1,6°
Greenland: Davis Strait, — 80 — (without further details).

The synonymy of this species is extremely difficult to determine; we are to a great extent forced to rely on geographical data. Kirchenpauer (1884) was really the first to point out what particular characters distinguish the two species which have been taken together under the name of *Thujaria articulata*; to him belongs the credit of having given the definite characterisation of that South Sea form for which he has — doubtless correctly — reserved the name *Thujaria articulata* (Pallas). This is specifically quite different from the northern species which has been given the same name, but which should properly be known as *Thujaria lonchitis* (Ellis et Solander). That the two have hitherto been so generally confused is due partly to the fact that writers have relied upon the records in the extant literature, partly to the frequent inability on the part of investigators to procure material of more than the one species. Thus it happens also, that even Bedot, in his brilliant work: "Matériaux pour servir à l'histoire des Hydroïdes" has committed the error of noting the two species as synonyms, despite the fact that the drawings given by Hincks (1868), and Allman (1888) could hardly be regarded as illustrating the same species. Stechow (1913 p. 152) and Broch (1914 p. 34) have, after further study of both species, given a closer definition of *Thujaria articulata*, from which, and from the descriptions given of *Thujaria lonchitis*, it is evident that they differ even more than is usual between other species of the genus in question.

Thujaria lonchitis appears to be an arctic circumpolar species, which may penetrate into the boreal areas. But as it has constantly been confused with related forms, especially with *Thujaria laxa*, its geographical character cannot be defined with certainty. From the list of material for the remaining northern species, we see that it has also in the waters here investigated constantly been confused with other *Thujaria* species, and it will therefore be most correct to leave the final decision as to its biogeographical position in abeyance, pending the acquisition of new and more reliable data.

Thujaria carica Levinsen.

1893 *Thujaria carica* Levinsen, Meduser, Ctenophorer og Hydroider, appendix, pl. 7, figs. 26—29.

The upright colonies are pinnate in their basal parts, spirally coiled in the distal, with branches secondarily somewhat ramified dichotomously; the symmetrical plane of the branches is vertical in the pinnate parts, but horizontal in the spiral. The stem has two single, opposite longitudinal rows of hydrothecæ; there are two to five, generally three hydrothecæ between two successive branches on the same side of the stem, the lowest in the branch angle. The branches are divided into irregular internodia with four to eight hydrothecæ on each; the hydrothecæ are set subalternately in two opposite longitudinal rows, their plane of symmetry coinciding with the broad plane of the branch. The hydrothecæ have a large free distal part; the length of the free portion of the adcauline wall exceeds the diameter of the opening, and is between one-third and one-half the length of the hydrotheca itself; the opening margin is smooth, without sinus, with a round opercular plate abcaulinally fixed. The interval between two hydrothecæ in the same row varies somewhat, but is never less than the opening diameter.

The gonothecæ are set on the upper side of the branches in the spiral parts of the colonies. They are asymmetrical oval to pear-shaped, with a rudimentary neck and broad, round opening.

Material:

"Ingolf" St. 143 62°58′ N., 7°09′ W., depth 388 fathoms, ÷ 0,4°
"Thor" 66°19′ N., 23°14′ W., depth 115—120 metres [labelled *Thujaria lonchitis*].
Iceland: 32 miles S. of Selvogstangar, depth 170 metres.
Kara Sea "Dijmphna" [type-specimen].

Thujaria carica is an arctic species known from the waters between Spitzbergen and Beeren Island to the New Siberian islands; in the high arctic tracts it belongs to the upper third of the littoral region. South of the range mentioned, the species has hitherto only been found at the southwest point of Iceland, and north of the Faroe Islands, where it moves down into the abyssal region. Up to now, it has not been recorded from Greenland, and thus appears to be an easterly arctic species.

Thujaria sp. aff. distans Fraser.

Material:

"Ingolf" St. 85, 63°21′ N., 25°21′ W., depth 170 fathoms

The small *Thujaria* colonies from the "Ingolf" St. 85 very much resemble *Thujaria carica*, and may possibly prove to belong to that species; there are, however, certain points of difference which render the identity somewhat doubtful, and for the present, these colonies should doubtless be kept apart from *Thujaria carica*. It is not unlikely that they really represent a distinct species, but as the colonies are quite small, and without gonangia, it is very difficult to give a thorough characterisation.

The colonies are pinnate, with simple branches. The stem, which is monosiphonic, is divided into irregular internodia, and lacks both branches and hydrothecæ on its lower part. A couple of centimetres from the base, the hydrothecæ begin to appear; they are set as a rule alternately in two opposite longitudinal rows. The stem is slightly zigzag, and has on its upper part, besides the hydrothecæ mentioned, also alternating branches; the largest colony which is of quite regular build has

throughout three hydrothecæ between the origins of two branches on the same side of the stem; in the two smaller colonies, on the other hand, the number varies from two to five, but these colonies are at the same time irregular in the whole development of the branches in several places. The division of the branches into internodia is highly irregular; there may be from two to nineteen hydrothecæ on the branch internodia. The hydrothecæ are set in two opposite rows; their symmetrical plane coincides with the broad plane of the branches, which is everywhere vertically placed, i. e. parallel with the axis of the stem. The distance between two hydrothecæ on the same side of the branch is very great, as a rule about $1^1/_2$ times the length of the hydrotheca itself. The hydrotheca (fig. LXXIX) is not particularly deeply imbedded in stem or branches; the distal third of the adcauline wall is free; the free part of the adcauline wall is straight, or not infrequently curving slightly upward. The opening plane of the hydrotheca is parallel with the branch axis. The aperture is round, the margin exhibits indication of a pair of broad lateral teeth, further accentuated by the abcauline sinus in which the large single opercular plate is fastened. The structural character of the polyp it was impossible to investigate, owing to the state of preservation of the material.

Fig. LXXIX. *Thujaria* sp. aff. *distans* from "Ingolf" St. 85. Part of a branch. (× 40).

These colonies appear in the main to agree with the Pacific species *Thujaria distans* established by Fraser (1914 p. 197, pl. 32, fig. 123). There are, however, lacunæ in Fraser's description, so the identity cannot be determined with certainty. Fraser's species has often secondary dichotomous ramification of the branches; this must be considered as due to difference in age. On the other hand, the hydrothecæ in *Thujaria distans* appear to have a larger free portion; Fraser states "about one-half free", and the figures appended, which are not very carefully drawn, even show hydrothecæ more than half free; they give, moreover, no clear impression as to the character of the hydrotheca aperture, which is likewise somewhat vaguely treated in the diagnosis: "margin without distinct teeth but rather bilabial". Only when a conscientious description of the Pacific species is available will it be possible to decide whether the colonies here found in the North Atlantic should be referred to the same.

Family series **Proboscoida** (Broch).

Family Campanulariidæ.

The hydrothecæ are radially symmetrical, bell-shaped, without closing apparatus, and provided with a basal chamber separated off from the distal main part of the hydrotheca by a diaphragm, or by a simple ring-shaped thickening of the wall. The polyps can withdraw entirely into the hydrothecæ. The hydranth has a club-shaped proboscis, attached by a narrow base to the body of the polyp above the tentacle crown; the gastral endoderm is homogeneous, the stomach part not divided into separate regions. The colonies are stolonial or sympodial.

The diagnosis of the family as here given excludes the two bilaterally built genera *Silicularia* and *Eucopella*; these two genera should, partly on account of their being bilateral, partly also from their peculiar, almost leathery hydrothecæ, and the small size of the latter, which can only accomodate the basal part of the contracted polyp, be separated off as a distinct family *Silicularïidæ*, as I have pointed out already in a former work (1909). Nutting, in his latest work on *Campanularïidæ* (1915) still treats the two families as one, though he gives no reason for so doing[1].

The *Campanularïidæ*, as here defined, make up a well marked family which can hardly be the subject of much dispute; the generic sub-division of the family, however, is a highly debatable question, and a study of the literature thereupon affords an interesting example of the extent to which, even at the present day, it is found "convenient" (i. e. less troublesome), or "advisable" to persevere in the adherence to earlier tradition, or acceptance of biological phenomena, in dealing with the great group of the Hydroids. This is in fact the obstacle which for years has barred our progress towards an understanding of the group in question, its development, and the various degrees of relationship between its subdivisions. — I have in a previous work (1909) explained at length why, in the northern waters, it is only permissible to recognise two genera of *Campanularïidæ* from a phylogenetic point of view, to wit, *Campanularia* and *Laomedea*. The description of *Laomedea sargassi* (Broch 1913 p. 13) does not weaken this standpoint. Nutting, however, opines (1915 p. 24) that "while there may be considerable argument on theoretical grounds for such a course, it undoubtedly leads to unnecessary and practically insurmountable difficulties when large numbers of species are to be handled and described". The correctness of this view is not immediately obvious. In the first place, it is hard to see why the same characters should be easier to handle as generic than as specific distinctions; furthermore, it should be borne in mind that the pursuit of science is not an armchair occupation. In comparison with large genera of other groups — the pennatulid genus *Pteroëides*, for instance, or the cirriped genus *Balanus* — or even with the hydroid genus *Plumularia*, the species with which we are here concerned are neither more numerous nor more difficult of distinction; yet it has not hitherto been found necessary to break up one genus into several merely because it comprised a large number of species, or because these were difficult to distinguish one from another; any such subdivision should be based upon grounds of far greater scientific importance. The "insurmountable" difficulties in connection with the *Campanularïidæ* arise from the enormous number of badly described species which have been established — often, moreover, on the basis of inadequate investigations with regard to the study of variations. The result is a state of things which absolutely precludes a thorough biogeographical survey. And this is just where the recognition of phylogeny as fundamentum divisionis would help us to clear matters up; from a biogeographical point of view, co-operation between phylogeny and biology is of the highest interest, and by giving phylogeny the precedence, with biology in the second place, we should obtain a sound basis and definite lines on which to set about a rational reconstruction of the chaos at present existing, particularly with regard to the *Campanularïidæ*.

We have, as a matter of fact, to face the simple question, whether biology or phylogeny is to be regarded as the fundamental principle for systematics. The medusa system, in its present state, cannot help us in dealing with the thecaphore hydroids. The plasticity of the pelagic organism under the influence of physical factors in its environment is

[1] Nutting still writes "*Campanularidæ*".

enormous, and makes itself felt among the medusæ to the same degree as among other planktonic organisms. But the variation of single species under different conditions has been even less studied in the case of the medusæ than in that of the polyp generation, and our ignorance as to these and similar phenomena has given rise to a medusa system in which phylogeny and biological convergency or divergency have been intermingled to a tangled confusion. A very fine proof of this is afforded by the fact that the *Campanulinidæ* have their medusæ distributed throughout almost all the families of Leptomedusæ, and yet we cannot, from this, proceed to split up the polyp family in question into a similar series of new families. The question as to a division into genera on the basis of gonophore types should be decided by a reference to the genus *Hydractinia*. Following this principle to its logical conclusion, with the *Campanulariidæ*, we should have to make generic distinction between the male and the female of *Laomedea flexuosa* Hincks, where, as we know, the female gonophores are heteromedusoid, the males styloid. But if this is out of the question, what gonophore type can we consider as being generically adequate? The heteromedusoids are in reality the only ones which differ in principle from all remaining types, which, since the discovery of the reduced cryptomedusoid in *Grammaria abietina* (M. Sars) form a finite series. — In *Campanularia integra* (Macgillivray) [*Campanularia compressa* Clark] we find, during one part of the breeding season free medusæ, at another, sessile eumedusoids; there is thus no clearer limit between free medusæ and sessile gonophores in *Campanulariidæ* than in several other families. The only type of gonophore which appears to be of any value must then be that of *Gonothyræa*. This is a highly interesting biological phenomenon; phylogenetically speaking, it is a typical cryptomedusoid, (cf. Kühn 1913 p. 187) differing but little from the gonophores in *Cladocoryne*. Its systematic value really lies in the fact that in certain forms, it is thrust out from the narrower gonotheca without breaking loose. From a biological point of view, this is a most interesting phenomenon, and we cannot but call to mind the gonophores in certain *Tubularia* species, where the larvæ are likewise developed in the sessile, medusa-like gonophore; it shows how nature here, in another way, has arrived at the same result as in several of the *Diphasia* species, in protecting the larvæ during their period of development. Such care of the young occurs, of course, elsewhere in the animal kingdom, but in all other cases, it is regarded as a biological phenomenon, which from a phylogenetic — and thus also from a systematic — point of view is of quite subordinate importance.

It may also be worth while to glance at one of the most interesting genera, *Orthopyxis* L. Agassiz, which Nutting (1915 p. 63) again seeks to revive by the side of *Clytia* and *Campanularia*, all on the basis of the gonophores. In his generic diagnosis, Nutting refers to the Medusæ of *Orthopyxis* as "without tentacles or manubrium", and under the heading of *Orthopyxis compressa* (l. c. p. 66) he states that Torrey (1902) gives for this species an illustration of "a medusa with 4 tentacles just escaping from the gonangium"; under *Orthopyxis everta*, again (l. c. p. 68) he informs us that "the female, at least, contain medusæ which eject their ova into an acrocyst without liberating the medusæ". Nutting has here given us a striking illustration of the value both of the genus itself and of the characters on which it is founded. The genus in question is really a connecting link, standing as it does with one foot, so to speak, in each of the other biological groups which we find represented in the family *Campanulariidæ*.

Here, as elsewhere, when drawing the limits of a genus, we must seek to emancipate ourselves from the interesting biological features of the gonophores, and have recourse to Levinsen's fundamental point of view; the study of the nutritive polyps and the colonies themselves.

We find then, that the family falls into two great groups, according to the diaphragm of the polyp, the arrangement being further accentuated by the two fundamentally different colony formations, the stolonial and the sympodial. Levinsen (1893) believed to have discovered that the diaphragma of the one group or genus — *Campanularia* — was a double formation, consisting of a central, thin membranous diaphragm, proceeding from a circular inner thickening of the wall, the boundary between the main cavity of the hydrotheca and the basal chamber. A thorough investigation of the point has convinced me (1909 p. 183) that Levinsen's conclusion must be due to his not having employed microtome sections; for microtome series reveal the fact that the "diaphragm" in the *Campanularia* group is produced by the high power of resistance against dissolvent influences which characterises the basal part of the supporting lamella, and that a true diaphragm, i. e. a chitinose, membranous bottom under the basal ectoderm, is altogether lacking.

Nutting (1915 p. 9) has arrived at a different result. He supports his view upon an unpublished manuscript of his pupil, J. H. Paarmann, and on original preparations by the same hand. It is on Paarmann's original drawings also, that Nutting's text figures 24—44 are based. These figures appear to have been sketched from optical sections, not from microtome series, and present altogether the impression of being not particularly reliable. Nor is this impression removed by the following passage quoted by Nutting from Paarmann's manuscript: "The simple diaphragm can with difficulty be seen in optical section of the hydrotheca, while the complex diaphragm is plainly distinguishable without sectioning". Now the fact is, that the thickening of the wall in *Campanularia* is as a rule fairly easily visible, while the true diaphragm here, in such North-European species as I have been able to investigate, does not even show up in microtome section. — Paarmann has figured the "complex" diaphragm also in our European species *Campanularia verticillata* (Linnè). He gives, as a matter of fact, two figures of this, and the two are not very much alike (Nutting 1915, figs. 38 and 43); I have not, however, succeeded in finding the membranous part of the diaphragm in European specimens of the species. Paarmann's drawing also reveals a peculiarity in *Laomedea flexuosa* Hincks (l. c. text figs. 9 and 26), the free margin of the diaphragm being here double, a phenomenon which is not discernible in Kühn's illustration (reproduced in Nutting's text fig. 47) and is similarly lacking in my preparations. Details of this sort are apt to cast some doubt upon the value of Paarmann's drawings. — We should note, however, that all the species in which Nutting, following Paarmann, finds a "simple" diaphragm, have sympodial colonies, while among species with "complex" diaphragm only two species are cited: *Obelia geniculata* (Linné) and *Obelia flabellata* Hincks, which have no stolonial colonies. From this is might be supposed that the two species should be regarded as types of a distinct genus, but this is not the case. Even in Paarmann's drawing (Nutting 1915, text fig. 41) the diaphragm of *Obelia flabellata* is simple; somewhat thicker, it is true, than in most *Laomedea* species, but by no means resembling the broad wall thickening in *Campanularia*. This, together with the sympodial growth of the colony, places the species undoubtedly in the *Laomedea* group. With regard to *Obelia geniculata*, it might be a somewhat different matter. This species

evinces a remarkably high power of variability in the thickness of its chitinose parts, a point which has been noted by Sæmundsson (1902 p. 57) and later by myself (1909 p. 190); this variation, moreover, also affects the diaphragm in a peculiar manner. In finely built specimens, the diaphragm is of the same structure as in typical *Laomedea* species, that is to say, it consists merely of a thin basal plate spread out below the base of the polyp; in colonies of coarser build, the chitinose thickening makes itself especially apparent in the adthecal part of the diaphragm, only approaching the margin at a much later stage, so that in longitudinal hydrotheca sections, the diaphragm appears triangular, supported on a broad base resting upon the hydrotheca wall. The diaphragm here, however, is in no wise more "complex" than before, and does not particularly resemble the low, ring-shaped wall thickening in *Campanularia*. Taking all this in connection with the sympodial development of the colonies, we can have no doubt we have here to deal with a typical *Laomedea*.

The figure of *Laomedea flexuosa* mentioned above as reproduced by Nutting after Kühn (1909 Taf. 17, fig. 7) shows the typical *Laomedea* diaphragm. A typical picture of what we find in *Campanularia* is shown in fig. 1, Pl. I.

Gen. **Campanularia** (Lamarck).

The colonies are stolonial, creeping or upright rhizocaulomes. The hydrothecæ have no true diaphragm, but are divided by an inner thickening of the wall, more or less restricted in extent, into a large outer cavity and a smaller basal. The polyp can withdraw entirely into the radially symmetrical hydrotheca; it has a club-shaped proboscis and homogeneous gastral endoderm.

Quite exceptionally we find, among certain species, a slight approach to the formation of upright colonies based upon a sympodial mode of ramification, so that one stalk may carry a single secondary lateral stalk with hydrotheca. This must be regarded as the earliest indication of the typical sympodial colonies which characterise *Laomedea*. The *Campanularia* species lack true diaphragm, but have a ring-shaped thickening of the wall (plate I fig. 1) which forms the upper limit of the basal cavity, and furnishes, in its superior part, the point of attachment for the basal supporting lamella of the polyp, which is fixed to the thickened part by a wreath of small chitinose bodies. The chitinose thickening may be broad and not very sharply defined, or more sharply defined and narrower, in which latter case it assumes the character of an incipient diaphragm, but also in this case it is restricted to a low ridge.

Campanularia volubilis (Linné) Schweigger.

1758 *Sertularia volubilis*, Linné, Systema naturæ, Ed. 10, p. 811.

1820 *Campanularia volubilis*, Schweigger, Handbuch der Naturgeschichte, p. 425.

Creeping colonies, from the stolons of which proceed the hydrothecæ stalks, these being as a rule distinctly coiled in a spiral throughout their entire length; more rarely, the spiral may be less marked in certain parts, or throughout the entire length of the stalk. The stalk invariably terminates in a distinct ball-shaped joint under the hydrotheca. The hydrothecæ themselves are not very

large, about twice as long as broad; they are very nearly cylindrical, or somewhat tumid in the lower third, and with a very slightly expanded opening section; the basal third or fourth part of the hydrotheca tapers down, after an evenly curved transition part, rapidly to the stalk. The basal cavity of the hydrotheca is small, separated off from the main chamber by a narrow, but as a rule fairly prominent ring-shaped thickening of the inner wall. The transverse section of the hydrotheca at the aperture is circular, the opening margin has from nine to thirteen low, but generally distinct, rounded teeth.

The gonothecæ proceed from the stolons. They are oval to bottle-shaped, with a very short, often ringed stalk, in the broad end, and a long and narrow, cylindrical distal neck. Thegonotheca is smooth, often slightly asymmetrical, rarely with curved neck.

Material:

"Ingolf" St. 33 67°57′ N., 55°30′ W., depth 35 fathoms, 0,8°
— - 86 65°03,6′ N., 23°47,6′ W., — 76 — —
— - 87 65°02,3′ N., 23°56,2′ W., — 110 — —
"Thor", 65°52′ N., 23°58′ W., depth 62 metres.
— 64°16′ N., 22°17′ W., — 50 —
— 64°02′ N., 22°33′ W., — 34 —
Greenland: Kutdlisat, Disco (depth not stated)
Proven (— - —) [labelled *Clytia Johnstoni*]
Store Hellefiskebanke, off Holstensborg, depth 18—20 fathoms
Lille Hellefiskebanke (without further details)
Sukkertoppen, on *Boltenia* (depth not stated)
Frederikshaab (— - —)
Iceland: Seydisfjord, depth 6 fathoms
Vestmanö, — 25 —
Hvalfjord, — 22 —
Bredebugt, 65°17,5′ N., 23°22′ W., depth 7—12 fathoms
— 64°45,8′ N., 23°55,2′ W., depth 30 —
Stykkisholm, — 20—30 —
6 miles W. of Iceland, (without further details) [some of them labelled *Campanularia Johnstoni*]
Patreksfjord, depth 15—50 fathoms
Off Dyrafjord, depth 30 fathoms.
The Faroe Islands: 6 miles N. by W. of Store Kalsö, depth 60 fathoms
7 miles N. by E. of Myggenæs point, depth 57 fathoms
Deep hole at north point of Nolsö, depth 100 fathoms.

Campanularia volubilis is a circumpolar boreal species, with a very wide distribution in the arctic areas; it would perhaps be more correct to describe it as an arctic-boreal species. It does not penetrate very far into the warmer waters, and the records as to its occurrence in the Mediterranean

would seem to be exclusively due to confusion with *Campanularia Johnstoni* Alder (cf. Broch 1912 p. 51). The species belongs chiefly to the littoral region, especially its upper half, but may quite exceptionally penetrate some way down into the abyssal. Within the waters investigated, *Campanularia volubilis* is one of the most common *Campanulariidæ*; it is but rarely found, however, out in the open sea regions, which must probably be understood as standing in connection with its bathymetrical character (fig. LXXX). The species is not uncommon in West Greenland waters, but on the east

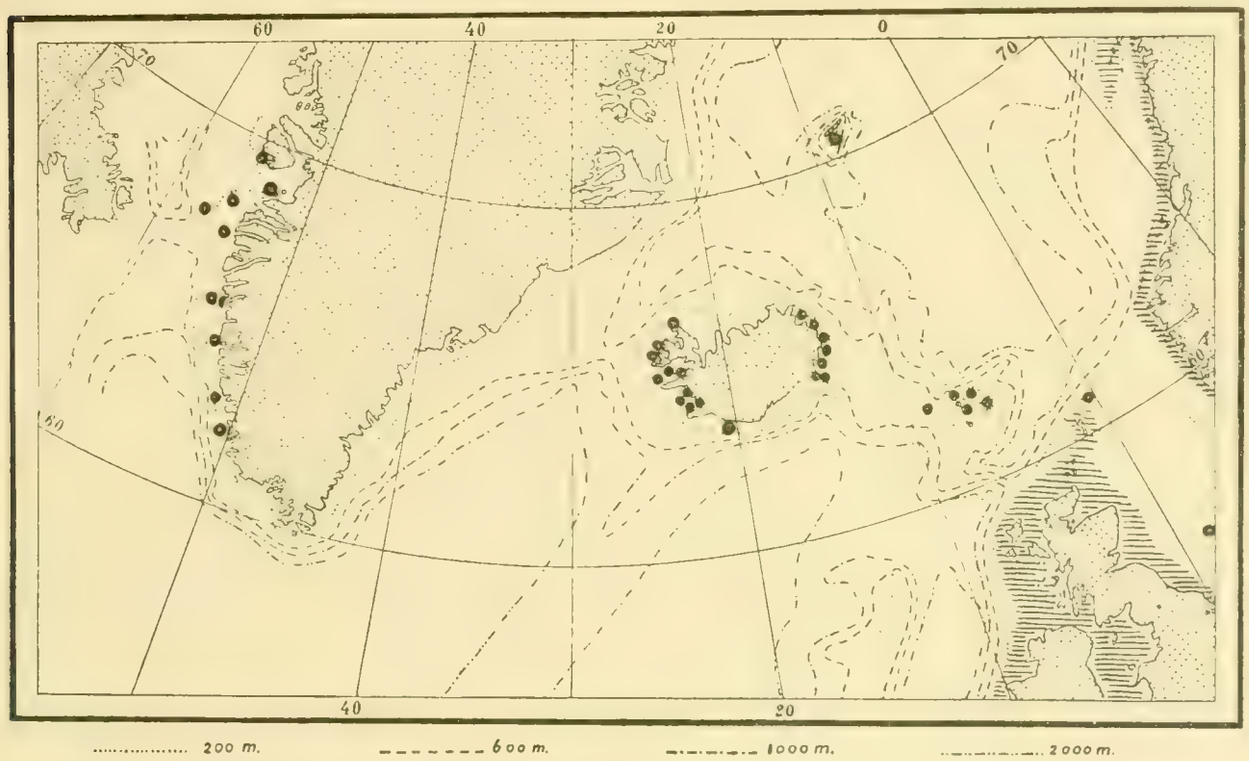

Fig. LXXX. The distribution of *Campanularia volubilis* in the Northern Atlantic.
In the hatched regions a common although scattered occurrence is stated.

coast of Greenland it has only been met with north of 76°. Of the Iceland coasts, it seems to prefer the east and west; it is less frequent at the Faroe Islands, and is stated as being of common, though scattered occurrence round the British Isles and off the west coast of Norway.

Campanularia verticillata (Linné) Lamarck.

1758 *Sertularia verticillata*, Linné, Systema naturæ, Ed. 10, p. 811.
1816 *Campanularia verticillata*, Lamarck, Histoire naturelle, vol. 2, p. 113.
nec. 1907 *Campanularia verticillata*, Hickson and Gravely, National Antarctic Expedition, p. 23.

Upright, stiffly built rhizocaulomes, from the numerous tubes of which the hydrotheca stalks proceed, arranged approximately in wreaths. The stalks exhibit distinct rings, which are most pronounced near the origin, and nearer the hydrotheca; the stalk always terminates under the hydrotheca in a ball-shaped joint; the middle of the stalk is generally smooth. The hydrotheca is about twice as

long as broad, cylindrical, with a curved basal part tapering sharply towards the stalk. The hydrotheca is circular in transverse section near the aperture; the opening margin is furnished with ten to fourteen low, rounded teeth. The basal cavity of the hydrotheca is small; the limit between this and the large main chamber is formed by a low, but often fairly narrow and sharply defined ring-shaped inner thickening of the wall.

The gonothecæ proceed from the tubes of the rhizocaulome, and are attached to the same by an almost rudimentary stalk. They are bottle-shaped, with a broadly rounded basal part, and a short, rather narrow, tubulous neck, as a rule curved or somewhat asymmetrical.

Material:

"Ingolf" St. 127 66°33′ N., 20°05′ W., depth 44 fathoms, 5,6°.
"Thor" 64°02′ N., 22°33′ W., depth 34 metres
— 63°30′ N., 20°14′ W., — 80 —
Greenland: Davis Strait, depth 80 fathoms (without further details)
— — , 67°24′ N., 55°39′ W. (depth not stated).
Iceland: Vestmanö, depth 49 fathoms.
The Faroe Islands: 6 miles N. by W. of Store Kalsö, depth 60 fathoms
Glyversnæs near Thorshavn, together with red algæ (depth not stated).

Campanularia verticillata is a circumpolar arctic-boreal species, penetrating only slightly to the south, but still met with off the coast of France. The statements in one or two recent works, how-

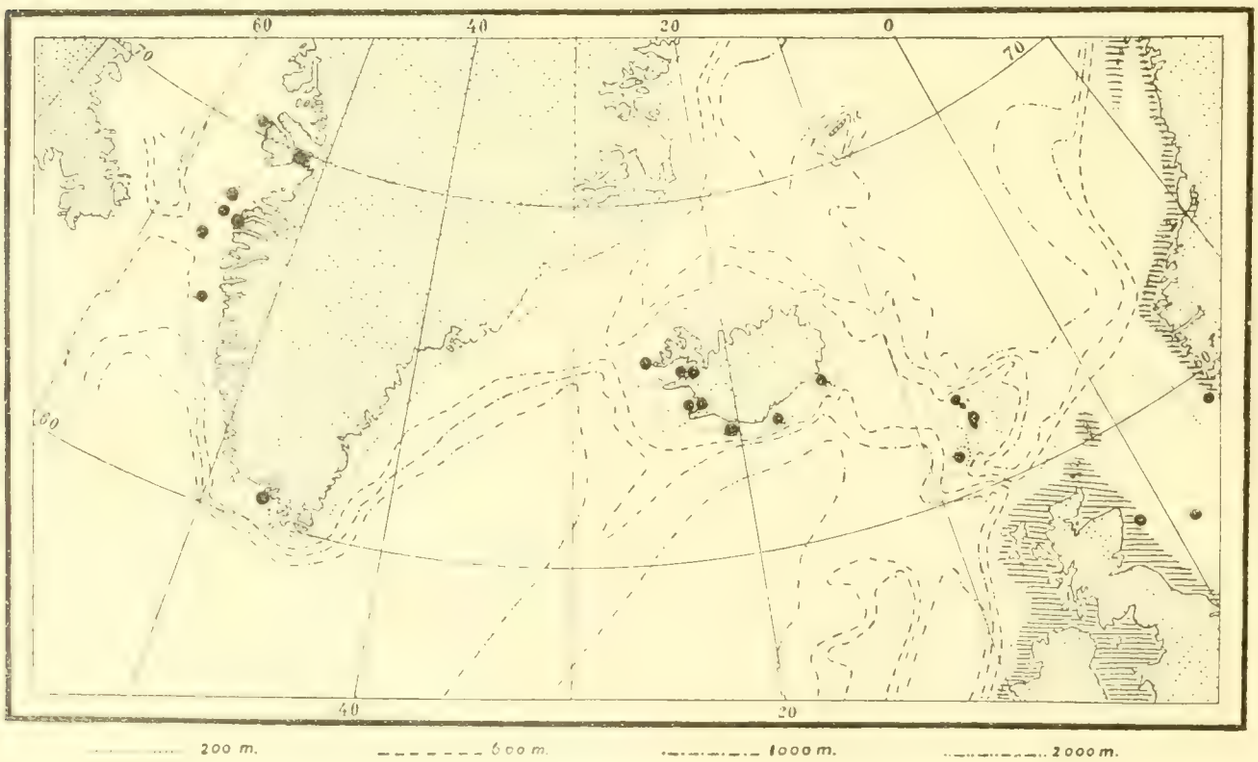

Fig. LXXXI. The distribution of *Campanularia verticillata* in the northern Atlantic.
In the hatched regions the literature notes a common occurrence.

ever, (Kramp 1914 p. 1069; Nutting 1915 p. 31) as to its also belonging to the antarctic region, are incorrect. Hickson and Gravely (1907 p. 23) mention, it is true, *Campanularia verticillata* var. *grandis* from Mc Murdo Bay, but what they found there was, as Vanhöffen has pointed out (1909 p. 294) really the altogether different antarctic species *Campanularia lobata* Vanhöffen, which has but one character in common with our northern *Campanularia verticillata*: the fact that the colonies are, as in the latter, rhizocaulomes. *Campanularia verticillata* is thus not a bipolar species. — *Campanularia verticillata* belongs to the middle parts of the littoral region, but may also be met with in quite shallow water; not infrequently also, it may penetrate down into the abyssal region, where it has even been found at no less than 600 metres' depth. Its distribution in our seas (fig. LXXXI) shows that it is restricted to the coastal waters. The species is not uncommon on the west coast of Greenland; on the east coast, however, it has only once been taken north of 76°. In Iceland waters, it seems to keep chiefly to the southern coast; it is also found scattered about the Faroe Islands. Round the British Isles and off the coast of Norway it is of very common occurrence.

Campanularia groenlandica Levinsen.

1893 *Campanularia groenlandica*, Levinsen, Meduser, Ctenophorer og Hydroider p. 26 pl. 5 figs. 10—12.

Creeping colonies, from the stolons of which the hydrotheca stalks proceed; the latter may be ringed throughout their entire length, or, more commonly, having a smooth middle part; more rarely, the rings are found to be almost entirely lacking. The stalk invariably terminates under the hydrotheca in a ball-shaped joint. The large hydrothecæ are about $1^1/_2$ times as long as broad, typically bell-shaped, with gently curving sides, the greatest bend occurring in the basal third to fourth of the hydrotheca. At the aperture, the hydrotheca is polygonal in transverse section, with from ten to fifteen, generally twelve or thirteen straight or slightly concave sides, each running out at the opening into a markedly prominent rounded tooth. In the intervals between the teeth, the margin is slightly curved outwards. The basal chamber is quite low, and bounded at the top by a faintly developed narrow ring-shaped inner thickening of the hydrotheca wall.

The gonothecæ proceed from the stolons, and are attached to the same by a rudimentary stalk. They are elongated oval or bottle-shaped, with a fairly long, narrowly cylindrical neck; they are smooth or indistinctly wrinkled, generally somewhat asymmetrical; the neck is straight or more or less curved.

Material:

"Ingolf" St. 31 66°35′ N., 55°54′ W., depth 88 fathoms 1,6°
- 34 65°17′ N., 54°17′ W., — 55 —
— - 87 65°02,3′ N., 23°56,2′ W., — 110 — —
Greenland: Davis Strait — 80 — (without further details) } Levinsen's
Store Hellefiskebanke (— — —) } type-specimens
Iceland: 64°17,5′ N., 14°44′ W., — 75 metres 5,12°
Bredebugt, 65°45,8′ N., 23°55,2′ W., depth 30 fathoms.

Campanularia groenlandica is a circumpolar arctic species belonging to the littoral region. It is undoubtedly of more common occurrence than the data to hand appear to show; this is probably owing to its having been confused with *Campanularia Hincksii* Alder, the prismatic hydrothecæ of which present a certain likeness to those of *Campanularia groenlandica*. That such confusion has taken place as far as the Norwegian waters are concerned would seem to be beyond doubt; we find here, that *Campanularia groenlandica* moves southward at any rate as far as Trondhjem Fjord (fig. LXXXII). The species has once or twice been encountered off the east and west coasts of Iceland; on the east coast of Greenland it has not been met with south of 76°, but along the whole of the west coast, which is its classical ground, it is fairly common, occurring often in company with *Campanularia volubilis*.

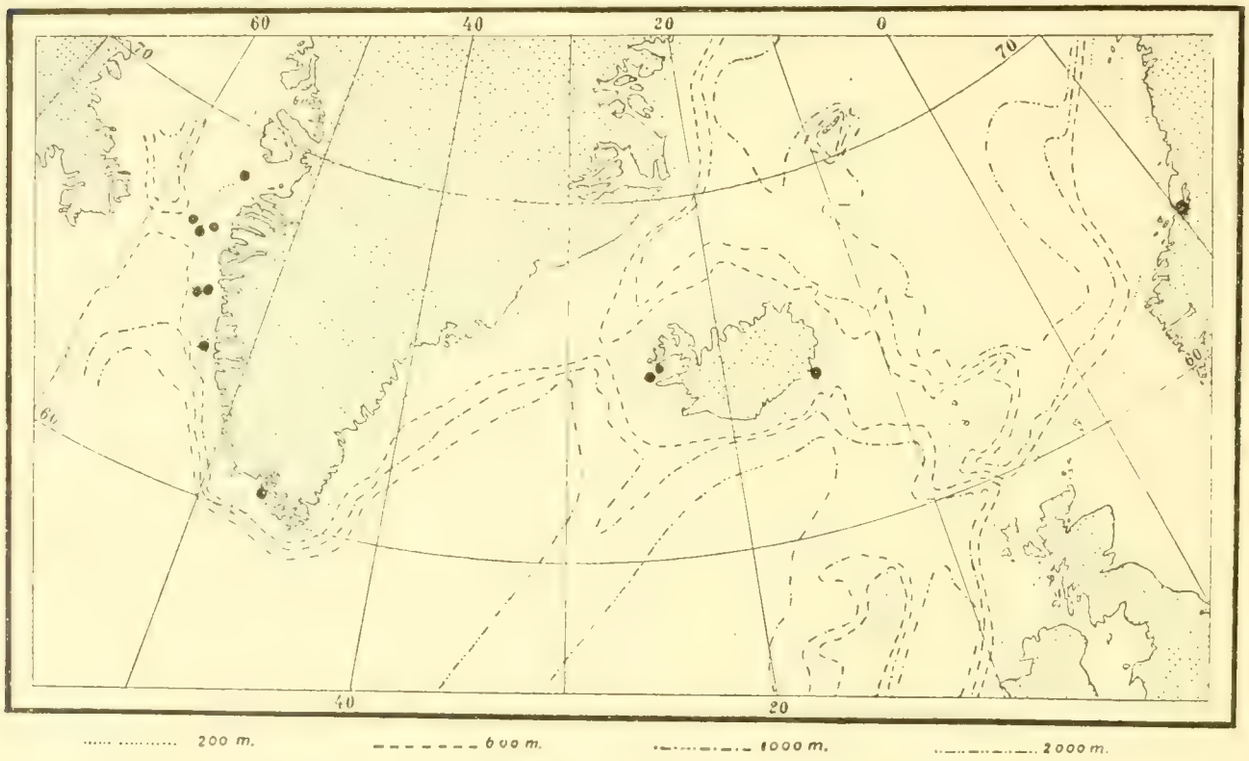

Fig. LXXXII. Finds of *Campanularia groenlandica* in the Northern Atlantic.

Campanularia speciosa Clark.

1876 *Campanularia speciosa*, Clark, Report on the Hydroids .... Alaska, p. 214, pl. 9, fig. 11.

1913 *Campanularia magnifica*, Fraser, Hydroids from Vancouver Island and Nova Scotia, p. 164, pl. 11, figs. 1—3.

Creeping colonies, from the stolons of which proceed shorter or longer, irregularly wrinkled or ringed stalks, terminating under the hydrotheca itself in a ball-shaped joint. The large hydrothecæ are swollen at the bottom, with gently curving sides, narrowing upwards, but rapidly expanding again distally near the aperture, so that the opening margin curves strongly outwards. The margin is

furnished with seven to ten broad, slightly prominent teeth. The opening part curving more strongly out between the teeth, we have a broad furrow running from the highest point of the teeth and continuing some way down the hydrotheca, where it disappears. The longitudinal axis of the hydrothecæ is often somewhat curved. The basal cavity is very small, bounded at the top by a sharply defined, fairly prominent ring-shaped thickening of the inner wall.

The gonothecæ are attached to the stolons by a short, often rudimentary stalk. They are egg-shaped to oval, attached to the stalk by their broad end, and running out distally to a fairly long, narrow cylindrical neck. The gonothecæ are often slightly bent, and faintly and irregularly wrinkled transversely.

Material:

Greenland: Store Hellefiskebanke, depth 24 fathoms.

The above-noted synonym *Campanularia magnifica* Fraser (1917 p. 164, pl. 11, figs. 1—3) ought not really to require any further explanation. Fraser (1917 pl. 11, fig. 4) figures for purposes of comparison a gonotheca of *Campanularia speciosa* from Alaska; this is, like the one shown by Levinsen (1893 pl. 5, fig. 7) a developmental stage, only a little younger still. I have previously described the fully developed gonotheca after specimens from the Kara Sea (1912 p. 18 fig. 3); the conformity with Fraser's pl. 11 fig. 2 is evident. The other distinctive characters noted by Fraser are void of all significance, as will be seen from a somewhat richer material of the species.

Campanularia speciosa is a panarctic species, belonging to the shallower parts of the littoral region. Within the areas investigated, it is only known from West Greenland, where its most southerly occurrence was noted on the Store Hellefiskebanke.

Campanularia integra Mac Gillivray.

1842 *Campanularia integra*, Mac Gillivray, Catalogue of the marine Zoophytes of the neighbourhood of Aberdeen, p. 465.
1853 — *caliculata*, Hincks, Further notes on British Zoophytes, p. 178, pl. 5, fig. B.
1876 — *compressa*, Clark, Report on the Hydroids .... Alaska, p. 214, pl. 8, figs. 5—6.
1901 — *Ritteri*, Nutting, Papers from the Harriman Alaska Expedition, p. 171, pl. 17, fig. 5.
1915 — — Nutting, Campanularidae, p. 35, pl 2, fig. 2.
1915 — *integra*, Nutting, l. c. p. 33, pl. 1, fig. 7, pl. 2, fig. 3.
1915 *Orthopyxis caliculata*, Nutting, l. c. p. 64, pl. 15, fig. 4.
1915 — *compressa*, Nutting, l. c. p. 65, pl. 15, figs. 5—10.

Creeping colonies, from the stolons of which proceed hydrotheca stalks, smooth, or more or less distinctly ringed or spirally coiled, especially near their origin, and close under the hydrotheca; the stalk here always terminates in a ball-shaped joint. The hydrothecæ are large, inversely conical to nearly cylindrical; the conical ones taper gently down throughout their whole length towards the stalk; otherwise, the hydrothecæ are rounded smoothly off at their basal part; every possible kind of intermediate form may be found. The hydrotheca margin is smooth, with no indication of teeth,

often curving slightly outward. The basal chamber is well developed, and bounded at the top by a more or less pronounced ring-shaped thickening of the wall, often with a fairly thick base.

The gonothecæ are attached to the stolons by a short, generally rudimentary stalk. They are oblong oval to cylindrical; the wall is often furnished with oblique furrows forming a spiral, but may as often as not be quite smooth; all intermediate forms and types occur in one and the same colony. The gonophores are eumedusoid and sessile, or break loose during a part of the breeding season as defective medusæ (*Agastra*).

Material:

"Ingolf" St. 34, 65°17′ N., 54°17′ W.; depth 55 fathoms
— - 127, 66°33′ N., 20°05′ W.; — 44 — 4,6°
"Thor" 64°02′ N., 22°33′ W.; — 34 metres
Greenland: Godhavn (depth not stated)
Jakobshavn (— - —)
Egedesminde (— - —)
Store Hellefiskebanke, off Holstensborg (depth not stated)
Davis Strait, depth 100 fathoms (without further details)
Sukkertoppen on algæ (depth not stated)
Godthaab (— - —)
Iceland: Bakkefjord, depth 10 fathoms
Vopnafjord, on littoral algæ
Seydisfjord, depth 6 fathoms
Vestmanö, on littoral algæ
Reykjavik, depth 2—3 fathoms
10 miles W. of Akranes, depth 26 fathoms
Keflavik, on littoral algæ
Bredebugt, 65°17,5′ N., 23°32′ W., depth 7—12 fathoms
— 65°18,5′ N., 23°02′ W., — 9—12 —
Stykkisholm — 30 —
The Faroe Islands: Svinö, on laminarians, depth 60 fathoms.

The synonymy of this species should be clear enough after the investigations which have been made by Levinsen (1893) Kramp (1911) and myself (1909); nevertheless we find, that Nutting (1915) again distributes the species among no fewer than four, and even places these in two different genera. With regard to the transition stages between *Campanularia integra* and *Orthopyxis caliculata*, we find the following (1915 p. 34) "Broch ... says that the gonangia of the two species intergrade, but I have seen no instance of the kind, and, as the two may occur together, a very careful dissection would be necessary to place the matter beyond doubt". It is precisely such careful dissections which have convinced Levinsen and myself that all transition forms and variants do occur on the same stolons; we have only to regret that Nutting has not been equally conscientious in his methods of work.

It might be supposed that Nutting's material of *Campanularia integra* was restricted to some few colonies from scattered localities, each representing accidental variant groups, since the species is distributed under four separate names. The above indication of the methods pursued, however, taken together with the following statement, will give a good idea as to the cause (Nutting 1915 p. 34): "It should be understood moreover, that the present writer repudiates the idea that occasional intergradation in these low forms is sufficient ground for uniting species that are usually and perfectly distinguishable".

Giard (1899) has pointed out that the gonophores in *Campanularia integra* break away during

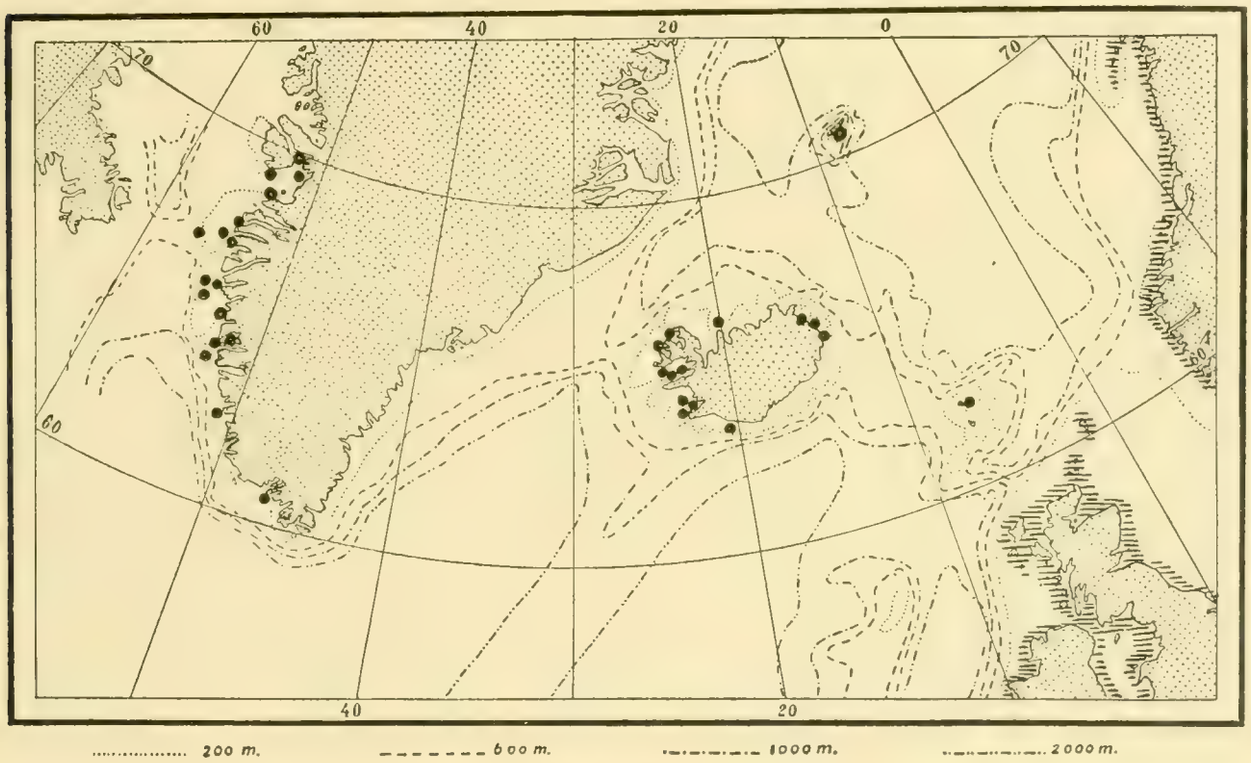

Fig. LXXXIII. Distribution of *Campanularia integra* in the Northern Atlantic.
In the hatched regions a common occurrence is stated.

part of the breeding season as defective medusæ, but are otherwise sessile. The correctness of this observation has been doubted, but is further confirmed through the investigations of Behner (1914). This writer refers to the species investigated as *Campanularia compressa* Clark, but it is impossible to discern wherein the difference between that species and *Campanularia integra* should be supposed to lie. The species thus stands with one foot in each of the two old genera *Campanularia* and *Clytia*. Nutting grasps at this as a welcome opportunity of separating off yet another genus, *Ortypyxis*, and believes to have rendered the system clearer and easier to deal with thereby.

Campanularia integra is a purely cosmopolitan species, which prefers the upper part of the littoral region, but may nevertheless occassionally be met with a good way down in the abyssal, exhibiting thus, apart from its enormous power of variation, a high degree of elasticity with regard to temperature. In respect of salinity, on the other hand, it appears to be more susceptible, and does

not move far up into the fjord waters. This may possibly also account for the distribution of the species within the area investigated (fig. LXXXIII). *Campanularia integra* is very common along the west coast of Greenland, but lacking on the east coast south of 76° N., according to what we know up to the present. The remarkable paucity of hydroids — arctic or boreal, — along this coast cannot be explained as due exclusively to temperature conditions, but must doubtless, judging from *Campanularia integra*, be partly occasioned by an accumulation of the fresh glacier water along the shore in contrast to the west coast, where warmer atlantic currents occasion a livelier interchange of water supply. A further peculiarity appears to lie in the scantiness of the species at the Faroe Islands; this, however, may possibly be accounted for by the fact that zoological bottom investigations have for the most part been made at greater depths than those at which the species chiefly lives in these waters.

Campanularia Hincksii Alder.

1856 *Campanularia Hincksii*, Alder, A notice of some new genera and species, p. 360 pl. 13, fig. 9.

Creeping colonies, from the stolons of which proceed long hydrotheca stalks, more or less distinctly ringed above their point of origin and under the hydrotheca; the stalk terminates below the hydrotheca in a ball-shaped joint. The hydrothecæ are very nearly cylindrical, with an evenly curving, rapid transition from the bottom to the stalk. In transverse section, the hydrotheca is polygonal, with eight to fourteen straight sides, each running out at the opening into a strong tooth, transversely cut off; the teeth may also at times exhibit a slight median incision. The basal cavity is small, bounded at the top by a sharply defined low and narrow ring-shaped thickening of the inner wall.

The gonothecæ are attached directly or by a rudimentary stalk to the stolons. They are elongated egg-shaped, broadest about the lower third, cut off transversely at the distal part, and with more or less prominent transverse furrows.

Material:

Iceland: Vestmanö, depth 28 fathoms.

North Sea: 57°07′ N., 2°40′ E., depth 37 fathoms.

Sæmundsson (1911 p. 77) mentions under this species an instance in which an approach to rhizocaulome formation was found, giving rise to a stem 1 cm high, whereby the colony assumed a considerable resemblance to *Campanularia verticillata*.

Campanularia Hincksii is a southern species doubtless more rare in northern waters than would appear from the records extant. It has frequently been confused with *Campanularia groenlandica*, which it somewhat resembles in a sterile state. Its occurrence in arctic waters is in reality very doubtful, and we must await further data before we can decide its biogeographical character with any certainty.

Campanularia Johnstoni Alder.

1856 *Campanularia johnstoni*, Alder, A notice of some new genera and species, p. 359, pl. 13, fig. 8.
1860 *Clytia bicophora*, L. Agassiz, Contributions to the natural history of the United States, Second Monogr. vol. 4, p. 304, pl. 29, figs. 6—9.
1868 — *johnstoni*, Hincks, A History of the British Hydroid Zoophytes, p. 143, pl. 24, fig. 1.

Creeping colonies, from the stolons of which proceed fairly long hydrotheca stalks, ringed at the base and below the hydrothecæ, the middle part generally smooth. The stalk terminates below the hydrotheca in a ball-shaped joint. The hydrothecæ are of varying size, from twice to $2^1/_2$ times as long as broad, cylindrical or inversely conical, with gently curving basal part. The hydrotheca is circular in section at the aperture; the opening margin is furnished with ten to sixteen sharp or pointedly rounded, highly prominent teeth. The basal cavity is rather large, terminating at the top in a narrow, sharply defined ring-shaped thickening of the inner wall, which in finely built specimens often presents the appearance of a very low diaphragm.

The gonothecæ are attached to the stolons by a short, ringed stalk. They are cylindrical, narrowing sharply at the base, cut off transversely at the distal end, and have deep transverse furrows generally forming a slowly ascending, close spiral. The gonophores develope into free medusæ (*Clytia*).

Material:

Iceland:	Vestmanö, depth 25 fathoms.			
The Faroe Islands:	6 miles N. by W. of Store Kalsö,	depth	60	fathoms
	deep hole at north point of Nolsö,	—	100	—
	61°40′ N., 7°40′ W.,	—	135	—
North Sea:	57°07′ N., 2°40′ E.,	—	37	—

Nutting (1915 p. 54) endeavours once more to divide *Campanularia Johnstoni* from *Clytia bicophora*, partly on the ground that the latter species is said to possess a diaphragm, partly because it is finer in the chitinose parts. The thinner chitinose formations involve, in *Campanularia Johnstoni* as in other species, a more restricted thickening of the wall, so that there may often be some considerable resemblance to a low diaphragm, and hydrothecæ of this type always exhibit a marked tendency to wrinkle up on preservation. There is, however, no reason to take all this as furnishing sound specific characters, and we also find that all other investigators agree in uniting the two species as *Campanularia Johnstoni*. This is doubtless correct.

Campanularia Johnstoni is a widely distributed southern form, which thrives to a marked degree upon *Sargassum*; it can, however, penetrate quite far down within the littoral region. In the northern seas (fig. LXXXIV) it appears as a southern visitor, found once so far to the north as Hammerfest on the coast of Norway, but otherwise only once met with at Bergen. In the North Sea it is more common, as also at the Faroe Islands; it is of very frequent occurrence round the British Isles, but rare in Iceland waters. Its distribution is that of a species typically belonging to the warm atlantic current.

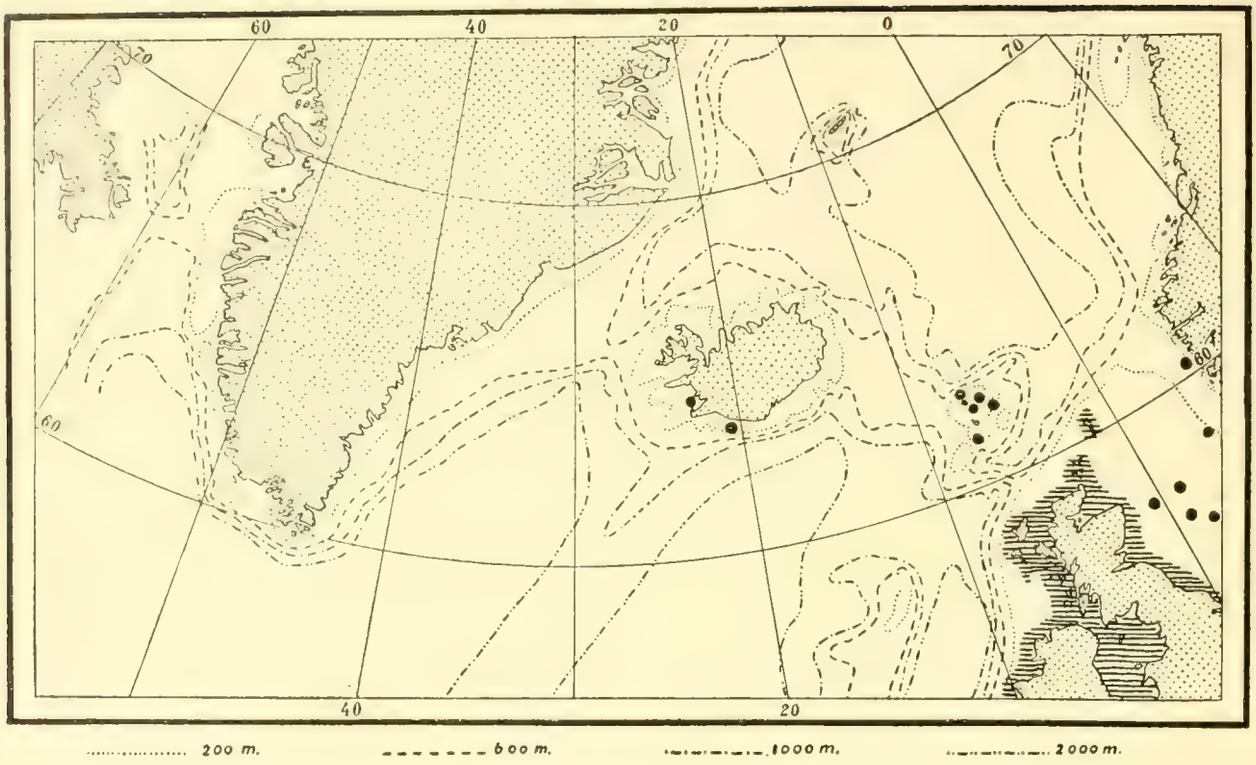

Fig. LXXXIV. The occurrence of *Campanularia Johnstoni* in the northern Atlantic. In the hatched region a common occurrence is stated.

Gen. Laomedea Lamouroux.

Upright, sympodial colonies only occasionally exhibiting creeping parts with unbranched polyp stalks. The hydrothecæ have a typical broad diaphragm which forms the boundary between the main cavity and the basal chamber. The polyps can be withdrawn entirely into the radially symmetrical hydrothecæ. The hydranth has a club-shaped proboscis, and homogeneous gastral endoderm.

Lamouroux (1812) gave the following diagnosis of the genus: "Polypier phytoïde, rameux; cellules stipitées ou substipitées, eparses sur les tiges et les rameaux". This thus embraces the upright colonies of *Campanulariidæ*, but Lamouroux has nevertheless placed *Campanularia verticillata* in his genus *Clytia*. There is thus no reason to suppress the name *Laomedea* for later and more narrowly restricted genera, and we cannot, on phylogenetic grounds, break up the genus as here defined on account of the biological peculiarities apparent in the gonophores. Nor is a better survey obtained by dividing the genus according to the nature of the gonangia, which it is in most cases impossible to determine with certainty from the colonies obtained. And that characters should be easier to handle when raised to generic rank than when applied to species it is not easy to understand.

In this genus, we find quite exceptionally that certain species, such as *Laomedea dichotoma* (Linné) may occur with creeping growth modification (cf. Broch 1913 p. 55); in such case, however, the diaphragm distinctly shows to what genus the species must belong. These creeping parts are

biological adaptations, which cannot in themselves afford grounds for distinction of species. How they arise, however, has not yet been thoroughly explained.

Laomedea flexuosa Alder.

1850 *Laomedea flexuosa* Alder, Description of three new British Zoophytes p. 440.

Upright, bushy colonies with monosiphonic hydrocaulus. There is no thickening of the periderm under the apophyses. Branches and stem are zigzag, with a short, ringed hydrotheca stalk from the apophyse at each bend. The hydrotheca is as a rule $1^1/_2$ times as long as broad, or hardly as much. In shape it is inversely conical, with sides very slightly curved and quite smooth margin The basal cavity is large, bounded at the top by a distinct diaphragm. The hydrotheca exhibit no unilateral thickening of the wall.

The gonothecæ are carried on short ringed stalks proceeding from the apophyse beside the hydrotheca stalk. They are slenderly conical, as a rule tapering narrowly upward again at the distal part, and cut off broadly transversely at the distal end, without neck. The gonophores are dimorphous, the males styloid, the female heteromedusoid.

Material:

Iceland: Vestmanö, on the beach
Grindavik (depth not stated)
Reykjavik (— - —)
Grafarvogur (— - —)

Laomedea flexuosa is a boreal species characteristic of the tidal zone. On a former occasion (1909 p. 228 footnote) I suggested that the recording of this species from deeper water, down to 60 metres depth near Iceland, must be due to confusion with other species. A revision of Sæmundsson's material has entirely confirmed the correctness of this; the specimens he mentions (1902 p. 56) from deeper water are *Laomedea geniculata* (Linné) and *Laomedea longissima* (Pallas). Sæmundsson later (1913 p. 78, footnote) quotes in support Levinsen's determinations from the cruises of the "Hauch" (1893); these, however, must be taken with some reserve, and they will probably only be found correct provided they refer to water layers of very low salinity. In fjords with an intermixture of fresh water and in inland seas, the limits for the tidal zone will require to be somewhat modified, if it is to correspond with the conditions for fauna and flora in the tidal zone of the open sea shore. The deepest-living *Laomedea flexuosa* are met with out here on the upper *Laminaria*, which at deepest low water are not infrequently found lying dry; up in the fjords also the upper *Laminaria* must be taken as the limit, though they are here only found considerably deeper. Here, however, *Laomedea flexuosa* rarely goes so far down. The species is, as mentioned, boreal, characterising the tidal zone along the coast of Scandinavia, round the British Isles and at Iceland; it will probably, on further investigation, also prove to be common at the Faroe Islands. In Greenland waters, however, the species seems to be altogether lacking. It does not penetrate into the strictly arctic tracts.

Laomedea geniculata (Linné) Lamouroux.

1758 *Sertularia geniculata*, Linné, Systema naturæ, Ed. 10, p. 812.

1816 *Laomedea geniculata*, Lamouroux, Histoire des Polypiers coralligènes flexibles, p. 208.

1864 *Obelia geniculata*, Allman, On the construction and limitation of Genera, p. 372.

Upright, more rarely branched colonies with zigzag stem, the colony as a rule strongly built, and with an (inner) thickening of the perisarc under the apophyse; the stem and branches without rings. The hydrothecæ are borne on short, ringed stalks proceeding from the apophyses. Hydrothecæ long, about as long as broad, inversely conical with slightly curved sides. The abcauline side has as a rule a thicker wall than the adcauline. The basal cavity is large, bounded at the top by a strong diaphragm, which, especially in colonies with strongly developed periderm, has a thickened adthecal part. The hydrotheca margin is even, without indication of teeth or convexities.

The gonothecæ are set on short ringed stalks proceeding from the apophyses at the side of the hydrotheca stalks. The gonothecæ are slender, inversely conical, with a clearly defined, sharply tapering distal part, and short, narrow central neck. The gonophores develope into free medusæ (*Obelia*).

Material:

"Thor" 64°16′ N., 22°17′ W., depth 50 metres.
— 64°02′ N., 22°33′ W., — 34 —
Iceland: Bakkefjord, depth 25—32 fathoms
Seydisfjord, — 6 —
Vestmanö, — 25 — [labelled *Laomedea flexuosa*]
Reykjavik, — 3—4 —
Olafsvik (depth not stated) [labelled *Laomedea flexuosa*]
Stykkisholm, depth 6—9 fathoms
Bredebugt, 65°17,5′ N., 23°22′ W., depth 7—12 fathoms
— 65°18′ N., 23°02′ W., — 9—10 —
Dyrafjord, on *Laminaria* (depth not stated)
Önundarfjord, depth 10 fathoms
Adelvik, — 5—5,5 —
Ofjord, on *Lernæa* (depth not stated)
Grimsö, depth 15 fathoms
Vidarvig, — 13,5 —
Thistil fjord, Raudarnes 1.5 miles in S.51E., depth 18 fathoms.
Jan Mayen, on *Laminaria*, depth 15 fathoms (East Greenland Expedition).
The Faroe Islands: Thorshavn, depth 3—15 fathoms
Vestmanhavn, — 10 —
Solmunde, on *Laminaria* (depth not stated)
Svinö, depth 20 fathoms.

Laomedea geniculata is a cosmopolite, belonging to the upper part of the littoral region; in northern seas it is chiefly restricted to the *Laminaria*, but may also occur on deeper-growing *Zostera* and on shallow red algæ in large quantities. Albeit properly cosmopolitan, the species is nevertheless very rare in strictly arctic waters, but may occur here right into the White Sea. It is most frequent in the boreal areas. Along the coasts of Norway, round the British Isles, the Faroe Islands and Iceland it is present in great numbers (fig. LXXXV). It is also mentioned from Greenland, but no definite locality has yet been recorded.

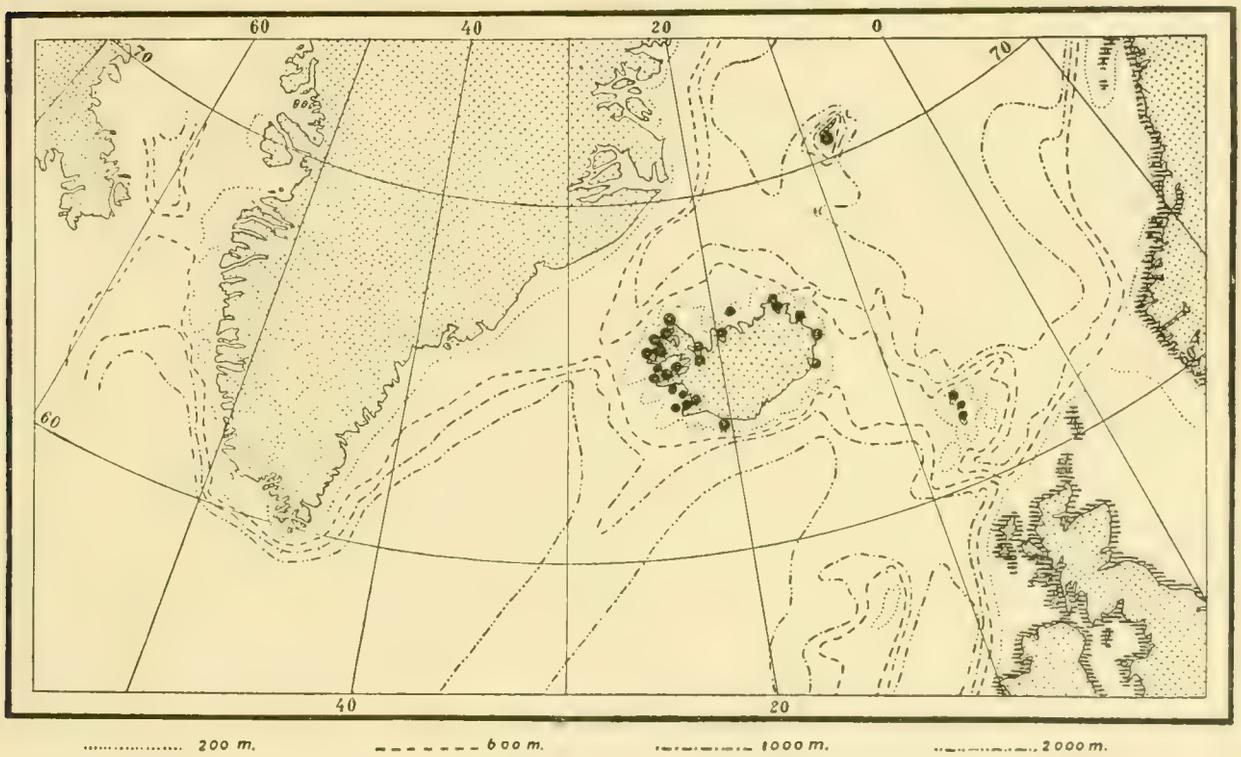

Fig. LXXXV. The distribution of *Laomedea geniculata* in the Northern Atlantic.
In the hatched regions the species is abundant.

Laomedea longissima (Pallas) Alder.

1766 *Sertularia longissima*, Pallas, Elenchus zoophytorum, p. 119.
1858 *Laomedea* — , Alder, A Catalogue of the Zoophytes of Northumberland, p. 121.
1868 *Obelia* — , Hincks, A History of the British Hydroid Zoophytes, p. 154, pl. 27.
1868 — *flabellata*, Hincks, l. c. p. 157, pl. 29.

Large graceful colonies with monosiphonic, brown stem, generally flexuous. From this proceed secondarily ramified branches, which again give off a hydrotheca stalk from the apophyse at each bend. There is no thickening of the periderm under the apophyses. The hydrothecæ are about twice as long as broad, slender, inversely conical, with more strongly curved basal part. The hydrotheca margin is more or less curved, at times with distinct teeth, at others quite smooth. The basal chamber is fairly large, and bounded at the top by a finely built but distinct diaphragm.

The gonothecæ are borne on short, ringed stalks, proceeding from the apophyses beside the hydrotheca stalks. They are oblong, inversely conical, distally cut off transversely with a central short and narrow, almost tubulous neck. The gonophores develope into free medusæ (*Obelia*).

Material:

"Thor" 64°02′ N., 22°33′ W., depth 34 metres [labelled *Laomedea gelatinosa*]
— 63°30′ N., 20°14′ W., — 80 —
— 58°11′ N., 2°28′ W., — 60 —
Greenland: Jakobshavn (depth not stated)
Provens havn (— - —)
Holstensborg (— - —)
Tasiusak, depth 3—5 fathoms (East Greenland Expedition).
Iceland: Berufjord, depth 6 fathoms [labelled *Laomedea flexuosa*]
Hornafjord (depth not stated) [labelled *Laomedea Lovenii*]
Vestmanö, depth 25—28 fathoms [some of the specimens labelled *Laomedea flexuosa*]
10 miles W. of Akranes, depth 26 fathoms [labelled *Laomedea flexuosa*].
Stykkisholm, depth 20—30 fathoms [labelled *Laomedea flexuosa*]
Kollafjord, — 4—5 —
Dyrafjord (depth not stated).
The Faroe Islands: 5 miles N. by E. of Myggenæs point, depth 50 fathoms.

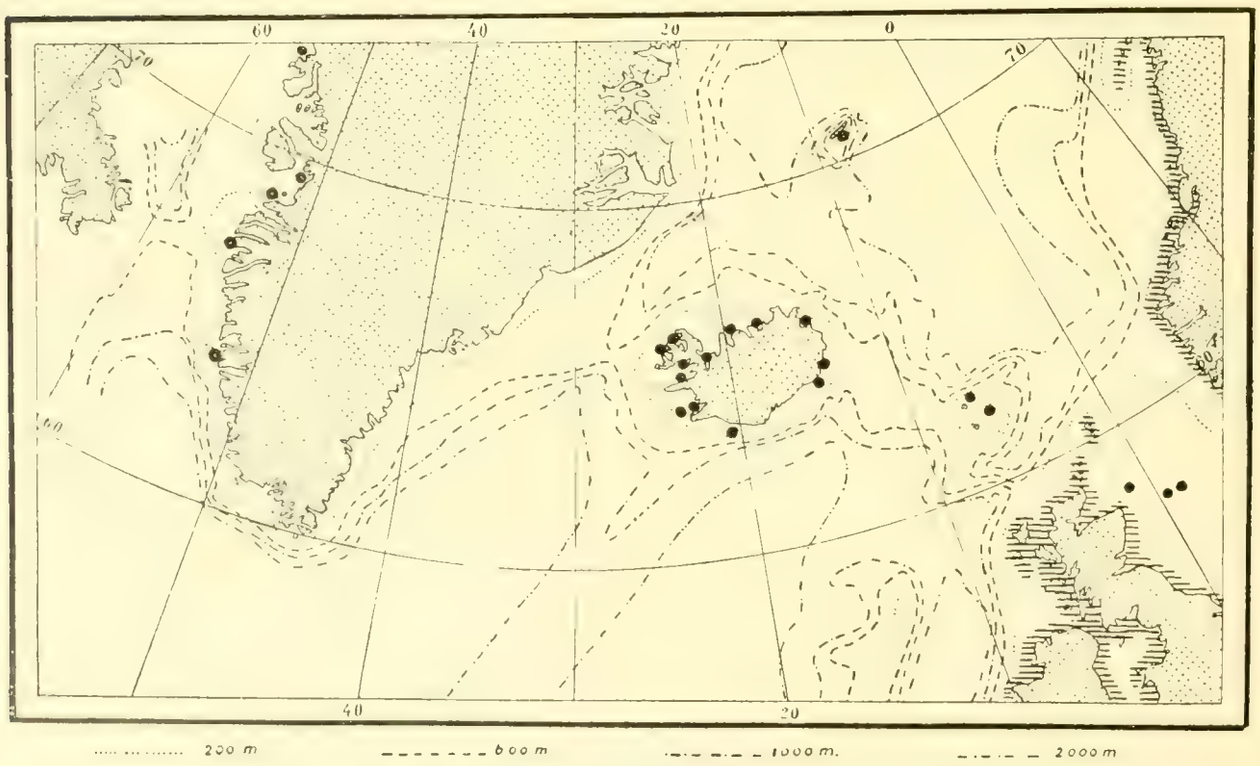

Fig. LXXXVI. The distribution of *Laomedea longissima* in the Northern Atlantic.
In the hatched regions a common occurrence is stated.

Sterile colonies of this species with almost or entirely smooth margin may at times present a certain resemblance to *Laomedea flexuosa*, and have frequently been confused with this species by Sæmundsson. — Nutting (1915 p. 73) endeavours to revive *Obelia flabellata* Hincks on the ground that the extreme branches of this species exhibit dichotomous ramification, whereas in the present species they are "flabellate"; unfortunately, however, he does not further explain the difference between the two terms. In the present colonies, both might often apparently be applied to the same branch. Nor does his other distinctive character, the fact that the branches in *Obelia longissima* are "regularly alternate" while those in *Obelia flabellata* are "alternate or opposite" give us any sound basis to work on. Bonnevie (1899 p. 71) is undoubtedly right in uniting the two species, and they cannot be revived on the strength of what Nutting here seeks to show.

Laomedea longissima appears to be a cosmopolitan species, albeit the data on record from tropic-subtropical waters are but scanty. The species belongs to the upper third of the littoral region, and goes far up into arctic waters, where it has a circumpolar distribution. In the area investigated (fig. LXXXVI) it appears to be entirely lacking in East Greenland waters, but is otherwise fairly regularly met with on all coasts.

Laomedea hyalina (Hincks) Levinsen.

1866 *Gonothyræa hyalina*, Hincks, On new British Hydroida, p. 297.
1893 *Laomedea* — Levinsen, Meduser, Ctenophorer og Hydroider, p. 28.

Finely built upright colonies with monosiphonic main stem, the latter being, like the main branches, generally brown in colour. The colony often assumes a bushy appearance, owing to irregular ramification. The hydrothecæ are carried on short ringed stalks proceeding from the branch apophyses; the latter are set in a plane on the branch directed alternately to either side. The hydrothecæ are slender, inversely conical to cylindrical, tapering somewhat more at the basal part toward where the stalk begins; they are twice to three times as long as broad. The hydrotheca margin is furnished with low teeth, having a slight, often almost imperceptible median sinus in their distal end, which is cut off almost straight, so that they are divided into two denticles; from this sinus a slight furrow runs for a varying distance down the hydrotheca on its outer side. The basal chamber is small, bounded at the top by a thin, but well developed diaphragm.

The gonothecæ are borne on short, ringed stalks, proceeding from the apophyses beside the hydrotheca stalks. They are inversely conical, cut off straight at the distal end, without neck. The gonophores develope into crypto-medusoid meconidia, which extend out from the gonotheca without breaking away; the larval development takes place in the interior of the meconidium. (*Gonothyræa* medusæ).

Material:

"Ingolf" St. 34,	65°17′ N.,	54°17′ W.,	depth	55	fathoms.
"Thor"	66°23′ N.,	14°24′ W.,	—	45	metres
—	65°52′ N.,	23°58′ W.,	—	62	— [labelled *Laomedea Lovenii*]
—	64°16′ N.,	22°17′ W.,	—	50	—

"Thor" 64°02′ N., 22°33′ W., depth 34 metres
— 63°30′ N., 20 14′ W., — 80 — [labelled *Laomedea Loveni*]
Greenland: Pröven (depth not stated)
Umanak (— - —)
Christianshaab (— - —) [labelled *Gonothyræa Loveni*]
Egedesminde (— - —) [labelled *Gonothyræa Loveni* and *Obelia longissima*]
Store Hellefiskebanke, depth 32 fathoms
Sukkertoppen, on *Psolus* and *Boltenia* (depth not stated)
— (depth not stated) [labelled *Obelia longissima*].
Iceland: Hvalfjord, depth 22 fathoms.
The Faroe Islands: without further details [labelled *Gonothyræa Loveni*]
6 miles N. by W. of Store Kalsö, depth 60 fathoms
Deep hole at north point of Nolsö, — 100 —

Laomedea hyalina is very closely allied to the *Laomedea Loveni* Allman, so much so that the two species have very often been confused. The characteristic distinctive marks of *Laomedea hyalina* are the fine narrow furrows running from the teeth some way down over the side of the hydrotheca, often giving the teeth themselves a double point. Nutting (1901 p. 352) mentioned intermediate forms between the two species from Plymouth; as however, the furrows in question are not noted by Nutting in the American waters, it is doubtful which of the species he has here been investigating. Probably all his specimens were typical *Laomedea Loveni*.

Laomedea hyalina must, from the data on record, be characterised as an arctic boreal, atlantic species. Its true home appears to lie at the transition between boreal and truly arctic regions, and from there it extends both north and south, everywhere within the upper third of the littoral region. Kramp (1914 p. 1071) notes the species as circumpolar, citing in evidence Clark (1876 p. 215) who mentions a *Gonothyræa hyalina* from Alaska. Marktanner-Turneretscher however, (1895 p. 408) has pointed out that Clark's specimens represent the type of a distinct species, *Laomedea Clarki* (Marktanner-Turneretscher). The validity of the species may seem somewhat doubtful, and it is highly probable that Kramp is correct in his geographical characterisation, but new and conscientious investigations in American waters will be needed before we can be fully certain. *Laomedea hyalina* is widely distributed within the waters investigated (fig. LXXXVII). It is surprising to find that a species having so wide a distribution in the arctic regions appears to be altogether lacking i East Greenland waters; it is otherwise of general occurrence within the area concerned, but becomes less frequent around the British Isles and off the southern west coast of Norway.

Laomedea gracilis M. Sars.

1851 *Laomedea gracilis*, M. Sars, Beretning om en i Sommeren 1849 foretagen zoologisk Rejse, p. 138.
1868 *Gonothyræa gracilis*, Hincks, A History of the British Hydroid Zoophytes, p. 183, pl. 36, fig. 1.

Upright colonies, slightly and irregularly branched, finely and stiffly built. There are no distinctly prominent apophyses, but the branches and hydrotheca stalks proceed from a faintly marked

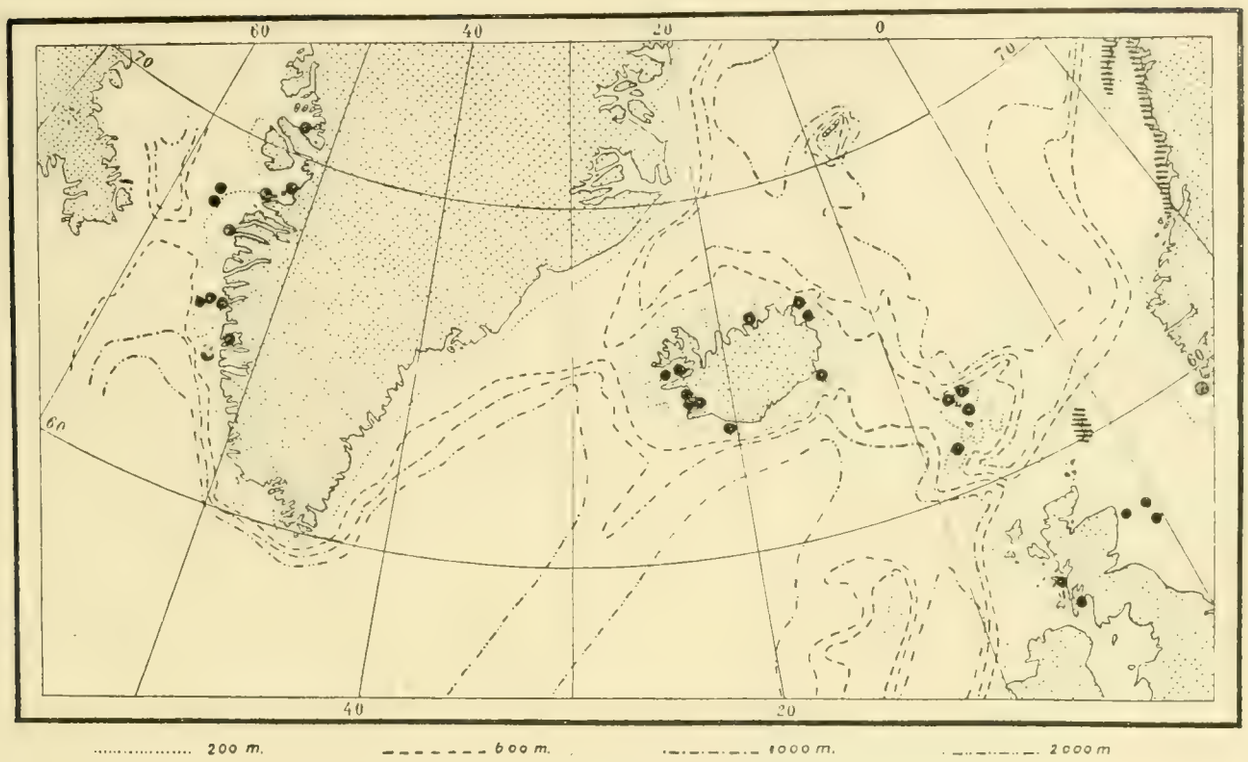

Fig. LXXXVII. The distribution of *Laomedea hyalina* in the Northern Atlantic.
In the hatched region the literature notes a scattered occurrence.

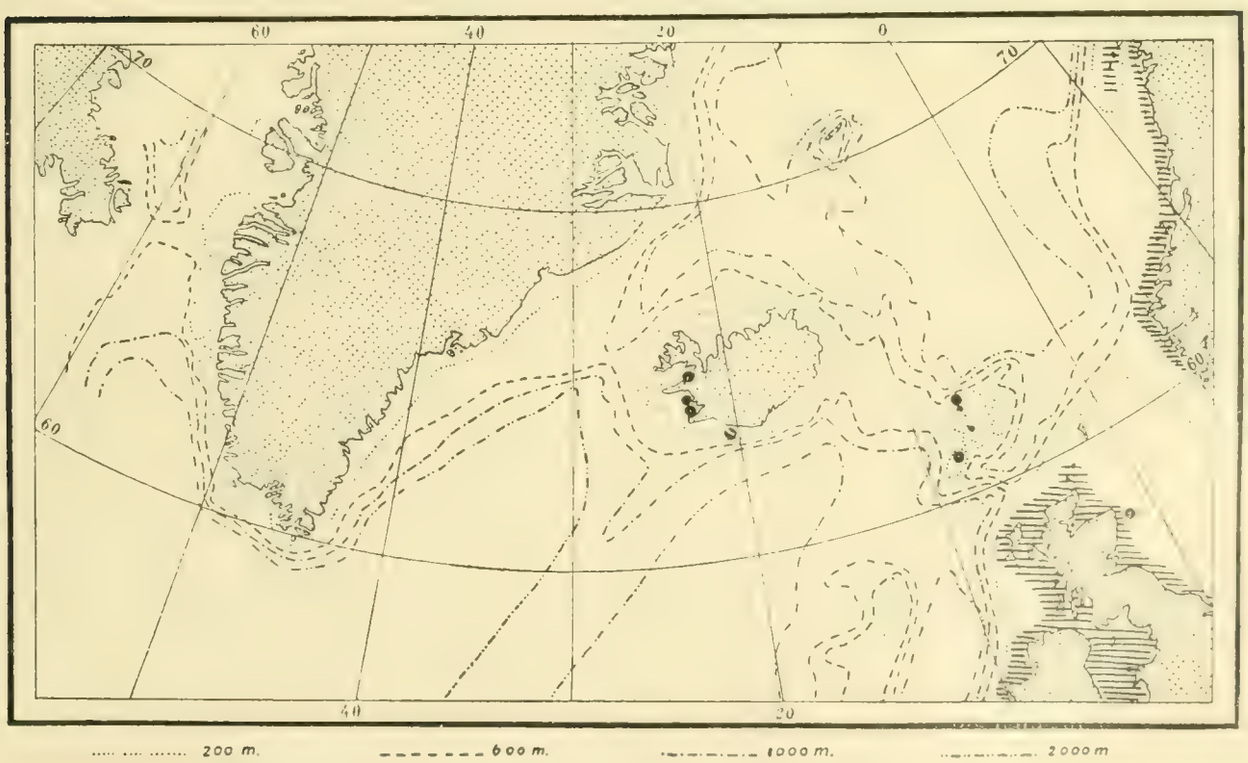

Fig. LXXXVIII. The distribution of *Laomedea gracilis* in the Northern Atlantic.
In the hatched regions the literature notes a scattered occurrence.

monosiphonic main stem, which not infrequently appears to be dichotomously branched. The branches and the hydrotheca stalks are ringed close above their origin, and below the hydrothecæ, otherwise smooth. The hydrothecæ are twice to three times as long as broad, cylindrical, or rather inversely conical, passing over by an evenly curved transition into a short, almost cylindrical basal part; the basal chamber is small, bounded at the top by a fine, well developed diaphragm, often somewhat assymetrically placed. The hydrotheca margin is provided with seven to fourteen markedly prominent pointed or pointedly rounded teeth.

The gonothecæ are attached by short, ringed stalks proceeding from stem or branches, rarely from the stolons. They are inversely conical or slightly oval, elongated, cut off transversely at the distal end, without neck. The gonophores develope into cryptomedusoid meconidia, projecting from the gonotheca without breaking away. The larval development takes place within the interior of the meconidium (*Gonothyræa* medusæ).

Material:

"Thor" 64°02′ N., 22°33′ W., depth 34 metres

Iceland: (without further details) on the back of a *Dinematura ferox* taken from a *Somniosus microcephalus*.

Laomedea gracilis is a southern visitor to the northern waters (fig. LXXXVIII) where it penetrates up to the northern point of Norway. The species is altogether of rare occurrence here, but has been taken more especially about the British Isles. One or two finds show that it also occurs sparsely at the Faroe Islands and south-west Iceland, always in the middle or upper third of the littoral region.

Gen. Bonneviella (Broch).

Stolonial colonies with enormous, often slightly bilateral hydrothecæ, having a finely built diaphragm. The large polyps can be withdrawn entirely into the hydrotheca. The hydranth has a crown of strong tentacles with multiserial endoderm; the oral part is thin, forming a thin lamella, consisting of two cell-layers, which a little above the tentacle base extend out like a velum in towards the central oral aperture. The tentacle base thrusts itself into the polyp, so that a large proboscoidal cavity is formed between this and the oral aperture. The gastral endoderm is uniformly developed.

As already mentioned, I am unable to agree with Nutting, who is inclined (1915 p. 94) to support the view advanced by me in a former work (1909 p. 197), that the ectoderm covers the tentacle base and the inner side of the velum-like proboscoidal part. Kühn (1913 p. 253) is justified in doubting whether the part in question can be reckoned as belonging to the endoderm, and I am more disposed to follow him here, considering the part as an extreme development of the indifferent endoderm cell-layer, as found for instance on the proboscis of *Campanulariidæ*. The point can, however, only be decided by study of the polyp development. The systematic position of the genus is still altogether doubtful.

Bonneviella grandis (Allman) Broch.

1876 *Campanularia grandis,* Allman, Diagnoses of new Genera and Species, p. 259, pl. 12, figs. 2—3.
1899 *Lafoea gigantea*, Bonnevie, Den norske Nordhavs-Expedition, p. 68, pl. 6, fig. 2.
1909 *Bonneviella grandis,* Broch, Hydroidenuntersuchungen, II, p. 198.

The colonies form enormous upright and irregularly branched rhizocaulomes. From the tubes proceed hydrotheca stalks of differing length, often segmented, with a spherical swelling immediately below the hydrotheca. The latter are twice to three times as long as broad, swollen for the lower third part, somewhat narrower above, with expanded margin; in transverse section, the hydrotheca is circular below, oval nearer the aperture; the aperture itself is as a rule somewhat asymmetrical, the margin quite smooth. The basal cavity is small, bounded at the top by a quite thin diaphragm.

The gonothecæ proceed from the tubes of the stem; they are more or less closely set, and occur scattered about all over the colony. The gonothecæ are egg-shaped to spindle-shaped with six to eight longitudinal ribs and a short, narrow trumpet-shaped neck.

Material:

Iceland: 64°17,5′ N., 14°44′ W., depth 75 meters 5°12
The Faroe Islands: Thorshavn (depth not stated).

The genus *Bonneviella* includes several species from the northern Pacific, for the further description of which we are indebted to Nutting (1915 p. 95). One of these species is *Bonneviella*

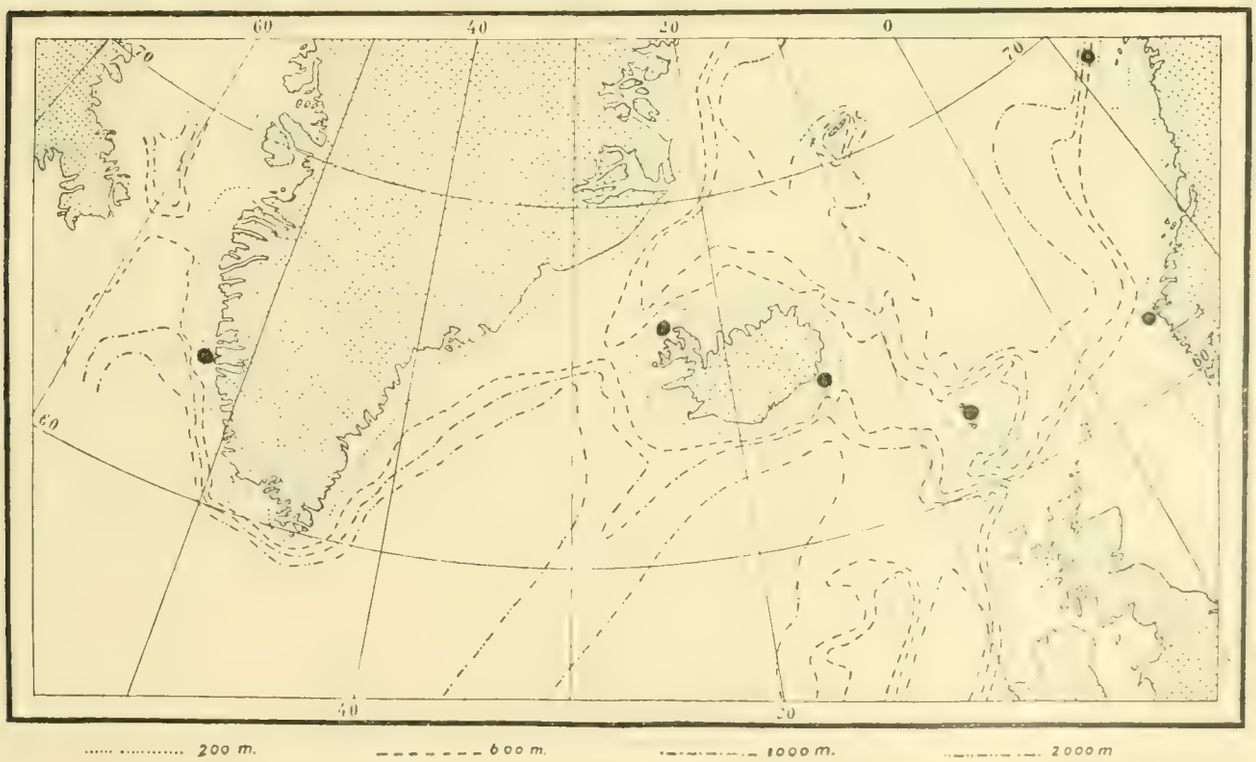

Fig. LXXXIX. Localities of *Bonneviella grandis* in the Northern Atlantic.

grandis, first described from some colonies from Japan, Tsugor Strait, preserved at Copenhagen. The species differs from the others by its longitudinally ribbed gonothecæ; the other species in which the gonangia are known, have the gonothecæ transversely furrowed. The next find of *Bonneviella grandis* was made off the west coast of Norway. We have since learned, that the species, besides occurring at several places in the North Pacific, is also widely distributed in European waters. It has been met with in the Barents Sea, at Lofoten (fig. LXXXIX), at Moldoen near Stat on the west coast of Norway. It is mentioned from the south-east point of Iceland and from Fyllas Banke in Davis Strait. We may now add some new localities; the Faroe Islands, and outside Isafjord, Iceland, where it was taken by the "Michael Sars" in the summer of 1903. *Bonneviella grandis* must thus be characterised as a boreal circumterrestrial species, belonging to the lower parts of the littoral region and the upper portion of the abyssal.

III. Addenda to the Athecate Hydroida.

In going through the athecate hydroids, some few glasses were overlooked, and are here included.

Corymorpha nutans M. Sars (Part I, p. 31).

Iceland: Keflavik (depth not stated)

Bredebugt 65°12,5′ N., 23°28′ W., depth 36 fathoms.

Corymorpha groenlandica (Allman) Broch (Part I, p. 33).

"Ingolf" St. 15 66°18′ N., 25°59′ W., depth 330 fathoms ÷ 0,75°

This find forms an interesting complement to the former data (cf. Part I, text fig. I); it lies in Danmark Strait, on the northern slope of the threshold, and shows that the species also occurs between Iceland and Greenland.

Family Branchiocerianthidæ.

Athecate hydroids without calcareous skeleton. The tentacles of the grown polyp, which are all filiform, make two main circles; the tentacles have a central cavity not connected with the gastral chamber. The supporting lamella exhibits no particular development in any of the tentacles. The hydranths are bilateral in structure. At the base of the proximal tentacles, numerous radial canals occur, reducing the mesogloeal formations to a minimum. The gastral chamber is divided by a horizontal septum into two parts, a smaller proboscoidal, and a larger basal. The gastral endoderm is homogeneous in both.

Gen. Branchiocerianthus Mark.

The polyps are bilaterally symmetrical, the stalk being excentrically attached; the oral aperture also is excentrically situated, being thrust over towards the opposite side of the point where the stalk

is attached. The hydranth has a proximal tentacle crown, the growth of which takes place from the part of the hydranth periphery nearest the stalk, where the shortest tentacles are found. The tentacles of the oral circle are homogeneously developed. The periderm of the stalk is reduced and soft. The blastostyles are situate between the tentacle crowns, the youngest ventrally above the point of attachment of the stalk. The polyps are solitary.

Allman (1888 p. 5) described the first *Branchiocerianthus* species, which was brought home by the "Challenger", under the name of *Monocaulus imperator*. The family *Monocaulidæ* had been previously founded by Allmann (1871 p. 395) with the following diagnosis: "Hydrocaulus solitary, naked. Hydranths with a proximal and a distal set of filiform tentacles. — Gonophores in the form of fixed sporosacs". This diagnosis thus makes no mention of the essential point, to wit, the bilateral character of the polyp. Nor is any reference to this found under the heading of the only genus, *Monocaulus*, which is thus described:

"Hydranth abruptly distinct from the hydrocaulus; proximal tentacles longer than the distal and disposed in a single verticil near the base of the hydranth, the distal set scattered over a zone close to the summit of the hydranth. — Sporosacs borne upon peduncles, which spring from the body of the hydranth between the proximal and distal sets of tentacles.

The genus *Monocaulus* is constituted for the *Corymorpha glacialis* of Sars, a form which, though its trophosome is that of a *Corymorpha*, is yet strongly distinguished from the true Corymorphas by its adelocodonic gonophores" (Allman 1871, p. 396).

In addition to *Corymorpha glacialis*, Allman also places *Corymorpha pendula* L. Agassiz in the genus, this being a species with free medusæ. Later on, *Corymorpha groenlandica* is also placed in the same genus. And here, finally, *Monocaulus imperator* is likewise included, Allman (1888 p. 5) having entirely overlooked the bilateral structure of the species, and disregarding the morphological peculiarities noted in his descriptions.

With reference to *Corymorpha* I have pointed out that Allman's typical *Monocaulus, Corymorpha glacialis* M. Sars must remain in the genus where M. Sars placed it, like *Monocaulus groenlandica* Allman, the only species which entirely answers to the diagnosis given by Allman. It would therefore be altogether wrong to follow the suggestion given in "Nomina conservanda" (cf. p. 53) and retain the generic name *Monocaulus* for a genus where *Monocaulus imperator* has been somewhat arbitrarily chosen as type, the more so since the essential feature of the species, which is even characteristic of the genus as a family type, was distinctly emphasised by E. L. Mark in 1899 in his description of the central American Pacific species *Branchiocerianthus urceolus* Mark. Since then, the genus has been referred to in all leading works under the generic name given it by Mark, *Branchiocerianthus*, and as the species in question have been accorded only the briefest mention in the handbooks, there will be no confusion caused by general adoption of the appellation. Moreover, after the publication of the fundamental studies on *Branchiocerianthus* by Mark (1899), Miyajima (1900), and Stechow (1908, 1909) it would certainly be confusing to adopt the name *Monocaulus*.

The genus *Branchiocerianthus* was hitherto only known from the Pacific (Alaska, Japan, Panama) and the Indian Ocean (Beluchistan, Oman, and East Africa). Stechow, in his description of

Branchiocerianthus imperator (1909, p. 71) states: "Da im übrigen die Familie[1] ganz kosmopolitisch ist so dürfen wir wohl annehmen, dass Branchiocerianthus-Arten auch im Atlantischen Ozean vorkommen, bisher aber nur wegen ihres Lebens in grösserer Tiefe noch nicht gefunden worden sind".

Excellent proof as to the correctness of this supposition has now been furnished by the finding of a *Branchiocerianthus* in the deep part of Davis Strait, where it occurs together with other representatives of a southerly deep-sea fauna. Stechow's characterisation of the habitat of the genus as "Kaltwassergebiet" however, is biogeographically erroneous; *Branchiocerianthus* has not yet been met with in the cold area, and is hardly likely to prove a characteristic element in the fauna of that region. The genus belongs to the abyssal region of the warmer seas, or strictly speaking, that portion of the same which makes the home of the "intermediate fauna". The temperature here may certainly fall pretty low in certain places, but is never below 0°. The "Kaltwassergebiet" would include the cold area, where the temperature is constantly below 0°.

Branchiocerianthus reniformis n. sp.

(Pl. I, figs. 2—5).

The hydranth, viewed from below, has a distinctly kidney-shaped appearance, with a deep (ventral) sinus reaching right in to the stalk. Owing to the depth of this incision, the stalk appears comparatively centrally situated, the distance to the dorsal edge (6 mm) being slightly more than that between the stalk and the margin of the disc perpendicular to the dorso-ventral axis (4,5 mm). The oral aperture seems to be somewhat more excentrically placed, being distant between a fourth and a third of the diameter of the disc from the dorsal margin of the disc. The oral aperture is very large, and in the present specimen it is curved over, revealing the highly folded gastral endoderm (Pl. I, fig. 3). It would almost seem as if the margin of the oral aperture were divided into lobes; from the single specimen here available, however, it is impossible to decide with certainty, whether this is natural, or due to accidental damage. The margin of the oral aperture is curled, with a closely packed tentacle crown, showing indications of multiserial arrangement. The oral tentacles are everywhere round in transverse section, and are strongly built. The basal tentacles form a single circle; they are very long, with exception of the ventral ones, which are placed along the margin of the disc in the incision. In the incision itself, the tentacles decrease rapidly in length in towards the stalk, at its base are the youngest tentacles, which are quite small. The basal tentacles are laterally compressed at the base, where they easily fall off; in the present specimen, only the tentacles in the incision and a pair beside it are intact, the remaining ones having fallen away. The stalk of the polyp is thin, longitudinally striped. The short basal part is covered with numerous fine root hairs extremely closely set, forming a tangled mass round the end of the stalk and entirely covering it there. There is no zone of incipient root hair formation discernible above the developed part.

The blastostyles form a crown, interrupted ventrally, about the hydranth between the tentacle crowns, nearer the basal. The blastostyles are closely set in a crown which may be up to triple-rowed. The large blastostyles divide near the base at once into two or three main branches of equal size, which later (Pl. I, fig. 5) again divide dichotomously at intervals two or three times. The top of

[1] I. e. *Corymorpha* and *Branchiocerianthus*.

the blastostyle is shaped rather like a cluster of grapes, the outermost swellings, shown in the figure, consist each of a compact accumulation of incipient gonophores. Nematocyst-bearing terminal buds appear to be altogether lacking. The size of the blastostyles decreases nearest the ventral interval, whence a new formation evidently takes place.

With regard to the anatomical character of the polyp, we must notice the large mesentery which divides the gastral cavity into an upper (oral) and a lower (basal) section; it has a large median opening. The radial canals have a large lumen; they do not appear to divide, and alternate with the tentacles, and thus do not stand in open connection with the latter; their number corresponds to that of the proximal tentacles. — The blastostyles are hollow, and communicate openly with the interior of the polyp, but it was impossible to determine exactly whether their communication with the gastral cavity is direct, or proceeding indirectly through the radial channel.

Material:

"Ingolf" St. 28 65°14′ N., 55°42′ W., depth 420 fathoms, 3,2°.

The only specimen procured presents the following features: Total length 120 mm., of which 110 mm. fall to the hydrocaulus. Distal diameter of the stalk 3 mm., close above the root hairs the transverse section is 7 mm. The polyp disc has a total breadth of 12 mm. and a length of 9 mm., measured from the bottom of the ventral incision. There are 85 proximal tentacles; the longest of those intact is 55 mm. The distal tentacles are very closely set, often displaced, giving a slight indication of three rows; there are between 80 and 90 oral tentacles of up to 5 mm. length. The blastostyles are closely packed together, and form three indistinct rows, the longest is 4 mm.; there are between 70 and 80 in all.

On comparing the present specimen with the species of *Branchiocerianthus* previously described, we find several points of difference, albeit none very striking in itself. The peculiar kidney-shaped appearance of the disc (Pl. I, figs. 2 and 3), as also the curled margin of the oral aperture, would seem to be different from the species previously described, and has led me to regard the specimen for the present as representing a distinct species, *Branchiocerianthus reniformis*. The lack of terminal buds bearing nematocysts in the blastostyles brings the species near to *Branchiocerianthus* n. sp. Stechow, (1913 p. 54) from which, however, it is immediately distinguished by its undivided radial canals. The habitus of the hydranth distinguishes it from *Branchiocerianthus urceolus* Mark; this may, however, possibly be taken as due to a difference in the state of contraction. From *Branchiocerianthus imperator* (Allman) again, the species differs in the lack of nettle buds on the blastostyles. From the appearance of the specimen in 1904, *Branchiocerianthus reniformis* has also a different colour; the body of the polyp was then white, the blastostyles being a deep violet blue; now, after having lain many years in alcohol, it is an even grey.

The individual can hardly be fully grown, and corresponds in point of size only with the smaller specimens of *Branchiocerianthus urceolus* found. The number of proximal tentacles agrees mainly with that in this species, but there are far fewer distal tentacles; save for one of Allman's specimens of *Branchiocerianthus imperator* (1888) all the other individuals found belonging to this genus had considerably more distal tentacles. The number of blastostyles takes up an intermediate place between the two mentioned species, and is somewhat lower than in *Branchiocerianthus* n. sp.

Stechow (1913). As, however, the specimen is unique, and moreover, apparently not fully grown, these points should not be considered as of too great importance in the present state of our knowledge. For the present, it will be most correct to regard the specimen as representative of a distinct species, bearing in mind, however, that subsequent investigations may possibly show it to be identical with one of those formerly described.

Branchiocerianthus reniformis will probably, as the find suggests, prove to belong to the abyssal region. Its occurrence shows that the genus is of circumterrestrial distribution.

IV. Zoogeographical observations on the Hydroid Fauna of the North Atlantic.

The study of the bathymetrical distribution among hydroids still leaves much to be desired; the data on record are still somewhat scanty, and merely suffice to give an occasional glimpse of the regularity which will doubtless be found to prevail throughout this animal group, just as in others. It has been a generally accepted notion, and is so to some extent even now, that a marine animal species with a wide horizontal distribution will prove of shallower occurrence the farther north it is found in our waters, or rather, the farther it penetrates into the cold areas. This rule, however, is not universally applicable. True, we find that species which must be regarded as more or less arctic are met with in more southerly tracts in the deeper water-layers, but on the other hand, warm atlantic character forms which are found farther south up in the littoral region often exhibit, in the few northern finds made, a tendency to prefer even much greater depths. Evidently then, the biophysical conditions here approach more nearly to those prevailing in the southern home of the species, though we cannot at present find any further explanation of this. At any rate, the question is seen to be a good deal more complicated than was at first supposed, and the available data are unfortunately far from sufficing to give a thorough exposition of the biogeography in hydroids in the northern waters.

In this connection, it will not be out of place to explain one or two expressions which are constantly recurring when dealing with the different species. I refer to the terms littoral and abyssal region. I have followed the general international acceptance in using "littoral region" for the upper 3—400 metres of the sea floor, "abyssal region" for depths beyond. It is true that certain northern writers have sought to give the terms in question new and sometimes quite different meanings. This, however, gives rise to confusion, and further complicates the still somewhat new field of research known as biogeography. The terms used should be as nearly as possible invariable, and should not require to be defined anew by each writer, as has hitherto been the case. Indeed, it might almost seem well to discard altogether the term littoral region, since it appears to be interpreted in almost as many different senses as there are writers in Scandinavia. I have here, however, as indicated, employed the expression in the general sense in which it is used outside the works of the scientists referred to.

A great majority of the northern hydroids are decidedly inhabitants of the littoral region, and among these we find a number of species which characterise its upper part, the tidal zone. This zone comprises, on open sea coasts, the belt between high- and low-water marks; in fjord grounds, however, where the water is mixed with fresh, we are obliged, on account of the altered hydrographical conditions, to draw the lower limit somewhat farther down, where the laminariæ begin. The tidal zone is in all parts of the northern waters characterised by Fucoids, and is distinguished in hydrographical respects by its rapidly and widely fluctuating temperature and salinity. Certain writers have objected to the validity of this zone as such, on the ground that all its character organisms are also normally to be met with deeper down; this, however, merely reveals a lack of knowledge as to the true state of the case. We may in the first instance take a species which has been utilised in several works for giving the zone in question its other name; to wit, *Balanus balanoides* Linné. This species does not normally penetrate deeper down. In this connection, however, we are naturally more interested in the characteristic hydroids; which are: *Coryne pusilla*, *Clava multicornis* and *Laomedea flexuosa*. These species are altogether restricted to the tidal zone, and their occurrence in deeper water in the open sea must be regarded as an anomaly, unless due to erroneous identification on the part of the investigator. It is likely that also other species, especially certain *Coryne*, should be grouped among the character forms of the tidal zone, but we have not yet sufficient data to assert this as a fact. The mentioned species are so completely restricted to the area in question, — which is not rich in species on the whole — that we are fully justified in distinguishing the tidal zone as a separate area with a fauna of its own.

The deeper zones are, from the character of the investigations, somewhat less strictly defined. It would nevertheless seem that species such as *Eudendrium IVrighti*, *Sertularella rugosa*, and *Laomedea geniculata* are altogether restricted to the Laminaria zone, while *Dynamena pumila* is common to the shallower part of this zone and the tidal zone. The great bulk of the hydroids commence to appear in the lower parts of the laminaria zone, reaching their most luxuriant occurrence in the red alga zone and the lower parts of the littoral region.

On passing down beyond about 600 metres depth, however, the lower limit of what may be called the "coast bank region", we encounter a sudden and very marked decrease in the number of hydroids; below this limit, their occurrence must be called more sporadic, and there are only a few unique species which have their chief occurrence at greater depths. The deep-sea species in question, which have their habitat down here, exhibit also, in each case, a merely sporadic occurrence, — though we cannot, of course, entirely disregard the possibility that this apparent state of things may in reality be due to lack of sufficiently exhaustive investigations in the proper localities. A clear indication of the inadequacy of our knowledge as to these deeper parts of the sea floor, even in the North Atlantic, is afforded by the "Ingolf" expedition's unexpected finding of species such as *Branchiocerianthus reniformis*, *Zygophylax biarmata*, *Grammaria conferta*, *Polyplumaria profunda*, and *Sertularella amphorifera* close south of the submarine ridges in Davis Strait, Danmark Strait, and between Iceland and the Faroe Islands.

With the paucity of available material, it is of but little interest to go into details regarding the bathymetrical distribution of the species. On the other hand, it is well worth while to consider

the extent of certain horizontal areas of distribution, and we may first of all endeavour to obtain a clearer idea as to what is commonly known as the boreal region, the definition of which at times appears to be somewhat vague. In the case of the hydroids, the data on record furnish valuable hints, as will be seen from the following.

Theoretically speaking, the northern limit of the boreal region should be drawn as the boundary where southern species of general occurrence in northern waters cease their northward progress, while similarly, the southern limit should mark the extreme margin of the arctic-boreal species' distribution. It should, moreover, constantly be borne in mind that the boreal area is decidedly a "mixed"

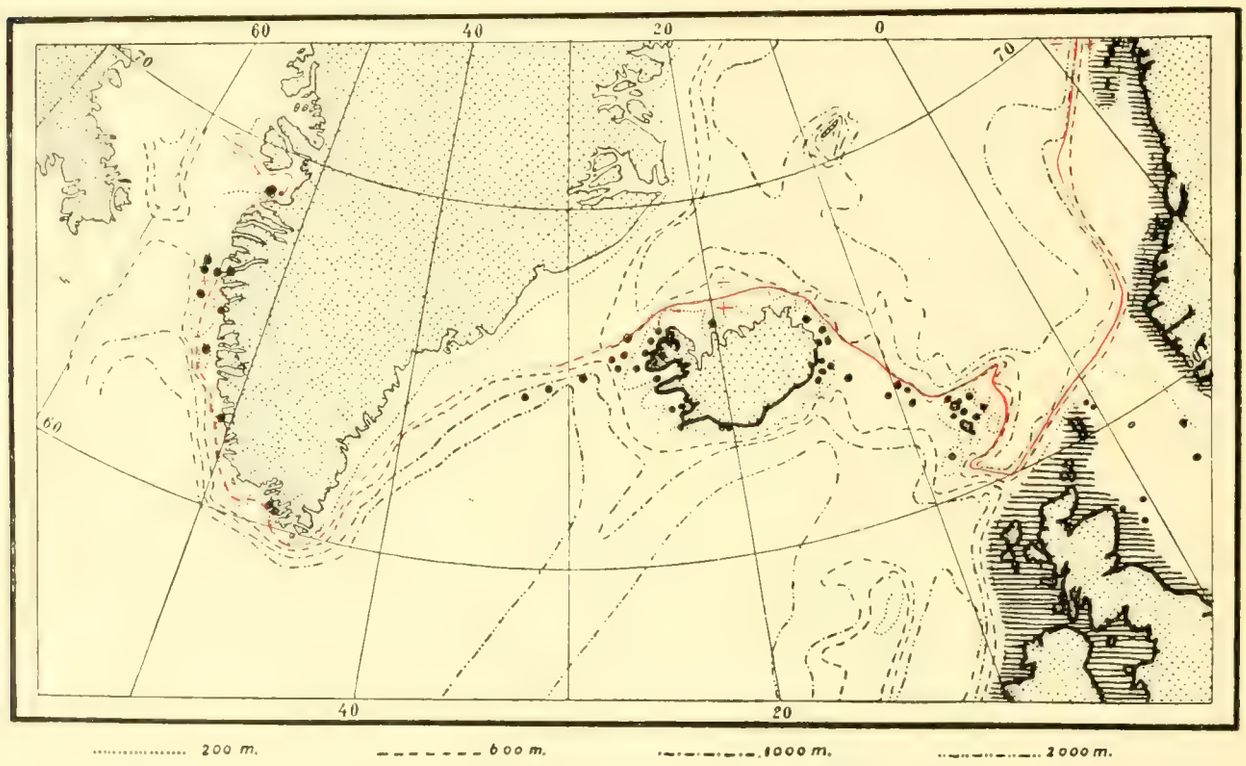

Fig. XC. The occurrence of *Nemertesia antennina*, *Dynamena pumila*, and *Thujaria thuja*, three species which are common in more southern European waters, but which only have been found in high arctic waters quite exceptionally. (The red line approximately indicates the limit of the cold area).

area; strictly boreal species are extremely few in number, among hydroids as among other animal groups, and will in many places penetrate out beyond the limits of the narrower region. — As examples of southern species extending up to the frontier of the arctic areas we may take for instance *Nemertesia antennina, Dynamena pumila,* and *Thujaria thuja.* These three are practically never found in true arctic waters; where finds have been made, it was always at places where north-going currents render the limits uncertain, or where the varying conditions of the coastal water afford southern species a precarious refuge in some isolated spot within the arctic seas. At such places we may encounter, for instance, scattered colonies of *Dynamena pumila.* As a general rule, we find (fig. XC) that these species do not cross beyond the limit of the cold area as indicated by the course of the 0° isotherm. At the same time it should be noted that the mentioned species are by no means infre-

quently met with in Davis Strait, which is thus proved to belong, at any rate in part, to the boundary waters of the boreal region. Yet the species penetrate only quite exceptionally into the west Greenland fjord area, which must be regarded as purely arctic, partly on account of the intermixture of melting water from the glaciers, and partly owing to the north-going branch of the East Greenland Polar Current, which turns round Cape Farewell and runs some distance up the coast. Here we still find *Dynamena pumila* sporadically, probably because the investigations were carried out at a time when the summer heat had brought the surface temperature up a little, enabling the species just to exist for a brief while, and under difficulties. Not until we reach the waters between Holstensborg

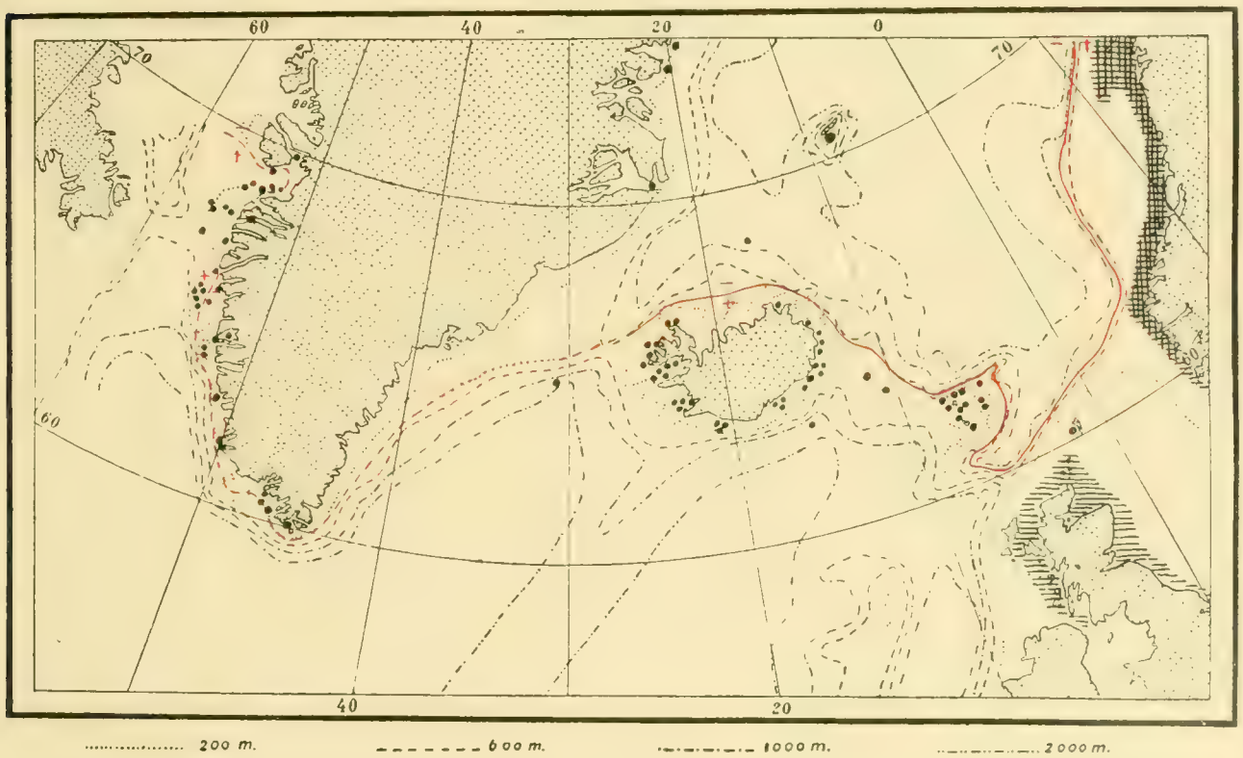

Fig. XCI. The occurrence of *Halecium muricatum*, and *Sertularella tricuspidata*, two arctic species which penetrate into the southern parts of the boreal region. (The red line approximately indicates the limit of the cold area).

and Egedesminde do the boreal elements in the coast fauna become more pronounced. In Danmark Strait, between Greenland and Iceland, we see that the finds group themselves closer as soon as we pass south of the 0° isotherm, where the depth conditions are more favourable. Despite their positive bottom temperature, the shallower North-Icelandic waters seem to take a more arctic character, though this may, as we shall presently see, perhaps be equally well explained as due to insufficient investigation. Between Iceland and the Faroe Islands, the species move up to the verge of the cold area, but do not pass it. And the whole of that part of the Norwegian coastal banks which falls within the limits of the chart presents an entirely boreal character.

Turning now to the other side, and taking the distribution of the arctic-boreal species *Halecium muricatum* and *Sertularella tricuspidata*, several peculiarities are also here apparent (fig. XCI)

Both species occur in Davis Strait, very commonly on both sides of the 0° isotherm, but do not go deeper down from the coastal banks. Both, however, are apparently entirely lacking along the east coast of Greenland south of 76° N. This may be due to paucity of investigations, but it would seem likely that the reason is rather to be sought in the fact that the water, owing to extensive intermingling of fresh and ice-cold glacier water is poor in suitable forms of nourishment, and unfavourable to the growth of hydroids generally. Altogether, only a very few hydroids have been found along the range in question, the finds in question invariably consisting of but few and small colonies. The apparent absence of the mentioned species in North Iceland waters, on the other hand, would seem

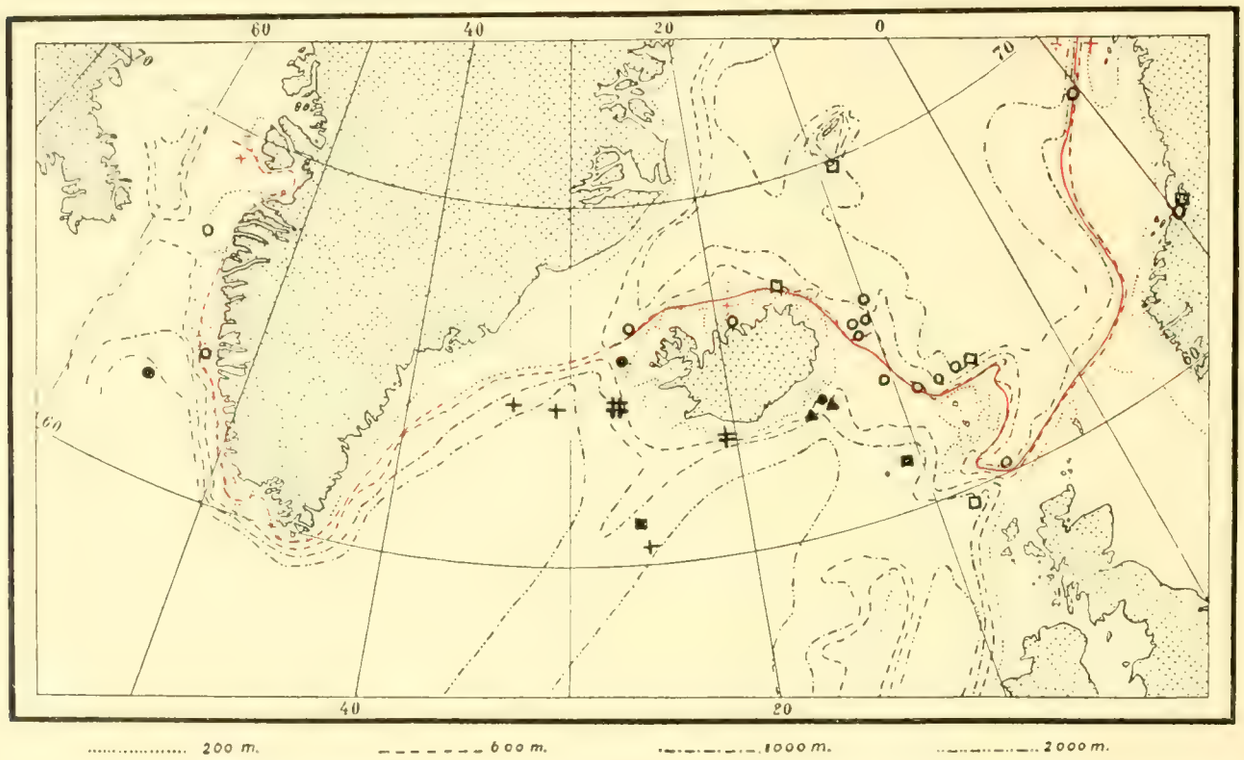

Fig. XCII. Localities of the arctic deep sea species *Myriothela phrygia* □, and *Corymorpha groenlandica* ○, and of the southern, exotic guests *Grammaria conferta* +, *Zygophylax biarmata* ǂ, *Polyplumaria profunda* ●, *Cladocarpus Diana* ■, *Sertularella amphorifera* ▲, and *Sertularia (?) tubuliformis* ǂǂ. (The red line approximately indicates the limit of the cold area).

rather to be due to lack of sufficient investigation; it is difficult to find any other explanation. The frequent occurrence of the species round all the remainder of Iceland's coast shows that the range in question must as a whole be included in the boreal area; there is no indication of warmer tendency at any place on the true coastal banks here. The ridge between Iceland and the Faroe Islands, and the waters round the latter down to 600 metres' depth must be taken as belonging to the boreal region, as also the western Scottish waters. The North Sea also is boreal, and the Norwegian coast to the extent shown on the chart.

Before concluding this characterisation of the boreal area, two other geographical groups of less frequently occurring hydroids should be considered. These are the deeper-living inhabitants of the cold area, represented by *Myriothela phrygia* and *Corymorpha groenlandica*, and the exotic warm-

water species of the Atlantic, found here and there in the waters investigated (fig. XCII). *Myriothela phrygia* is apparently an easterly arctic species which penetrates out to the southern limit of the cold area; it has in a single instance been taken on the southern, deep slope of the Wyville-Thomson Ridge, brought thither probably by larval transportation. *Corymorpha groenlandica* moves out everywhere to the boundary, and has once passed beyond it, in Davis Strait, on the Store Hellefiskebanke, and between Iceland and the Faroe Islands, probably likewise as a result of larval transportation. Both species are, moreover, met with in a single isolated spot far up in the boreal region, to wit, in Trondhjem Fjord, where they must probably be regarded as relicts — The opposite group, the exotics, will be represented by *Grammaria conferta, Zygophylax biarmata, Polyplumaria profunda,* and *Sertularella amphorifera.* One or two of them may in southern localities exhibit a shallower occurrence; here in the north, however, save for a single find of *Polyplumaria profunda* up in Danmark Strait, they are not met with beyond the 600 metre curve, nor within the true boreal region.

A study of the hydroids leads then to the result, as seen from the instances given, that the limits of the boreal zone as against northerly or arctic waters must be drawn along the 0° isotherm; to the south by the southern side of the ridges along the 600 metre curve. The boreal region extends thus from far up in Davis Strait, where, however, it extends only in a very few places in to the coast of West Greenland, across the highest part of the submarine ridge into Danmark Strait, round the coasts of Iceland, including also the plateau between Iceland and the Faroe Islands, the Faroe Islands Banks, the western Scottish waters, and the North Sea and the Norwegian coast plateaus (vide charts). Practically speaking, the region embraces all the coast banks of the waters investigated, down to 600 metres, save for the upper 200 metres of the Greenland banks.

On comparing the results here arrived at with the lines laid down in Appellöf's[1] and v. Hofsten's[2,3] fundamental works on Crustacea and Echinoderms, we find that they agree very closely therewith. We have, however, here disregarded the mixed areas, which in the works referred to are strongly emphasised. The "boreo-arctic" area, where arctic and boreal elements appear in equal proportions, should strictly speaking doubtless comprise the upper parts of Store and Lille Hellefiskebanke, possibly also Fylla Banke, West Greenland, while the north Icelandic coastal region likewise seems to belong to the same. The second mixed area, which according to Appellöf includes the southern parts of the North Sea, the English Channel, and the Irish Channel, should be characterised by a very marked intermixture of southern, Lusitanian or Mediterranean species.

It has previously been pointed out that hydroids only penetrate in small numbers down beyond 600 metres depth. It might therefore be objected that the southern boundary of the boreal region as against the Atlantic will in the case of other animal groups be found to follow a deeper curve than here indicated. In comparison therefore, we should also include arctic-boreal species of other animal groups which are more eurybathic. It will here suffice to refer to v. Hofsten's charts for *Ophiocten sericeum* and *Spirontocaris Gaimardii*; they show the same features as the corresponding hydroid species, and the same southern limits for the boreal region at about 600 metres' depth.

[1] 1906, Die dekapoden Crustaceen. Meeresfauna von Bergen, Heft 2 und 3. Bergen.

[2] 1915, Die Echinodermen des Eisfjordes. Zoologische Ergebnisse der schwedischen Expedition nach Spitzbergen 1908. Teil II. Stockholm.

[3] 1916, Die decapoden Crustaceen des Eisfjordes. Ibid. Teil II. Stockholm.

One risk attaching to the insertion of the mentioned boreo-arctic and Lusitanian mixed areas lies on the one hand in the fact that by such further division, the whole arrangement is rendered less easy to survey and handle. If, however, other and more essential advantages were procured by so doing, we should naturally not hesitate to accept the biogeographical sub-areas in question But here a very serious difficulty makes itself felt, more particularly on considering the group of hydroids as a whole, to wit, the question of how far up in the boreal area — sensu laterior — the intermixture of southern elements takes place to such a degree that the waters concerned should be regarded as a mixed area. By way of illustration we may take the distribution of the families *Plumulariidæ*

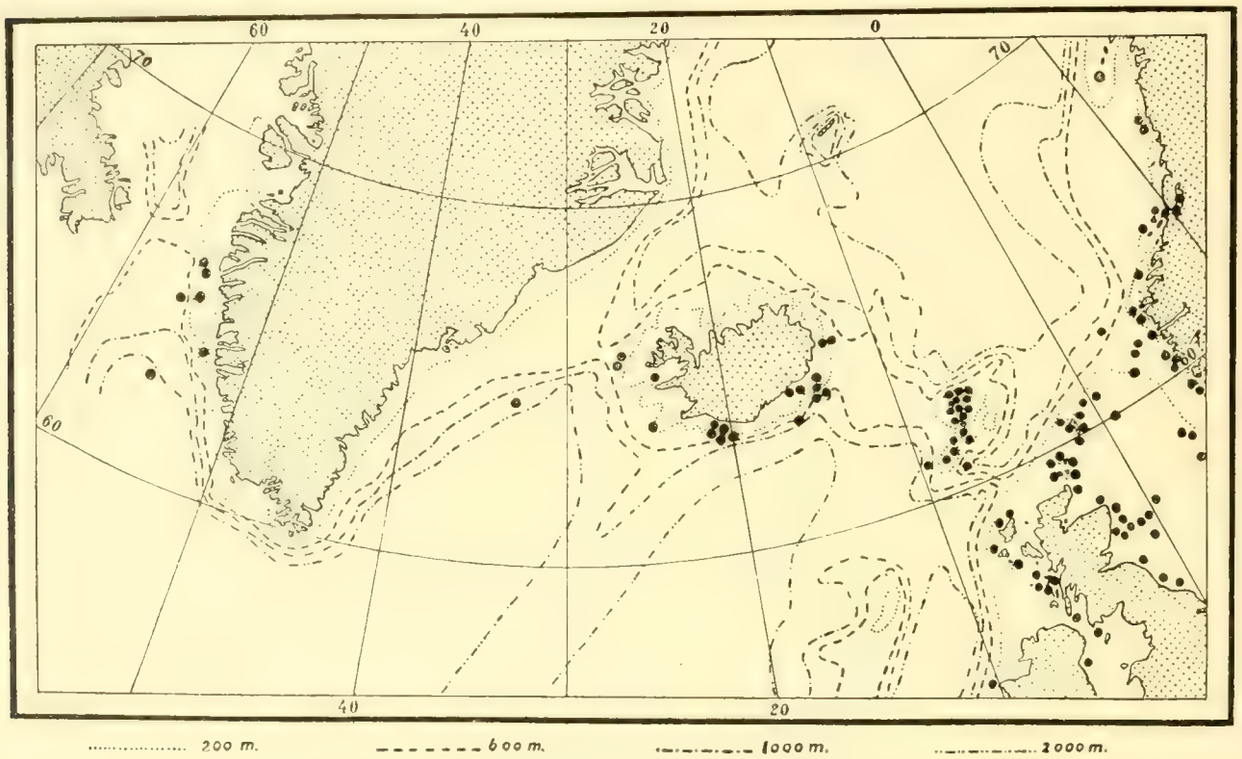

Fig. XCIII. Finds of *Plumulariidae* in the Northern Atlantic.

and *Aglaopheniidæ*, the members of which without exception have their chief occurrence in warmer and more southerly waters, and must in the boreal region be regarded as southern visitors, even though some few of them, such as *Nemertesia antennina*, and *Kirchenpaueria pinnata*, may here and there occur in considerable numbers. We should note then, that *Plumulariidæ* (fig. XCIII) which save for one or two exceptions belong to the upper 300 metres, are found — and found very frequently — in the North Sea and along the west coast of Norway, including the Trondhjem Fjord, round the Faroe Islands, along the east, south and west coasts of Iceland; indeed, several species have even been met with several times on the boreo-arctic Lille Hellefiskebanke in Davis Strait. Judging from the family *Plumulariidæ* then, we come to the result that the Lusitanian element plays a very prominent part in the heart of those areas which we have hitherto designated as the boreal; so much so indeed, that it would be necessary to place the greater part of the tracts concerned in the boreo-lusitanian mixed area if we were to follow Appellöfs principles to their logical conclusion. Taking now again the

family *Aglaopheniidæ* (fig. XCIV) we must first of all bear in mind that we are here dealing with the hydroid family which contains most true deep-sea species, so that we get a picture essentially different from the previous one. Yet there are also various resemblances observable. The boreal bottom region is, as will be evident from the foregoing, a restricted part of the typical coast bank region which runs down to about 600 metres depth. Up in this region, *Aglaopheniidæ* penetrate more rarely, but are yet not infrequently met with in the North Sea and along the coast of Norway, and may even in certain places be character forms, as for instance in the deep parts of the Trondhjem Fjord, where there is much current. The numerous finds group themselves about the Wyville-Thom-

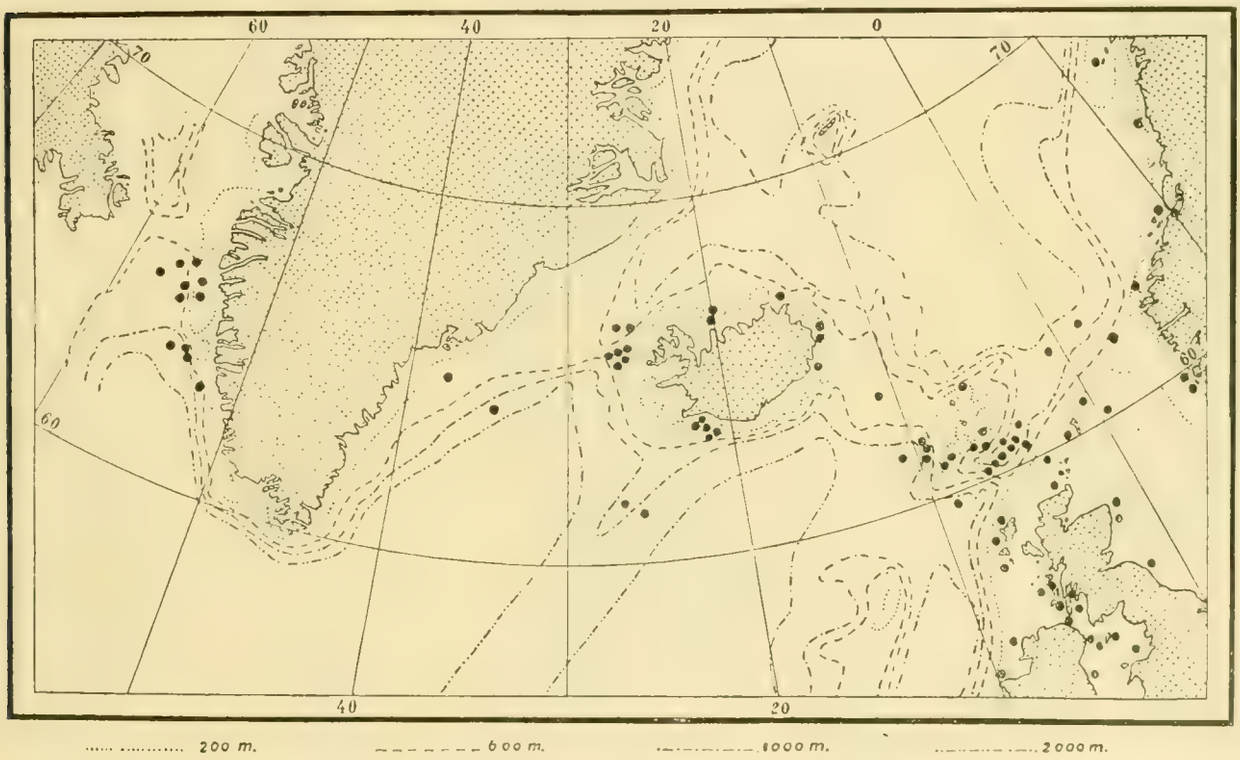

Fig. XCIV. Finds of *Aglaopheniidae* in the Northern Atlantic.

son ridge, and of these, about half lie, mirabile dictu, down in that part of the cold area which juts out into the Faroe Channel. In Danmark Strait, also, the finds are gathered about the top of the threshold, and distribute themselves from here round the north side of Iceland. In Davis Strait, the finds are closest in the north-eastern part of the cul de sac running from the Atlantic Deep up the western side of Greenland to the north side of Lille Hellefiskebanke. In this manner then, the intermediate parts between the aforementioned areas, where the strong intermixture of *Plumulariidæ* sets its mark on the fauna, are levelled out. And to be entirely consistent, we should perhaps also, in the Faroe Channel, include a lusitano-arctic mixed area.

The data here given serve to show that the establishment of the mentioned mixed areas, the boreo-arctic and the boreo-lusitanian, is attended by considerable drawbacks. No boundary of any region, of course will ever be perfectly clear and sharp, especially in the case of bottom forms. There are too many factors to be considered, with the result that the frontier as a matter of fact comes to

consist of a more or less broad belt, and such belts or mixed areas may under special circumstances attain relatively considerable extent, while in other places they may be quite narrow. We must also remember that the boreal region in itself is the mixed area par excellence, and has practically not a single species to itself, which makes it even more difficult to say what mixture percentage should be taken as limiting the extra mixed areas, the boreo-arctic and the boreo-lusitanian. The maintenance of these will as a matter of fact be to some extent a matter of arbitrary preference.

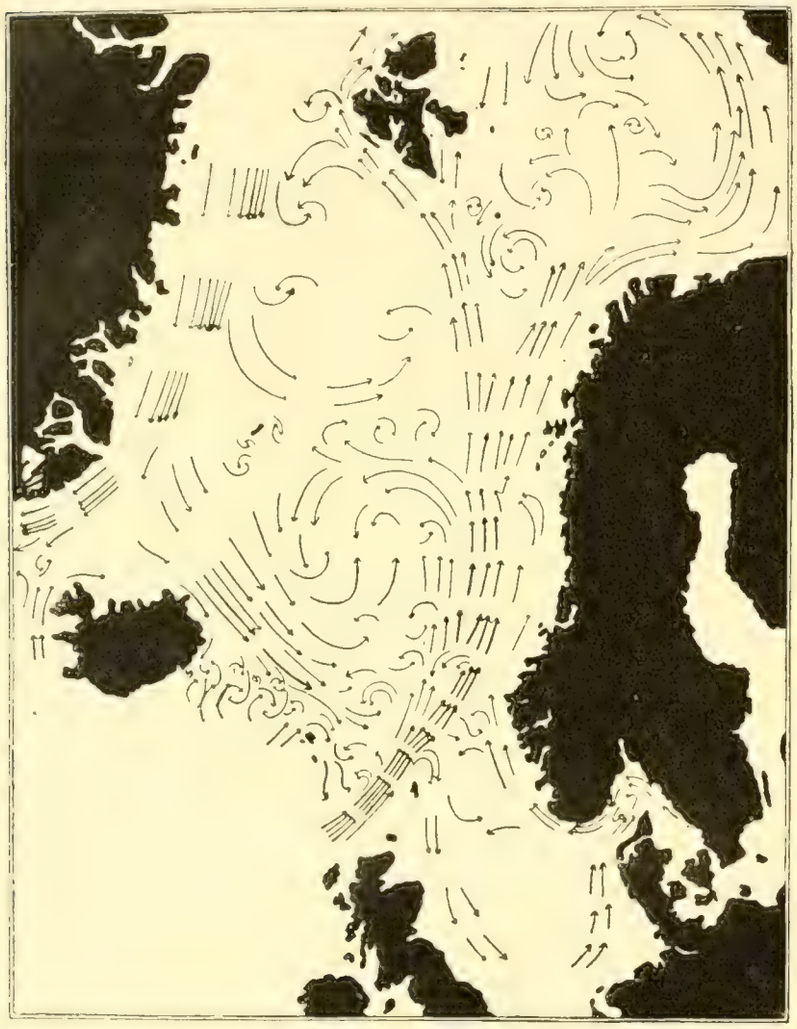

Fig. XCV. Currents of the Norwegian Sea (after Nansen and Helland-Hansen).

The factors exerting principal influence in the formation of the mixed areas are the positive transportation and the passive restriction of the attached organism to the spot once adopted. The latter factor presents no difficulty; if a hydroid colony has once settled down at a given spot on the bottom, then it cannot change its situation, even though the conditions under which it is there called upon to live prove unfavourable. A submarine wave may have produced suitable conditions at the time of attachment, after which a change for the worse sets in. If the colony manages to thrive in spite of this, it will then depend on its propagation whether the species becomes indigenous or not. It is probably the question of propagation which has prevented *Plumulariidæ* and *Aglaopheniidæ* from becoming indigenous in the Norwegian Sea area; save for a few species, they must evidently be constantly recruited from without. This renewal takes place in the case of certain species, which lack suitable active motive apparatus, by passive transportation. The transport of grown colonies is here practically speaking out of the question; these animals, we know, attach themselves normally to the sea bottom itself, or to other colonies already attached thereto. It is therefore larval transportation which plays the chief part[1]. How long the larval development takes in these forms before they attach themselves to the bottom we do not know; probably the time varies, being doubtless dependent upon external physical conditions; under certain circumstances it would seem that it may extend over a very considerable period.

[1] Cf. Appellöf 1905, Havbundens Dyreliv, Norges Fiskerier I, Norsk Havfiske. Bergen p. 114.

The explanation of the distribution in these two families must therefore be sought in the current conditions, and we here obtain a very good idea in the case of *Aglaopheniidæ*. The currents in Davis Strait have as yet been only very little investigated, but we know that there is an atlantic current moving up from the deep towards Store Hellefiskebanke and thus depositing larvæ in the cul de sac before mentioned. In the case of the Norwegian Sea, the currents are better known. On glancing at the chart (fig. XCV) and comparing it with the occurrence of *Aglaopheniidæ*, the solution is at once apparent. An atlantic current runs northward in the eastern part of Danmark Strait and sends a branch thence along the north side of Iceland and then southward along the east coast; this branch will thus carry larvæ from Danmark Strait and deposit them here and there along the coastal banks north and east of the island, where some few of them are able to develope further. This at once explains the scattered occurrence of *Aglaopheniidæ* in these waters. The main force of the northgoing atlantic current, however, is concentrated in the Faroe Channel, and here carries the larvæ in over the Wyville-Thomson ridge. Along the north side of this ridge, then, we find the heaviest "rain" of exotic larvæ in the Norwegian Sea, and here also the greatest percentage of individuals probably capable of developing further, provided they can stand the immersion in the icy waters of the cold area at all. A branch of the same current runs southward along the east coast of Scotland and England, causing a scattered occurrence of *Aglaopheniidæ* able to develope in shallower water, such as species belonging to the genera *Aglaophenia* and *Thecocarpus*. Other larvæ drift farther on with the main current, and sink to the bottom on the Norwegian coast plateaus, or the edges of the same, or are occasionally carried as far up as Spitzbergen, whence several finds of *Aglaopheniidæ* have been recorded, where offshoots from the Atlantic current break in over the plateaus in the shallower Murman Sea.

It would be of no value here to group the species investigated according to the separate geographical categories. Such arrangement has been made several times in recent works by Kramp (1914) and myself (1909 and later works). It should merely be pointed out that purely boreal hydroids are extremely rare, if indeed we can, after exhaustive investigation, maintain any such at all.

We may now proceed to a closer comparison of the hydroid fauna as it appears in the areas represented by Greenland, Iceland and the Faroe Islands. With regard to the two first-mentioned areas, surveys have recently been published by Kramp (1914), and Sæmundsson (1911); the latter, however calls for certain corrections, and there are also some few additions to be made.

Of the species here dealt with, the following have been met with in West Greenland waters (species new to the area are indicated by a *).

**Coryne Loveni*	*Monobrachium parasitum*	*Eudendrium annulatum*
Myriothela phrygia	**Hydractinia Sarsii*	— *capillare*
Tubularia indivisa	— *echinata*	*Lafœa dumosa*[1]
Corymorpha groenlandica	**Perigonimus abyssi*	— *fruticosa*
**Branchiocerianthus reniformis*	— *roseus*	— *gracillima*
? *Clava multicornis*	*Eudendrium rameum*	*Toichopoma obliquum*

[1] In the previous chapters the name has erroneously been spelt *Lafoëa*.

Grammaria serpens
* — *conferta*
— *abietina*
— *immersa*
Lictorella pinnata
Stegopoma plicatile
Cuspidella humilis
Lafoëina maxima
Campanulina turrita
Calycella syringa
Tetrapoma quadridentatum
**Halecium scutum*
— *curvicaule*
— *muricatum*
— *labrosum*
— *tenellum*

Halecium minutum
**Polyplumaria profunda*
Nemertesia antennina
**Polynemertesia gracillima*
Aglaophenopsis cornuta
**Cladocarpus integer*
— *formosus*
Thecocarpus myriophyllum
Sertularella tamarisca
— *tricuspidata*
— *polyzonias*
— *rugosa*
— *tenella*
Diphasia fallax
— *Wandeli*
Dynamena pumila

Abietinaria abietina
— *filicula*
Sertularia tenera
— *Fabricii*
— *mirabilis*
Thujaria thuja
— *laxa*
— *alternitheca*
Campanularia volubilis
— *verticillata*
— *groenlandica*
— *speciosa*
Campanularia integra
Laomedea longissima
— *hyalina*
Bonneviella grandis

By comparison with Kramp's list (1914) it must be noted, that the following species are synonyms:

Garveia groenlandica } = *Perigonimus roseus*
Perigonimus roseus }
Halecium Beani = *Halecium scutum*
Plumularia groenlandica = *Polynemertesia gracillima*
Cladocarpus Holmi = *Cladocarpus integer*

New to the area are thus in reality only the five species *Branchiocerianthus reniformis*, *Hydractinia Sarsii*, *Perigonimus abyssi*, *Grammaria conferta* and *Polyplumaria profunda.*

Of East Greenland species, the material contains the following:

Tubularia regalis
**Perigonimus abyssi*
* — *roseus*
Eudendrium rameum
Lafoea fruticosa
— *gracillima*
Toichopoma obliquum
Grammaria serpens
— *abietina*
— *immersa*
Cuspidella humilis
Lafoëina maxima

Calycella syringa
Tetrapoma quadridentatum
Halecium curvicaule
— *muricatum*
* — *labrosum*
— *tenellum*
— *minutum*
**Cladocarpus integer*
Sertularella tricuspidata
— *polyzonias*
* — *tenella*

Diphasia fallax
Abietinaria abietina
Sertularia tenera
Hydrallmania falcata
Thujaria thuja
— *laxa*
Campanularia volubilis
— *verticillata*
— *groenlandica*
— *integra*
Laomedea longissima

Taking into consideration the above noted synonyms, only three species are new to the area, viz: *Halecium labrosum*, *Cladocarpus integer* and *Sertularella tenella*. It should here further be noted that the new investigations have especially augmented the number of species south of 70° N. The East Greenland waters between 60° and 70° N. seem to be very poor in hydroids, even right out on the slope towards the deep of the Frozen Sea, and the Atlantic deep.

According to Kramp (1914) there are hitherto recorded 88 hydroids from Greenland. In the previous sections we have pointed out the following synonyms, which are given in the mentioned list:

Corymorpha groenlandica } = *Corymorpha groenlandica*
— *islandica* }

Perigonimus roseus } = *Perigonimus roseus*
Garveia groenlandica }

Halecium Beani = *Halecium scutum*

Lafoëa fruticosa }
— *pocillum* } = *Lafœa fruticosa*, forma *genuina* and forma *grandis*
— *grandis* }

Sertularia polyzonias } = *Sertularia polyzonias*, forma *typica* and forma *gigantea*
— *gigantea* }

Plumularia groenlandica = *Polynemertesia gracillima*

Antennularia antennina = *Nemertesia antennina*

Cladocarpus cornutus = *Aglaophenopsis cornuta*

— *Holmi* = *Cladocarpus integer*

This means, then, a reduction of five in the number of species. On the other hand, the five new species from the West Greenland area are entirely new to the fauna, so that the number of species is still 88, or, taking *Lafœa fruticosa* forma *grandis* and *Sertularella polyzonias* forma *gigantea* as distinct species, the number is increased to 90. The recent studies have thus not greatly increased the number of species, nor was this to be expected. The greatest increment of species new to the fauna was to be expected in Davis Strait, and the few investigation stations made there by the "Ingòlf" are entirely covered by the later expeditions with the "Tjalfe", the excellent treatment of which material has contributed in an essential degree to our comparatively close knowledge of the hydroid fauna in West Greenland waters.

Passing on now to the fauna area of Iceland, we find in the material the following species belonging to this section:

Coryne Sarsii
* — *pusilla*
Myriothela phrygia
Tubularia pulcher
— *indivisa*
— *larynx*
Corymorpha nutans
— *glacialis*
* — *groenlandica*
**Clava multicornis*
**Hydractinia Sarsii*
— *echinata*
Bougainvillia conferta
Eudendrium rameum
— *ramosum*
— *capillare*
Lafœa dumosa
— *fruticosa*

Lafœa gracillima
Grammaria serpens
— *abietina*
— *immersa*
Lictorella pinnata
**Zygophylax biarmata*
**Stegopoma plicatile*
Cuspidella humilis
Lafoëina maxima
Calycella syringa
Halecium halecinum
— *Beani*
— *scutum*
— *curvicaule*
— *muricatum*
— *labrosum*
— *tenellum*
— *minutum*
Kirchenpaueria pinnata
Plumularia setacea
— *Catharina*
Polyplumaria frutescens
* — *flabellata*
* — *profunda*
Nemertesia antennina
— *ramosa*
Polynemertesia gracillima
**Halicornaria campanulata*
**Nematocarpus ramuliferus*
**Aglaophenopsis cornuta*
**Cladocarpus integer*
* — *formosus*
* — *bicuspis*
**Thecocarpus myriophyllum*
Sertularella tamarisca
— *tricuspidata*
* — *amphorifera*
— *polyzonias*
— *Gayi*
— *rugosa*
Diphasia fallax
— *Wandeli*
— *rosacea*
* — *attenuata*
Dynamena pumila
Abietinaria abietina
— *filicula*
— *(?) fusca*
Sertularia cupressina
— *tenera*
— *Fabricii*
— *mirabilis*
Hydrallmania falcata
Thujaria thuja
— *lonchitis*
— *laxa*
* — *alternitheca*
— *arctica*
— *carica*
Campanularia volubilis
Campanularia verticillata
— *groenlandica*
— *integra*
— *Hincksi*
— *Johnstoni*
Laomedea flexuosa
— *geniculata*
— *longissima*
— *hyalina*
— *gracilis*
Bonneviella grandis.

An examination of Sæmundsson's material and list (1911) will show that it contains the following synonyms:

Clava squamata	= *Clava multicornis*
Coryne vermicularis	= *Coryne pusilla*
— *fruticosa*	= *Coryne pusilla*
Syncoryne eximia	= *Coryne pusilla*
Syncoryne Sarsii	= *Coryne Sarsii*
Auliscus pulcher	= *Tubularia pulcher*
Amalthæa islandica	= *Corymorpha glacialis*
Corymorpha glacialis	= *Corymorpha glacialis*
Eudendrium rameum	= *Eudendrium rameum*
rigidum?	= *Eudendrium rameum*
Dicoryne conferta	= *Bougainvillia conferta*
Laomedea gelatinosa	= *Laomedea longissima*
longissima	= *Laomedea longissima*

Lafoëa pygmæa	= *Lafæa gracillima*
— *gracillima*	
— *pocillum*	= *Lafæa fruticosa* forma *genuina* and forma *grandis*
— *symmetrica*	
— *fruticosa*	
Filellum serpens	= *Grammaria serpens*
Lictorella Levinseni	= *Zygophylax biarmata*
Sertularia cupressina	= *Sertularia cupressina*
— *argentea*	
— *pumila*	= *Dynamena pumila*
Diphasia fusca	= *Abietinaria (?) fusca*
— *abietina*	= *Abietinaria filicula*
Antennularia antennina	= *Nemertesia antennina*
— *ramosa*	= — *ramosa*
Plumularia pinnata	= *Kirchenpaueria pinnata*
— *gracillima*	= *Polynemertesia gracillima*
— *frutescens*	= *Polyplumaria frutescens*
Thecocarpus radicellatus	= *Thecocarpus myriophyllum*
Cladocarpus Holmi	= *Cladocarpus integer*

The synonyms noted reduce the number of species by 9; furthermore, Sæmundsson (1902, 1911) notes *Turris neglecta* Lesson, which here probably represents a young colony of *Clava multicornis*, and *Diplura fritillaria* (Haeckel) = *Coryne fritillaria* Steenstrup, an altogether uncertain species (cf. Part I, p. 23). Renewed investigations must also decide what species is concealed under the name *Perigonimus repens*. Altogether, we have then to reduce the 90 species noted by Sæmundsson to a certain 77. But the geographical details for these species are highly uncertain, as the determination has on revision often proved erroneous. In the revised collections, for instance, we find under the old label "*Thujaria lonchitis*" specimens of *Thujaria lonchitis*, *Thujaria laxa*, *Thujaria alternitheca*, and *Thujaria carica*, while under "*Laomedea flexuosa*" we find labelled, besides specimens actually belonging to that species, also others of *Laomedea geniculata* and *Laomedea longissima*. On the other hand, specimens of *Laomedea longissima* are distributed under the names of *Laomedea flexuosa*, *Laomedea longissima*, and *Laomedea gelatinosa* — taking examples at haphazard. The details are apparent from the notes under the separate headings. Even though the detailed records thus leave much to be desired, we have nevertheless a pretty fair survey of the species comprised under the area as a whole. The investigations have now added the following 14 new species to the list:

Corymorpha groenlandica
Hydractinia Sarsii
Stegopoma plicatile
Halecium scutum
Polyplumaria flabellata
Polyplumaria profunda
Halicornaria campanulata
Nematocarpus ramuliferus
Aglaophenopsis cornuta
Cladocarpus formosus
Cladocarpus bicuspis
Sertularella amphorifera
Diphasia attenuata
Thujaria alternitheca

We have thus reached a total of 91 species certainly known. The nature of the additions is not uninfluenced by the fact that the investigations were largely carried out on the deeper slopes of the coastal banks, so that southern and eurytherm species form the majority of the species thus added to the fauna list of the island.

We now come to the fauna of the Faroe Islands area. The species from here which are included in the material cover the entire range of our present knowledge as to the hydroid fauna of this section. We have here the following 57 species:

Coryne pusilla
Tubularia indivisa
— *larynx*
Clava multicornis
Merona cornucopiae
Bougainvillia conferta
Perigonimus repens
Eudendrium rameum
— *Wrighti*
— *capillare*
Lafoea dumosa
— *fruticosa*
— *gracillima*
Grammaria serpens
— *abietina*
Calycella syringa
Halecium halecinum
— *scutum*
— *muricatum*
Halecium labrosum
— *tenellum*
Kirchenpaueria pinnata
Plumularia Catharina
Polyplumaria frutescens
Nemertesia antennina
— *ramosa*
Nematocarpus ramuliferus
Cladocarpus formosus
Thecocarpus myriophyllum
Sertularella tamarisca
— *tricuspidata*
— *polyzonias*
— *Gayi*
— *tenella*
— *rugosa*
Diphasia fallax
— *rosacea*
Dynamena pumila
Abietinaria abietina
— *filicula*
— *(?) fusca*
Sertularia cupressina
— *tenera*
Hydrallmania falcata
Thujaria thuja
— *laxa*
Campanularia volubilis
— *verticillata*
— *integra*
— *Hincksi*
— *Johnstoni*
Laomedea flexuosa
— *geniculata*
— *longissima*
— *hyalina*
— *gracilis*
Bonneviella grandis

Along the deepest portions of the slope of the banks, the following five were found: *Tubularia regalis*, *Corymorpha glacialis*, *Corymorpha groenlandica*, *Lictorella pinnata*, and *Sertularella mirabilis*; save for the last but one, all of these belong to the cold area; finds lie so far out in the periphery that it is doubtful whether they should really be counted as belonging to the fauna of the Faroe Bank. If we do so, then we have up to now 62 species recorded from the Faroe Islands section, but the number will doubtless be increased by further study. We must at any rate expect to find the following six species at the Faroe Islands, since they are found, and partly also frequent, in Iceland waters and round the British Isles: *Coryne Sarsii*, *Corymorpha nutans*, *Hydractinia echinata*, *Cuspidella humilis*, *Plumularia setacea*, and *Diphasia attenuata*. This, however probably by no means exhausts the list of species, and in particular we may expect to find more southern forms as more or less sporadic visitors to the Faroe Islands.

A comparison between the fauna of the three areas shows that the Greenland area includes 11 species not known from Iceland or the Faroe Islands. These are:

Coryne Loveni	*Perigonimus abyssi*	*Campanulina turrita*
Tubularia regalis	— *roseus*	*Tetrapoma quadridentatum*
Branchiocerianthus reniformis	*Eudendrium annulatum*	*Campanularia speciosa*
Monobrachium parasitum	*Toichopoma obliquum*	

Of the species mentioned, however, *Coryne Loveni* is also known from the North Sea as far down as the Danish waters, and it would seem likely that it is identical with the polyp *Coryne fritillaria* Steenstrup, and thus belongs to the Iceland fauna area. *Perigonimus abyssi* and *Perigonimus roseus* extend southward along the west coast of Scandinavia at any rate as far as Bohuslän; *Eudendrium annulatum* has been recorded both in Norwegian and in British waters, and *Campanulina turrita* has been found in Irish waters, near Belfast. In the case of these species it is thus natural to suppose that they will also prove to occur in the intermediate areas at the Faroe Islands and Iceland. The geographical character of *Branchiocerianthus reniformis* is altogether unknown. We have then remaining, as peculiar to Greenland, the species *Tubularia regalis, Monobrachium parasitum, Toichopoma obliquum*, *Tetrapoma quadridentatum*, and *Campanularia speciosa*, high arctic or panarctic species which appear to be of particularly stenothermic character.

A far more unexpected state of things is met with in the Iceland area. The characteristic species here are:

Tubularia pulcher	*Plumularia setacea*	*Sertularella amphorifera*
Corymorpha nutans	*Polyplumaria flabellata*	*Diphasia attenuata*
— *glacialis*	*Halicornaria campanulata*	*Thujaria carica*
Zygophylax biarmata	*Cladocarpus bicuspis*	

Among these there are, as far as our knowledge at present goes, two easterly, panarctic species, to wit, *Corymorpha glacialis* and *Thujaria carica*. These species thus characterise the Icelandic fauna area as the frontier tract for east-arctic species. Similarly, the occurrence of the Greenlandic *Thujaria alternitheca* suggests that the area in question is also a boundary region for westerly, arctic-boreal species. The list given is, however, most striking from the many exotic warm-water species which it contains. The Iceland fauna area has, as a matter of fact, at present several more such species than the Faroe Islands area. It would thus seem as if the influence of the warm atlantic area upon the southern slope of the Iceland grounds is more immediate. How far the Rockall Banks may be partly responsible for the somewhat less marked immigration of warmer atlantic species to the Faroe Islands area cannot be stated with certainty, but there are several indications that such might well be the case.

The Faroe Islands area is distinguished by only two species, *Merona cornucopiæ* and *Eudendrium Wrighti*, as against the two other areas; these two species contribute, however, but little to the characterisation of the waters in question as we know them at present. The most striking feature of the true Faroe Bank area is another, negative character, to wit, the lack of high arctic or panarctic species. Only deeper-living arctic species such as *Tubularia regalis, Corymorpha glacialis, Corymorpha groenlandica, Grammaria immersa, Stegopoma plicatile*, and *Sertularia Fabricii* verge now

and again on to the deepest parts of the Faroe Bank, where they rise from the cold area at the eastern slopes of the ground.

The community which is characterised by the last-named species, and which further includes *Lafœa fruticosa* forma *grandis, Lafœa gracillima* forma *elegantula*, and *Sertularella polyzonias* forma *gigantea,* has its home throughout the whole of the arctic regions; farther to the north, we find it in shallower water, in the southern parts of the cold area in deeper; here also, it penetrates out to the Wyville Thomson ridge in the Faroe Channel, where warm atlantic water-masses present a barrier to its further progress. Only a single find of *Myriothela phrygia* has been made on the southern slope of the Wyville Thomson ridge. These species thus characterise the Norwegian Sea Deep, and show the marked difference between it and the Atlantic deep sea region. The limit of their occurrence here in the south follows on the whole very closely the 0° isotherm.

True these species may at times, in higher latitudes, occur in water layers of higher temperature, but this can have no effect on the limitation of the cold area as a whole against the boreal and atlantic tracts. A biogeographical peculiarity is seen in the Trondhjem Fjord, where hydrographical conditions of an atlantic character prevail, nevertheless we here find *Myriothela phrygia, Tubularia regalis, Corymorpha groenlandica,* and *Stegopoma plicatile* thriving excellently; indeed, *Tubularia regalis*, and *Stegopoma plicatile* even appear as local character forms in the otherwise purely atlantic *Lophohelia*-biocoenoze. This can apparently only be explained by regarding the species as relicts in the fjord, which have been able to adapt themselves to altered conditions there. This exception, however, cannot alter their general character as arctic species.

On the other hand, we find in the material also species which are not able to penetrate beyond the limits of the warm atlantic water-layers, and which are thus entirely lacking in the boreal region. These species emphasise still further the marked difference between the fauna of the Atlantic abyssal region and the cold area. We may here in particular point out *Grammaria conferta, Zygophylax biarmata, Polyplumaria profunda,* and *Sertularella amphorifera*, typical representatives of the warm atlantic deep-sea fauna. The finding of these so far to the north shows us on the one hand how uniform the fauna must be throughout the deep region of the Atlantic, but also, on the other hand, how little we yet know as to the geographical distribution of the bottom fauna, and what great and tempting tasks still await the investigator in thoroughly elucidating the question of bottom fauna even here in the North Atlantic.

V. List of the genera treated, and type-species.

(Nomina conservanda).

Coryne, Gaertner	*Coryne pusilla*, Gaertner 1774.
Myriothela, M. Sars	Lucernaria *phrygia*, Fabricius 1780.
Tubularia, Linné	*Tubularia indivisa*, Linné 1758.
Corymorpha, M. Sars	*Corymorpha nutans*, M. Sars 1835.
Branchiocerianthus, Mark	Monocaulus *imperator*, Allman 1888.
Clava, Gmelin	Hydra *multicornis*, Forskål 1775.
Merona, Norman.	Tubiclava *cornucopiae*, Norman 1864.
Monobrachium, Mereschkowsky.	*Monobrachium parasitum*, Mereschkowsky 1877.
Hydractinia, van Beneden.	Alcyonium *echinatum*, Fleming 1828.
Bougainvillia, Lesson.	Eudendrium *ramosum*, van Beneden 1844.
Perigonimus, M. Sars.	*Perigonimus muscoides*, M. Sars 1846.
Eudendrium, Ehrenberg.	Tubularia *ramosa*, Linné 1758.
Lafœa, Lamouroux.	Campanularia *dumosa*, Fleming 1820.
Toichopoma, Levinsen.	Calycella *obliqua*, Hincks 1874.
Grammaria, Stimpson.	Campanularia *abietina*, M. Sars 1851.
Lictorella, Allman.	Lafoëa *pinnata*, G. O. Sars 1874.
Zygophylax, Quelch.	*Zygophylax profunda*, Quelch 1885.
Stegopoma, Levinsen.	Calycella *plicatilis*, G. O. Sars 1874.
Cuspidella, Hincks.	Campanularia *humilis*, Alder 1863.
Lafoëina, M. Sars.	*Lafoëina tenuis*, M. Sars 1869.
Campanulina, van Beneden.	*Campanulina tenuis*, van Beneden 1847.
Calycella, Hincks.	Sertularia *syringa*, Linné 1767.
Tetrapoma, Levinsen.	Calycella *quadridentata*, Hincks 1874.
Halecium, Oken.	Sertularia *halecina*, Linné 1758.
Kirchenpaueria, Jickeli.	Sertularia *pinnata*, Linné 1758.
Plumularia, Lamarck.	Sertularia *setacea*, Linné 1758.
Polyplumaria, G. O. Sars.	*Polyplumaria flabellata*, G. O. Sars 1874.
Nemertesia, Lamouroux.	Sertularia *antennina*, Linné 1758.
Polynemertesia, nov.	Plumularia *gracillima*, G. O. Sars 1873.
Halicornaria (Busk).	*Halicornaria bipinnata*, Allman 1876.
Nematocarpus, nov.	Halicornaria *ramulifera*, Allmann 1874.
Aglaophenopsis, Fewkes.	*Aglaophenopsis hirsuta*, Fewkes 1881.
Cladocarpus, Allman.	*Cladocarpus formosus*, Allman 1874.
Thecocarpus, Nutting.	Sertularia *myriophyllum*, Linné 1758.
Aglaophenia, Lamouroux.	Sertularia *pluma*, Linné 1758.
Sertularella, Gray.	Sertularia *polyzonias*, Linné 1758.

Diphasia, L. Agassiz.	Sertularia *rosacea*, Linné 1758.
Dynamena, Lamouroux.	Sertularia *pumila*, Linné 1758.
Abietinaria, Kirchenpauer.	Sertularia *abietina*, Linné 1758.
Sertularia, Linné.	*Sertularia cupressina*, Linné 1758.
Hydrallmania, Hincks.	Sertularia *falcata*, Linné 1758.
Thujaria, Fleming.	Sertularia *thuja*, Linné 1758.
Campanularia, Lamarck.	Sertularia *volubilis*, Linné 1758.
Laomedea, Lamouroux.	*Laomedea flexuosa*, Alder 1856.
Bonnevielia, Broch.	Campanularia *grandis*, Allman 1874.

Trondhjem, 24.—VI.—1917.

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ERRATA.

Part I pag. 6, line 10 stands: *heteromedusoid*, read: *cryptomedusoid.*

Part II pag. 2 and following: *Lafoëidae*, *Lafoëa*, read: *Lafœidae*, *Lafœa.*

Part II pag. 99, text, line 2 stands: From there is penetrates, read: From there it penetrates.

Plate I.

Fig. 1. *Campanularia integra.* Part of median longitudinal section showing basal part of hydranth and inner thickening of hydrotheca wall, to the upper side of which the hydranth is attached. No trace of diaphragm whatever. Specimen from Herlö, near Bergen, fixed in picrin-sublimate-acetic acid (after Rabl), coloured with Delafield's hæmatoxyline — van Giesson. 320/1.

Fig. 2. *Branchiocerianthus reniformis.* Type specimen from "Ingolf" St. 28. Nat. size.

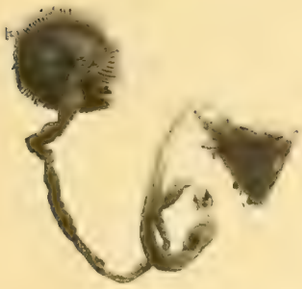
Fig. 3. *Branchiocerianthus reniformis.* Hydranth seen from below. 2/1.

Fig. 4. *Branchiocerianthus reniformis.* Hydranth seen from above. The richly folded gastral endoderm distinctly visible through the large oral aperture. 2/1.

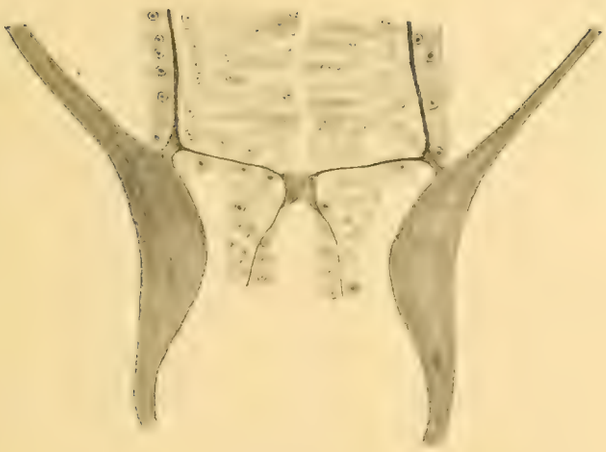
Fig. 5. *Branchiocerianthus reniformis.* Primary branch of a blastostyle, showing method of ramification. The outer, grape-like swellings are close collections of quite small incipient gonophores. 30/1

4

3



2



1

Hj. Broch del. et phot.

Ljustr. A. B. Lagrelius & Westphal, Stockholm

THE INGOLF-EXPEDITION

1895—1896.

THE LOCALITIES, DEPTHS, AND BOTTOMTEMPERATURES OF THE STATIONS

Station Nr.	Lat. N.	Long. W.	Depth in Danish fathoms	Bottom-temp.	Station Nr.	Lat. N.	Long. W.	Depth in Danish fathoms	Bottom-temp.	Station Nr.	Lat. N.	Long. W.	Depth in Danish fathoms	Bottom-temp.
1	62° 30′	8° 21′	132	7°2	24	63° 06′	56° 00′	1199	2°4	45	61° 32	9° 43′	643	4°17
2	63° 04′	9° 22′	262	5°3	25	63° 30′	54° 25′	582	3°3	46	61° 32′	11° 36′	720	2°40
3	63° 35′	10° 24′	272	0°5		63° 51′	53° 03′	136		47	61° 32′	13° 40′	950	3°23
4	64° 07′	11° 12′	237	2°5	26	63° 57′	52° 41′	34	0°6	48	61° 32′	15° 11′	1150	3°17
5	64° 40′	12° 09′	155			64° 37′	54° 24′	109		49	62° 07′	15° 07′	1120	2°91
6	63° 43′	14° 34′	90	7°0	27	64° 54′	55° 10′	393	3°8	50	62° 43′	15° 07′	1020	3°13
7	63° 13′	15° 41′	600	4°5	28	65° 14′	55° 42′	420	3°5	51	64° 15′	14° 22′	68	7°32
8	63° 56′	24° 40′	136	6°0	29	65° 34′	54° 31′	68	0°2	52	63° 57′	13° 32′	420	7°87
9	64° 18′	27° 00′	295	5°8	30	66° 50′	54° 28′	22	1°05	53	63° 15′	15° 07′	795	3°08
10	64° 24′	28° 50′	788	3°5	31	66° 35′	55° 54′	88	1°6	54	63° 08′	15° 40′	691	3°9
11	64° 34′	31° 12′	1300	1°6	32	66° 35′	56° 38′	318	3°9	55	63° 33′	15° 02′	316	5°9
12	64° 38′	32° 37′	1040	0°3	33	67° 57′	55° 30′	35	0°8	56	64° 00′	15° 09′	68	7°57
13	64° 47′	34° 33′	622	3°0	34	65° 17′	54° 17′	55		57	63° 37′	13° 02′	350	3°4
14	64° 45′	35° 05′	176	4°4	35	65° 16′	55° 05′	362	3°6	58	64° 25′	12° 09′	211	0°8
15	66° 18′	25° 59′	330	—0°75	36	61° 50′	56° 21′	1435	1°5	59	65° 00′	11° 16′	310	—0°1
16	65° 43′	26° 58′	250	6°1	37	60° 17′	54° 05′	1715	1°4	60	65° 09′	12° 27′	124	0°9
17	62° 49′	26° 55′	745	3°4	38	59° 12′	51° 05′	1870	1°3	61	65° 03′	13° 06′	55	0°4
18	61° 44′	30° 29′	1135	3°0	39	62° 00′	22° 38′	865	2°9	62	63° 18′	19° 12′	72	7°92
19	60° 29′	34° 14′	1566	2°4	40	62° 00′	21° 36′	845	3°3	63	62° 40′	19° 05′	800	4°0
20	58° 20′	40° 48′	1695	1°5	41	61° 39′	17° 10	1245	2°0	64	62° 06′	19° 00′	1041	3°1
21	58° 01′	44° 45′	1330	2°4	42	61° 41′	10° 17′	625	0°4	65	61° 33′	19° 00′	1089	3°0
22	58° 10′	48° 25′	1845	1°4	43	61° 42′	10° 11′	645	0°05	66	61° 33′	20° 43′	1128	3°3
23	60° 43′	56° 00′	Only the Plankton Net used		44	61° 42′	9° 36′	545	4°8	67	61° 30′	22° 30′	975	3°0

Station Nr.	Lat. N.	Long. W.	Depth in Danish fathoms	Bottom-temp.	Station Nr.	Lat. N.	Long. W.	Depth in Danish fathoms	Bottom-temp.	Station Nr.	Lat. N.	Long. W.	Depth in Danish fathoms	Bottom-temp.
68	62° 06′	22° 30′	843	3°4	92	64° 44′	32° 52′	976	1°4	118	68° 27′	8° 20′	1060	—1°0
69	62° 40′	22° 17′	589	3°9	93	64° 24′	35° 14′	767	1°46	119	67° 53′	10° 19′	1010	—1°0
70	63° 09′	22° 05′	134	7°0	94	64° 56′	36° 19′	204	4°1	120	67° 29′	11° 32′	885	—1°0
71	63° 46′	22° 03′	46			65° 31′	30° 45′	213		121	66° 59′	13° 11′	529	—0°7
72	63° 12′	23° 04′	197	6°7	95	65° 14′	30° 39′	752	2°1	122	66° 42′	14° 44′	115	1°8
73	62° 58′	23° 28′	486	5°5	96	65° 24′	29° 00′	735	1°2	123	66° 52′	15° 40′	145	2°0
74	62° 17′	24° 36′	695	4°2	97	65° 28′	27° 39′	450	5°5	124	67° 40′	15° 40′	495	—0°6
	61° 57′	25° 35′	761		98	65° 38′	26° 27′	138	5°9	125	68° 08′	16° 02′	729	—0°8
	61° 28′	25° 06′	829		99	66° 13′	25° 53′	187	6°1	126	67° 19′	15° 52′	293	—0°5
75	61° 28′	26° 25′	780	4°3	100	66° 23′	14° 02′	59	0°4	127	66° 33′	20° 05′	44	5°6
76	60° 50′	26° 50	806	4°1	101	66° 23′	12° 05′	537	—0°7	128	66° 50′	20° 02′	194	0°6
77	60° 10′	26° 59′	951	3°6	102	66° 23′	10° 26′	750	—0°9	129	66° 35′	23° 47′	117	6°5
78	60° 37′	27° 52′	799	4°5	103	66° 23′	8° 52′	579	—0°6	130	63° 00′	20° 40′	338	6°55
79	60° 52′	28° 58′	653	4°4	104	66° 23′	7° 25′	957	—1°1	131	63° 00′	19° 09′	698	4°7
80	61° 02′	29° 32′	935	4°0	105	65° 34′	7° 31′	762	—0°8	132	63° 00′	17° 04′	747	4°6
81	61° 44′	27° 00′	485	6°1	106	65° 34′	8° 54′	447	—0°6	133	63° 14′	11° 24′	230	2°2
82	61° 55′	27° 28′	824	4°1		65° 29′	8° 40′	466		134	62° 34′	10° 26′	299	4°1
83	62° 25′	28° 30′	912	3°5	107	65° 33′	10° 28′	492	— 0°3	135	62° 48′	9° 48′	270	0°4
	62° 36′	26° 01′	472		108	65° 30′	12° 00′	97	1°1	136	63° 01′	9° 11′	256	4°8
	62° 36′	25° 30′	401		109	65° 29′	13° 25′	38	1°5	137	63° 14′	8° 31′	297	—0°6
84	62° 58′	25° 24′	633	4°8	110	66° 44′	11° 33′	781	0°8	138	63° 26′	7° 56′	471	—0°6
85	63° 21′	25° 21′	170		111	67° 14′	8° 48′	860	—0°9	139	63° 36′	7° 30′	702	—0°6
86	65° 03′6	23° 47′6	76		112	67° 57′	6° 44′	1267	— 1°1	140	63° 29′	6° 57′	780	—0°9
87	65° 02′3	23° 56′2	110		113	69° 31′	7° 06′	1309	—1°0	141	63° 22′	6° 58′	679	—0°6
88	64° 58′	24° 25′	76	6°9	114	70° 36′	7° 29′	773	— 1°0	142	63° 07′	7° 05′	587	—0°6
89	64° 45′	27° 20′	310	8°4	115	70° 50′	8° 29′	86	0°1	143	62° 58′	7° 09′	388	— 0°4
90	64° 45′	29° 06′	568	4°4	116	70° 05′	8° 26′	371	—0°4	144	62° 49′	7° 12′	276	1°6
91	64° 44′	31° 00′	1236	3°1	117	69° 13′	8° 23′	1003	1°0					

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600 – 700 – – – –
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